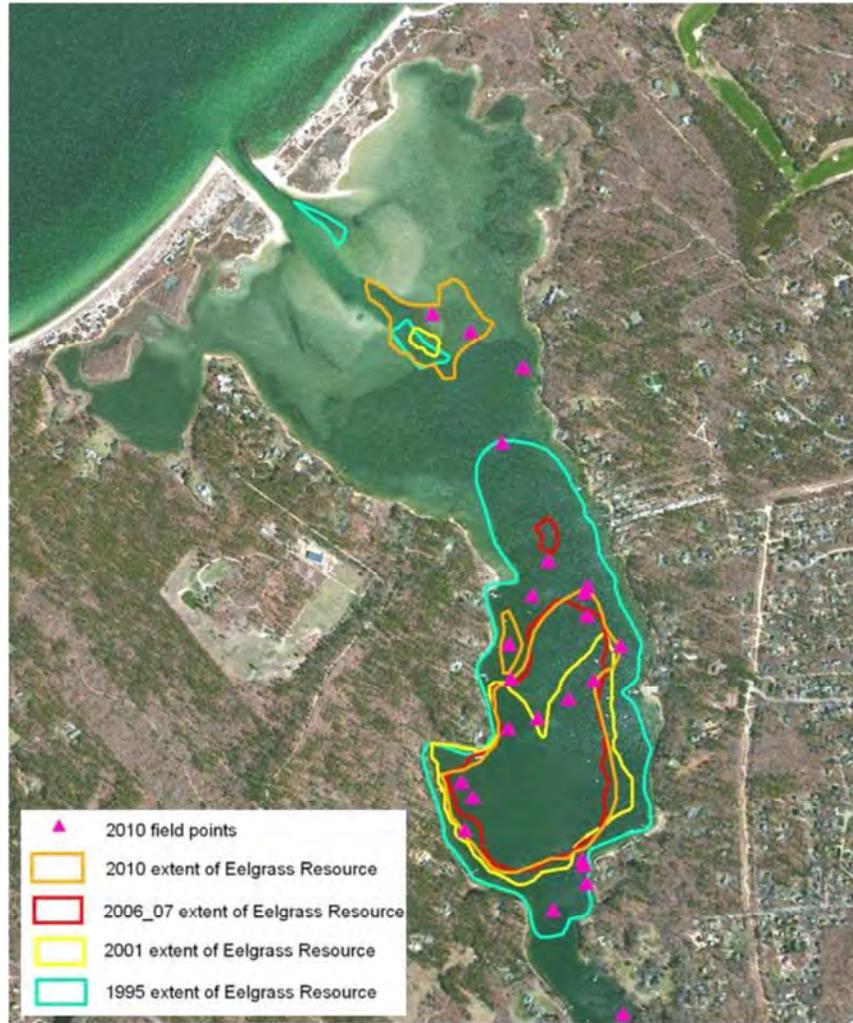


**Final  
Lake Tashmoo Estuarine System  
Total Maximum Daily Load  
For Total Nitrogen  
(CN 353.1)**



**COMMONWEALTH OF MASSACHUSETTS  
EXECUTIVE OFFICE OF ENERGY AND ENVIRONMENTAL AFFAIRS  
MATTHEW A. BEATON, SECRETARY  
MASSACHUSETTS DEPARTMENT OF ENVIRONMENTAL PROTECTION  
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**August 2017**



## **Executive Summary**

### **Problem Statement**

Excessive nitrogen (N) originating from a variety of sources has added to the impairment of the environmental quality of Lake Tashmoo. In general, excessive N in these waters is indicated by:

- Loss of eelgrass beds, which are critical habitats for macroinvertebrates and fish;
- Undesirable increases in macro-algae, which are much less beneficial than eelgrass;
- Periodic decreases in dissolved oxygen concentrations that threaten aquatic life;
- Reductions in the diversity of benthic animal populations; and
- Periodic algal blooms.

With proper management of N, inputs these trends can be reversed. Without proper management, more severe problems might develop, including:

- Periodic fish kills;
- Unpleasant odors and scum;
- Benthic communities reduced to the most stress-tolerant species, or in the worst cases, near loss of the benthic animal communities.

Coastal communities, including Tisbury, West Tisbury and Oak Bluffs, rely on clean, productive, and aesthetically pleasing marine and estuarine waters for tourism, recreational swimming, fishing, and boating, as well as for commercial fin fishing and shellfishing. Failure to reduce and control N loadings could lead to further loss of eelgrass and possible increases in macro-algae, a higher frequency of undesirable decreases in dissolved oxygen concentrations and fish kills, widespread occurrence of unpleasant odors and visible scum, and a complete loss of benthic macroinvertebrates throughout most of the system. As a result of these environmental impacts, commercial and recreational uses of Lake Tashmoo waters will be greatly reduced.

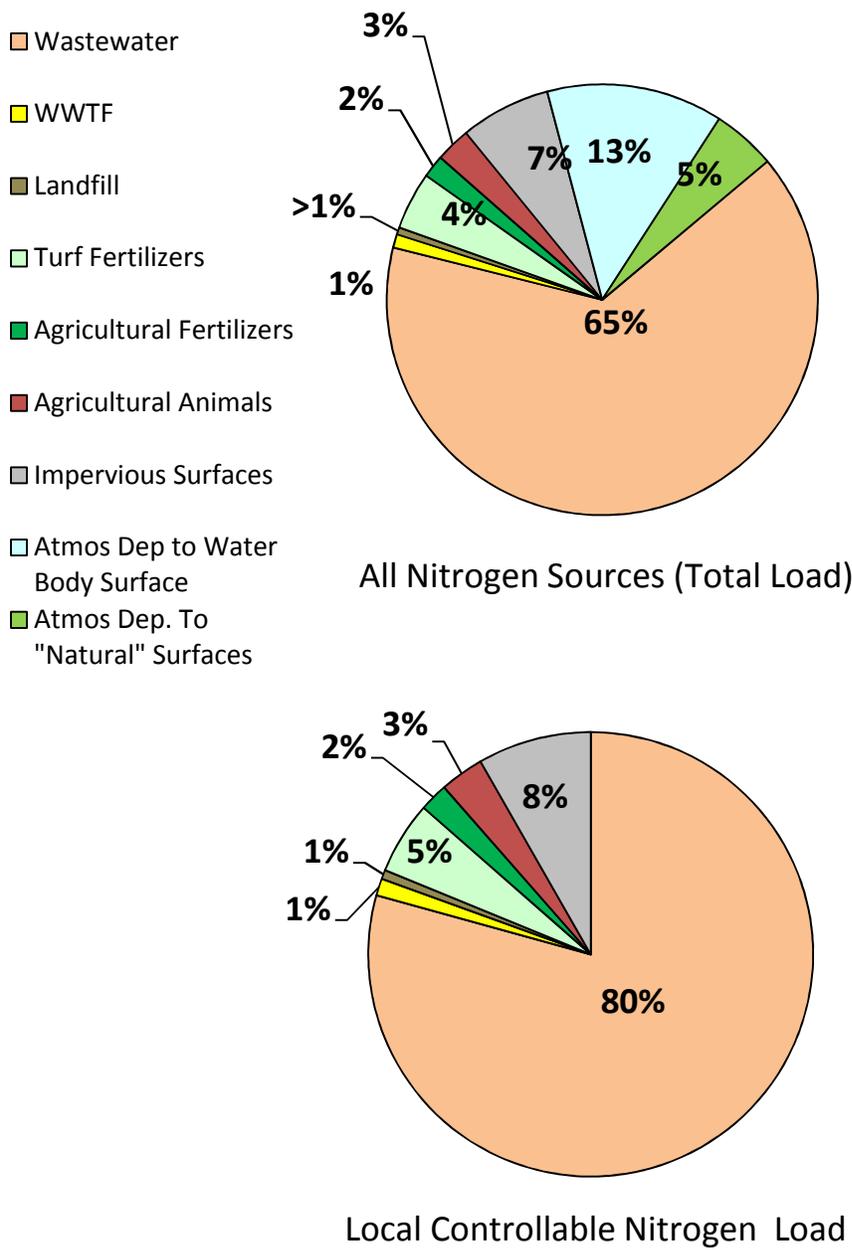
### **Sources of Nitrogen**

Nitrogen enters the waters of coastal embayments/ponds from the following sources:

- The watershed
  - on-site subsurface wastewater disposal (septic) systems
  - natural background
  - runoff
  - fertilizers
  - wastewater treatment facilities (WWTF)
  - landfills
  - agricultural activities
- Atmospheric deposition
- Nutrient-rich bottom sediments in the embayments/ponds

Figure ES-1 below indicate the percent contributions to the watershed of the various sources of N based on land use to Lake Tashmoo. Values are based on Table ES-1 and Table IV-2 from the Massachusetts Estuaries Project (MEP) *Linked Watershed-Embayment Model to Determine Critical Loading Threshold for the Lake Tashmoo Estuary, towns of Tisbury, West Tisbury and Oak Bluffs February 2015*, herein referred to as the MEP Technical Report (Howes *et. al*, 2015). As seen in the figure, most of the controllable N load to Lake Tashmoo originates from septic systems (80%).

**Figure ES-1: Percent Contributions of Nitrogen Sources to Lake Tashmoo**



## **Target Threshold Nitrogen Concentrations and Loadings**

Lake Tashmoo is located entirely within the town of Tisbury on Martha's Vineyard. The watershed of this system is located largely in Tisbury and West Tisbury with along with a very small portion of Oak Bluffs. The total watershed N that enters the estuary each day is 25.1 kg/day. This is the sum of attenuated loadings from natural background, fertilizer, runoff from impervious surfaces, septic systems, atmospheric deposition, and benthic flux. The resultant range in average annual concentration of N in Lake Tashmoo was 0.301 to 0.447 mg/L (milligrams per liter of N) (average of yearly means at the stations collected from 2001 – 2007 as reported in Table VI-1 of the MEP Technical Report and included in Appendix B of this report).

In order to restore and protect this estuarine system, N loadings, and subsequently the concentrations of N in the water, must be reduced to levels below the thresholds that cause the observed environmental impacts. This concentration will be referred to as the *target threshold N concentration*. It is the goal of the TMDL to reach this target threshold N concentration, as it has been determined for each impaired waterbody segment. The MEP has determined that for this estuarine system a N concentration of 0.36 mg/L at the sentinel station (in the channel adjacent to Brown Point) will restore eelgrass habitat in upper and lower basins of the Lake Tashmoo system. In addition, restoration of benthic habitat for infaunal animals will occur as management alternatives are implemented for eelgrass. Based on sampling and modeling analysis and the resulting Technical Report, the MEP has determined that the Total Maximum Daily Load (TMDL) of N to meet the target threshold N concentration of 0.36 mg/L is 35.55 kg N/day for the entire system. The mechanism for achieving these target threshold N concentrations is to reduce the N loadings to the Lake Tashmoo system.

This document presents the TMDL for this water body and provides guidance to the watershed communities of Tisbury, West Tisbury and Oak Bluffs on possible ways to reduce the N loadings to within the recommended TMDL and protect the waters of this estuarine system.

## **Implementation**

The primary goal of the TMDL implementation will be lowering the concentrations of N in Lake Tashmoo by reducing the loadings from on-site subsurface wastewater disposal systems in the watershed by 42.5%. It is important to note that there is a variety of loading reduction scenarios that could achieve the target threshold N concentration.

Implementing best management practices (BMPs) to reduce N loadings from fertilizers and runoff where possible will also help to lower the total N load to this system. The appropriateness of any of the alternatives will depend on local conditions and will have to be determined on a case-by-case basis using an adaptive management approach. Finally, growth within the watershed communities of Tisbury, West Tisbury and Oak Bluffs which would

exacerbate the problems associated with N loading should be guided by considerations of water quality-associated impacts.

Methodologies for reducing N loading from septic systems, storm water runoff and fertilizers are provided in detail in the “MEP Embayment Restoration and Guidance for Implementation Strategies”, available on the MassDEP website:

<http://www.mass.gov/eea/agencies/massdep/water/watersheds/coastal-resources-and-estuaries.html>.

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## Introduction

Section 303(d) of the Federal Clean Water Act requires each state (1) to identify waters that are not meeting water quality standards and (2) to establish Total Maximum Daily Loads (TMDLs) for such waters for the pollutants of concern. The TMDL allocation establishes the maximum loadings (of pollutants of concern) from all contributing sources that a water body may receive and still meet and maintain its water quality standards and designated uses, including compliance with numeric and narrative standards. The TMDL development process may be described in four steps, as follows:

1. Determination and documentation of whether or not a water body is presently meeting its water quality standards and designated uses.
2. Assessment of present water quality conditions in the water body, including estimation of present loadings of pollutants of concern from both point sources (discernable, confined, and concrete sources such as pipes) and non-point sources (diffuse sources that carry pollutants to surface waters through runoff or groundwater).
3. Determination of the loading capacity of the water body. EPA regulations define the loading capacity as the greatest amount of loading that a water body can receive without violating water quality standards. If the water body is not presently meeting its designated uses, then the loading capacity will represent a reduction relative to present loadings.
4. Specification of load allocations based on the loading capacity determination for non-point sources and point sources that will ensure that the water body will not violate water quality standards.

After public comment and final approval by the EPA, the TMDL will serve as a guide for future implementation activities. The MassDEP will work with the Towns of Tisbury, West Tisbury, and Oak Bluffs to develop specific implementation strategies to reduce N loadings and will assist in developing a monitoring plan for assessing the success of the nutrient reduction strategies.

In the Lake Tashmoo system the pollutant of concern for this TMDL (based on observations of eutrophication) is the nutrient nitrogen (N). Since nitrogen is the limiting nutrient in coastal and marine waters, as its concentration increases, so does plant productivity. This leads to nuisance populations of macro-algae and increased concentrations of phytoplankton and epiphyton that imperil the healthy ecology of the affected water bodies.

The TMDL for total N for the Lake Tashmoo system is based primarily on data collected, compiled and analyzed by University of Massachusetts Dartmouth's School for Marine Science and Technology (SMAST), the Martha's Vineyard Commission, and the towns of Tisbury, West Tisbury, and Oak Bluffs Water Quality Monitoring Programs as part of the Massachusetts Estuaries Project (MEP). The data were collected over a study period from 2001 to 2007. This study period will be referred to as the "Present Conditions" in the TMDL since it contains the most recent data available. The MEP Technical Report can be found at [http://www.mass.gov/eea/agencies/massdep/water/watersheds/the-massachusetts-estuaries-project-](http://www.mass.gov/eea/agencies/massdep/water/watersheds/the-massachusetts-estuaries-project)

[and-reports.html](#). The MEP Technical Report presents the results of the analyses of this coastal embayment system using the MEP Linked Watershed-Embayment Nitrogen Management Model (Linked Model).

The analyses were performed to assist the watershed communities with decisions on current and future wastewater planning, wetland restoration, anadromous fish runs, shellfisheries, open-space and harbor maintenance programs. Critical elements of this approach are the assessments of water quality monitoring data, historical changes in eelgrass distribution, time-series water column oxygen measurements and benthic community structure that were conducted on this embayment. These assessments served as the basis for generating a N loading threshold for use as a goal for watershed N management. The TMDL is based on the site-specific target threshold N concentration generated for this embayment. Thus, the MEP offers a science-based management approach to support the wastewater management planning and decision-making process in the watershed towns of Tisbury, West Tisbury and Oak Bluffs.

## **Description of Water Bodies and Priority Ranking**

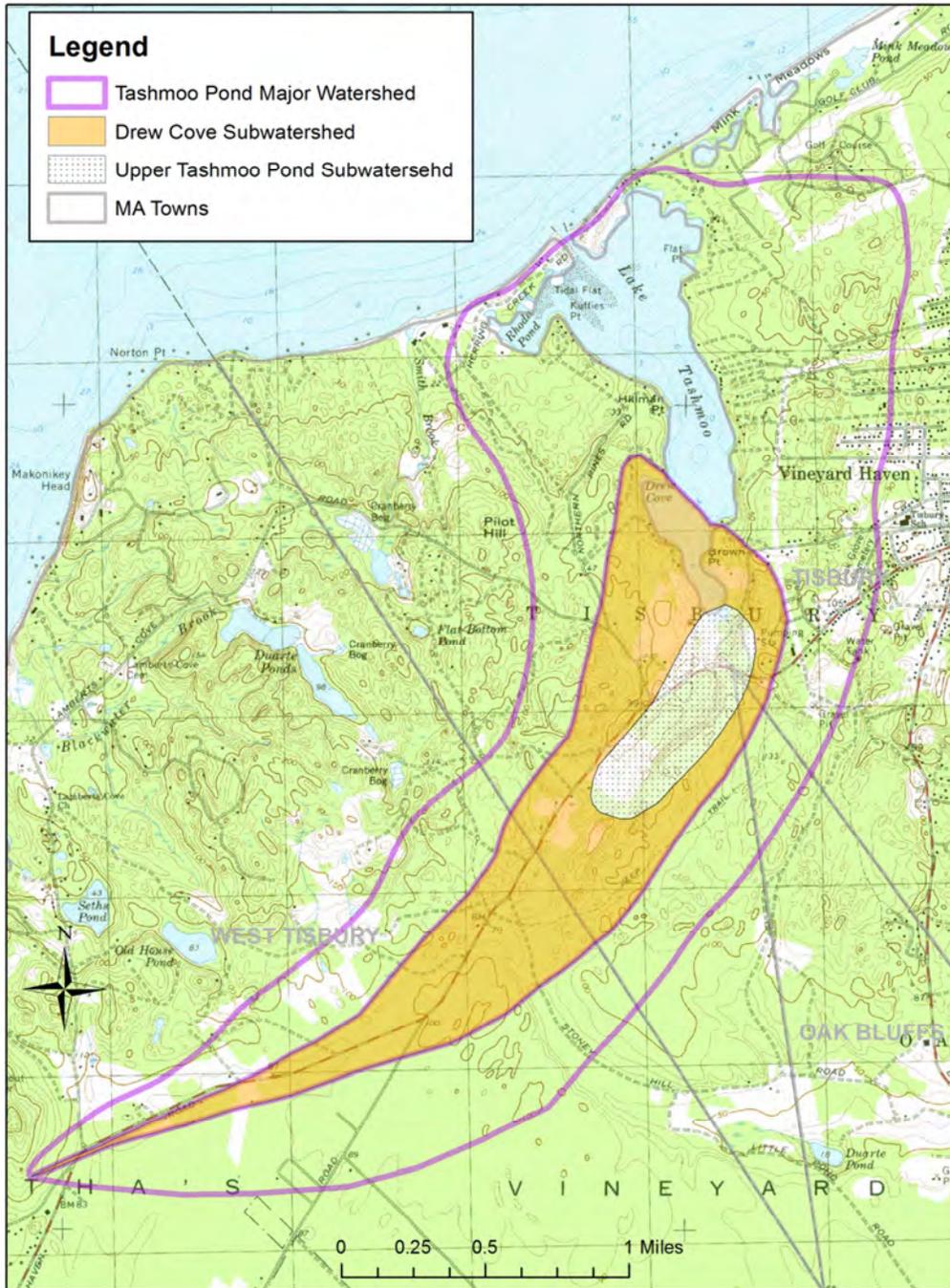
### **Watershed Characterization**

The MEP team has delineated a watershed area of approximately 4.1 square miles for the Lake Tashmoo system. The delineated contributory watershed includes two subwatersheds which were delineated for estimation of groundwater flows and nutrient export (Figure 1, Howes *et. al*, 2015, pg. 24). The MEP team has estimated a total groundwater flow for the system of 21,483 m<sup>3</sup>/day.

In the overall Lake Tashmoo System watershed, the predominant land use based on area is residential use, which accounts for 48% of the overall watershed area; public service lands represent the second highest percentage (25%) of watershed area (Figure IV-2 of MEP Tech report). Single-family residences (MADOR land use code 101) are 73% of the overall system residential land area. Undeveloped land is the third-most predominant land. Overall, undeveloped lands account for 16% of the entire Lake Tashmoo watershed area. (MEP Technical Report Ch. IV.1.1). The major stakeholder for management and restoration of Lake Tashmoo is the Town of Tisbury along with West Tisbury and Oak Bluffs.

### **Description of Waterbodies**

The Lake Tashmoo estuary is located within the Town of Tisbury on the island of Martha's Vineyard, Massachusetts. This system is located on the north side of Martha's Vineyard and exchanges tidal water with Vineyard Sound through a single inlet within a barrier beach. The watershed to the Lake Tashmoo estuary is mainly within the Towns of Tisbury and West Tisbury with a small portion located within Oak Bluffs.



**Figure 1: Lake Tashmoos Watershed Area Delineation**

The Lake Tashmoos estuary is a long narrow north/south oriented system that has one small tributary cove referred to as Rhoda Pond, with the main tidal reach consisting of a lower (North basin) and an upper basin (South basin) (Figure 2). Tidal water from Vineyard Sound enters the system into the lower (north) basin and travels through a main channel and sand flats before entering a deeper portion (~2-3 m) of the lower basin. Entering water also travels west into the shallow tributary sub-embayment of Rhoda Pond. Water from the lower deep basin is connected to

the upper basin via a narrow, relatively deep channel (2-3 m) which extends nearly to the estuary's headwaters (Figure I-3 of MEP Tech report). The Lake Tashmoo Estuary and most of its watershed is situated within the Nantucket Moraine sediments consisting mainly of folded pre-Wisconsin clay, sand, gravel and glacial till overlain by Wisconsin drift (Woodworth and Wigglesworth 1934). In the Lake Tashmoo watershed, there are no measured streams or freshwater ponds with delineated watersheds other than the small pond at the head of the estuary.

The nature of enclosed embayments in populous regions brings two opposing elements to bear: 1) as protected marine shoreline they are popular regions for boating, recreation, and land development and 2) as enclosed bodies of water, they may not be readily flushed of the pollutants that they receive due to the proximity and density of development near and along their shores. The Lake Tashmoo system is at risk of further eutrophication from high nutrient loads in the groundwater and runoff from the watershed.

A complete description of this estuarine system is presented in Chapters I and IV of the MEP Technical Report. A majority of the information presented here on this estuarine system is drawn from the Technical Report. Chapters VI and VII of the MEP Technical Report provide assessment data that show that the Lake Tashmoo estuarine system is impaired because of nutrients, low dissolved oxygen levels, slightly elevated chlorophyll-*a* levels, eelgrass loss and benthic fauna habitat degradation.

This estuarine system has been assessed by DEP and is listed as a waterbody requiring a TMDL for estuarine bioassessments (Category 5) in the Massachusetts 2014 Integrated List of Waters (MassDEP 2015). It was also found to be impaired for nutrients, low dissolved oxygen, elevated chlorophyll-A, loss of eelgrass, and degradation of benthic fauna habitat during the course of the MEP study (Table 1).

**Table 1: Comparison of DEP and SMAST Impaired Parameters for Lake Tashmoo**

Name	Water Body Segment	Size	DEP Listed Parameter	SMAST Impaired Parameter <sup>1</sup>
Lake Tashmoo	MA97-12	0.414 sq miles	Estuarine Bioassessments	-Nutrients -DO level -Chlorophyll <i>a</i> -Eelgrass loss Infaunal Animals

<sup>1</sup> As determined by the MEP Lake Tashmoo Study and reported in the Technical Report



**Figure 2: Overview of Lake Tashmoo**

**Priority Ranking**

The embayment addressed by this TMDL is determined to be a high priority based on three significant factors: (1) the initiative that the town has taken to assess the conditions of the entire estuarine system; (2) the commitment made by the town to restore and preserve the embayment; and (3) the extent of impairment in the embayment. In particular, this embayment is at risk of further degradation from increased N loads entering through groundwater and surface water runoff from the increasingly developed watershed. In both marine and freshwater systems an excess of nutrients results in degraded water quality, adverse impacts to ecosystems and limits on the use of water resources. Observations are summarized in Table 2 and the Problem Assessment section below and detailed in Chapter VII- Assessment of Embayment Nutrient Related Ecological Health of the MEP Technical Report.

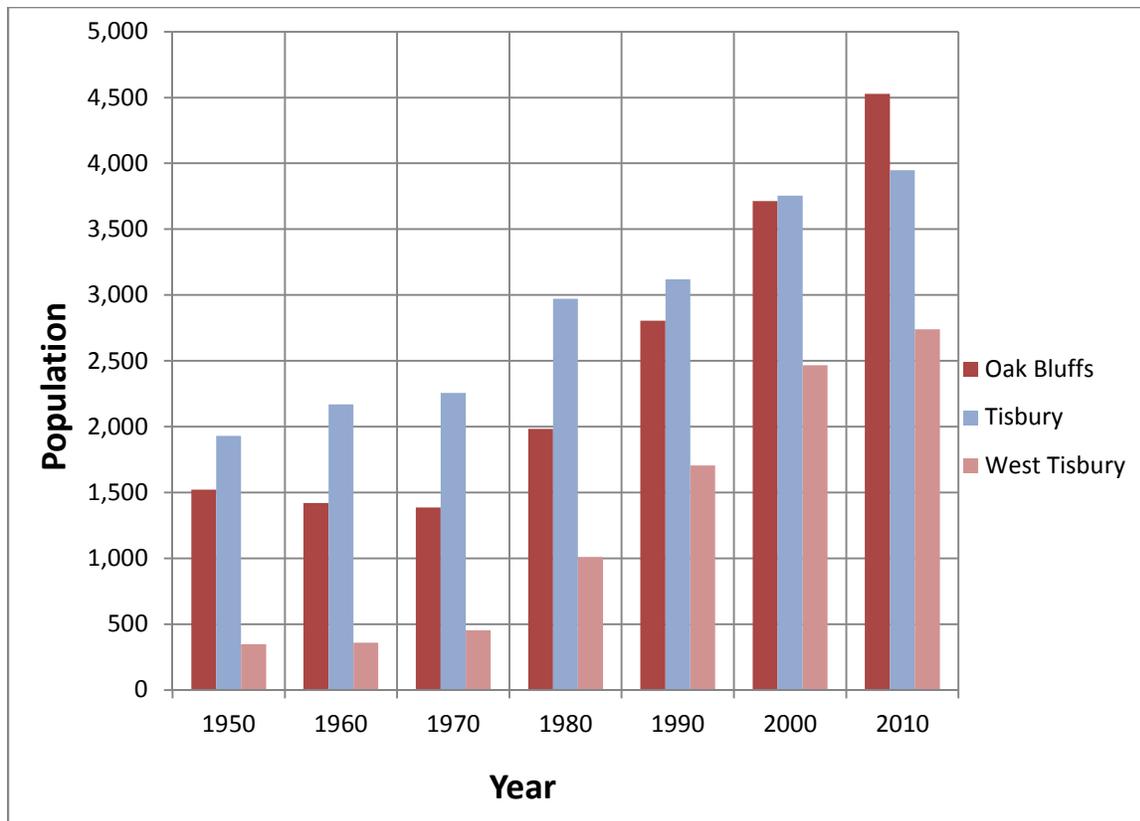
## **Description of Hydrodynamics of the Lake Tashmoo System**

The Lake Tashmoo system is open to Vineyard Sound through a set of jetties. Fresh water enters the system through direct discharge of groundwater as there are no significant streams flowing into it. The MEP project has evaluated the tidal circulation and flushing characteristics of this embayment system using both direct measurements and the RMA-2 model, a well-established model for estuaries. By comparing direct measurement of the tides at one location in the embayment system and one offshore location in Vineyard Sound, Howes *et. al* (2015) determined there was little tidal dampening. Little difference was found in amplitude of the M2, M4, and M6 tidal constituents between Vineyard Sound tide gage location and the tide gage in upper Lake Tashmoo. In addition the phase delay of the main tidal constituent (lunar, twice per day tide, aka M2) was only approximately 14 minutes. The MEP project also determined a system residence time of 1.1 days for this system. Given these facts the system is considered well flushed.

## **Problem Assessment**

Water quality problems associated with development within the watershed result primarily from septic systems and much less from runoff and fertilizers. The water quality problems affecting nutrient-enriched embayments generally include periodic decreases of dissolved oxygen, loss of eelgrass habitat, decreased diversity and quantity of benthic animals and periodic algae blooms. In the most severe cases, habitat degradation could lead to periodic fish kills, unpleasant odors and scums and near loss of the benthic community and/or presence of only the most stress-tolerant species of benthic animals.

The year round resident population of the Town of Tisbury has increased by 75% over the past four decades. (Figure 3) and the watershed of Lake Tashmoo has had extensive development of seasonal and year round single-family homes. The remaining build-out potential within the Lake Tashmoo watershed will increase unattenuated system-wide nitrogen loading by 38%. At the time of the data collection, 100% of the parcels in the Lake Tashmoo watershed relied on privately maintained septic systems for on-site treatment and disposal of wastewater.



**Figure 3: Tisbury, West Tisbury and Oak Bluffs Residential Population**

<http://factfinder2.census.gov/faces/nav/jsf/pages/index.xhtml>

Habitat and water quality assessments were conducted on this estuarine system based upon water quality monitoring data, analysis of historical changes in eelgrass distribution, time-series water column dissolved oxygen and chlorophyll-*a* measurements, benthic community structure assessments and sediment characteristics.

The Lake Tashmoo Estuary is showing nitrogen enrichment and impairment of both eelgrass and infaunal habitats (Table 2). The decline of eelgrass within this basin makes restoration of eelgrass the target for TMDL development. Currently, infaunal communities are moderately impaired in the lower basin to significantly impaired in the upper basin. The level of oxygen depletion and chlorophyll-*a* levels indicate conditions of poor habitat quality within the deep basin waters (>3 meters) of Lake Tashmoo. The MEP Technical Report concludes that the nutrient enrichment response in Lake Tashmoo is magnified by its basin structure, which when combined with the depositional nature of the upper basin and accumulations of macroalgae, results in poor quality and degraded benthic animal habitat within the deeper water of the upper basin.

At present, the Lake Tashmoo estuary is showing nitrogen enrichment and impairment of both eelgrass and infaunal habitats, indicating that nitrogen management of this system will be for restoration rather than for protection or maintenance of an unimpaired system. The upper basin and lower basin are relatively deep and this structure allows periodic weak salinity stratification (weak vertical mixing), which makes these basins sensitive to the negative effects of nitrogen enrichment.

The result is periodic hypoxia in the upper basin and oxygen depletion in the lower basin as a result of in situ phytoplankton production and deposition. In addition, the increased phytoplankton biomass decreases light penetration to the bottom colonizing eelgrass adding further stress and accelerating bed loss. It is almost certain that the observed periodic hypoxia in the uppermost headwater basin resulted in the loss of the beds observed between 1995 and 2001. The pattern of loss is consistent with nitrogen enrichment, following the gradient of increasing nitrogen and chlorophyll-*a* levels from the inlet to the headwaters. (MEP Technical Report Ch.VIII.2)

The primary ecological threat to Lake Tashmoo is degradation resulting from nutrient enrichment. Most of the “controllable” N load (80%) is from septic systems, with other controllable N contributions coming from runoff of impervious surfaces, wastewater treatment facilities, landfill, agricultural activities and fertilizers. Nitrogen from these sources enters the groundwater system and eventually enters the estuary system. In the sandy soils of Martha’s Vineyard nitrogen that has entered the groundwater travels toward the coastal waters at an average rate of one foot per day. Other sources that are not locally controllable include atmospheric deposition to the surface of the estuary and natural surfaces and from N-rich sediments.

Coastal communities, including Tisbury, rely on clean, productive and aesthetically pleasing marine and estuarine waters for tourism, recreational swimming, fishing, and boating, as well as commercial fin fishing and shellfishing. The continued degradation of this coastal embayment, as described above, could significantly reduce the recreational and commercial value and use of these important environmental resources.

**Table 2: General Summary of Conditions Related to the Major Indicators of Habitat Impairment Observed in the Lake Tashmoo System (excerpted Howes *et. al.* 2015, pg. 137)**

Health Indicator	Upper Basin (South)	Lower Basin (North)
Eelgrass Loss	MassDEP (C. Costello) indicates that eelgrass coverage significantly declined 1951-1995, 1995- 2001. However, still dense coverage in some areas. Loss is mainly in deeper waters (lower light penetration). [MI/SI]	MassDEP (C. Costello) indicates loss from uppermost margins of coverage with loss of dense beds in shallower water where periodic hypoxia and blooms were observed. But significant coverage still observed in 2010. [H-MI]
Dissolved Oxygen Depletion	Oxygen depletion at mooring shows periodic hypoxia (< 2mg/L) frequently <4 mg/L and < 3mg/L, 30% of record, WQM minima of 3.8 mg/L. in area of mooring. [SI]	Oxygen depletion at mooring typically >5 mg/L 87% of record and always >4 mg/L. DO consistent with WQM which showed grab sample DO minima 5.4-5.9 in area of mooring. [MI]
Chlorophyll <i>a</i>	Moderate summer chlorophyll levels generally <10 ug/L (92% of time), averaging 6.2 ug/L, maximum 15 ug/L. WQM average in summer (2002-2007) was 9.3 ug/L, maximum 20 ug/L. [MI]	Low to moderate summer chlorophyll levels <5 ug/L, 60% and <10 ug/L 94% of record, averaging 5.1 ug/L, maximum 13 ug/L. WQM summer mean (2002-2007)= 3.9-4.3 ug/L, maximum 7.6-9.8 ug/L. [H/MI]
Benthic Fauna	Low numbers of individuals (<30-50 per sample) and low number of species, habitat not presently supporting an infaunal animal community throughout the deep basin. [SD]	High numbers of individuals and moderate diversity (1.70-2.14), low-moderate species numbers (8-11) and Evenness (0.6), but with very few stress indicator species. Community dominated by polychaetes, crustaceans, and mollusks, with some amphipods. Indicative of moderate organic enrichment. [MI]
Macroalgae	Patches of dense drift Gracillaria, deposited in deep basin, (south basin has patches of algal mat) [MI]	Patches of sparse Gracillaria, sparse attached Codium. [MI]
Overall Health	Moderate-Significant Impairment: primarily due to reduction in eelgrass bed coverage (1995-2001) but persistence of some eelgrass beds, periodic D.O. depletion (hypoxia) and significantly degraded animal community habitat, moderate chlorophyll levels and moderate accumulation of drift macroalgae [MI/SI]	Moderate Impairment: primarily due to the loss of eelgrass from the deeper waters but persistence of some dense eelgrass beds, low species numbers and diversity of benthic community but with high numbers and low numbers of stress indicator species, consistent with moderate summer depletion in D.O, low summer chlorophyll levels and low-moderate accumulation of drift macroalgae. Eelgrass and infaunal habitat impairments form the major basis of the assessment. [MI]

WQM indicates: the Lake Tashmoo Water Quality Monitoring Program (2001-2007).

H - Healthy habitat conditions, MI – Moderately Impaired, SI – Significantly Impaired - considerably and appreciably changed from normal conditions, SD – Severely degraded

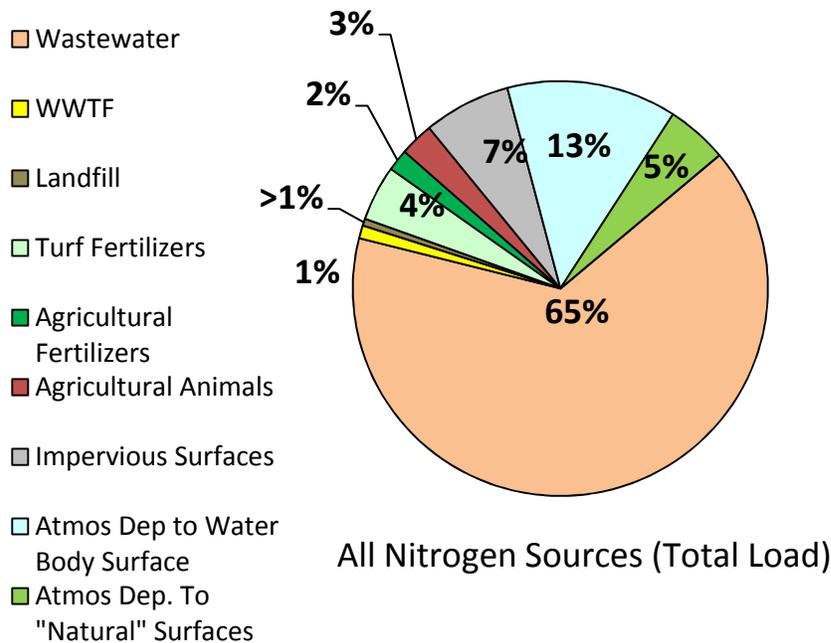
These terms are more fully described in MEP report “Site-Specific Nitrogen Thresholds for Southeastern Massachusetts Embayments: Critical Indicators” December 22, 2003.

<http://www.mass.gov/eea/docs/dep/water/resources/n-thru-y/nitroest.pdf>

## Pollutant of Concern, Sources and Controllability

In Lake Tashmoo, as in most marine and coastal waters, the limiting nutrient is nitrogen (N). Nitrogen concentrations above those expected naturally contribute to undesirable water quality and habitat conditions (such as described above).

Lake Tashmoo has had extensive data collected and analyzed through the MEP, with the cooperation and assistance from the towns of Tisbury, West Tisbury and Oak Bluffs Water Quality Monitoring Programs and the Martha's Vineyard Commission (MVC). Data collection included both water quality and hydrodynamics as described in Chapters I, IV, V, and VII of the MEP Technical Report. These investigations revealed that loadings of nutrients, especially N, are much larger than they would be under natural conditions and, as a result, the water quality has deteriorated. Figure 4 illustrates the sources and percent contributions of watershed N into Lake Tashmoo. The level of "controllability" of each nitrogen source, however, varies widely (Table 3). Cost/benefit analyses will have to be conducted for all possible N loading reduction methodologies in order to select the optimal control strategies, priorities, and schedules.



**Figure 4: Percent Contributions of All Nitrogen Sources to Lake Tashmoo**

**Table 3: Sources of Nitrogen and their Controllability**

Nitrogen Source	Degree of Controllability at Local Level	Reasoning
Agricultural fertilizer and animal wastes	Moderate	These nitrogen loadings can be controlled through appropriate agricultural Best Management Practices (BMPs).
Atmospheric deposition to the estuary surface	Low	It is only through region- and nation-wide air pollution control initiatives that significant reductions are feasible. Local control although helpful is not adequate.
Atmospheric deposition to natural surfaces (forests, fields, freshwater bodies) in the watershed	Low	Atmospheric deposition (loadings) to these areas cannot adequately be controlled locally. However, the N from these sources might be subjected to enhanced natural attenuation as it moves toward the estuary.
Fertilizer	Moderate	Lawn and golf course fertilizer and related N loadings can be reduced through BMPs, bylaws and public education.
Septic system	High	Sources of N can be controlled by a variety of case-specific methods including: sewerage and treatment at centralized or decentralized locations, transporting and treating septage at treatment facilities with N removal technology either in or out of the watershed, or installing N-reducing on-site wastewater treatment systems.
Sediment	Low	N loadings are not feasibly controlled on a large scale by such measures as dredging. However, the concentrations of N in sediments, and thus the loadings from the sediments, will decline over time if sources in the watershed are removed, or reduced to the target levels discussed later in this document. In addition, increased dissolved oxygen will help keep N from fluxing.
Stormwater runoff from impervious surfaces	Moderate	This nitrogen source can be controlled by BMPs, bylaws and stormwater infrastructure improvements and public education. Stormwater NPDES permit requirements help control stormwater related N loadings in designated communities.
Wastewater treatment facility (WWTF)	High	Wastewater treatment facilities as point sources of pollution are permitted under the National Pollution Discharge Elimination System. Treated wastewater effluent discharged to groundwater disposal systems are permitted by MassDEP. There is a high degree of regulatory certainty that within the limits of technology, nutrient sources at these facilities can be controlled.

## **Description of the Applicable Water Quality Standards**

The Water Quality Classification of Lake Tashmoo is SA. Water quality standards of particular interest to the issues of cultural eutrophication are dissolved oxygen, nutrients, aesthetics, excess plant biomass and nuisance vegetation. The Massachusetts Water Quality Standards (314 CMR 4.00, MassDEP 2007) contain numeric criteria for dissolved oxygen but have only narrative standards that relate to the other variables, as described in Appendix A.

Thus, the assessment of eutrophication is based on site-specific information within a general framework that emphasizes impairment of uses and preservation of a balanced indigenous flora and fauna. This approach is recommended by the US Environmental Protection Agency in their draft Nutrient Criteria Technical Guidance Manual for Estuarine and Coastal Marine Waters (Environmental Protection Agency, 2001). The Guidance Manual notes that lakes, reservoirs, streams and rivers may be subdivided by classes, allowing reference conditions for each class and facilitating cost-effective criteria development for nutrient management. However, individual estuarine and coastal marine waters tend to have unique characteristics and development of individual water body criteria is typically required.

## **Methodology - Linking Water Quality and Pollutant Sources**

Extensive data collection and analyses have been described in detail in the MEP Technical Report. These data were used by SMAST to assess the loading capacity of each sub-embayment. Physical (Chapter V), chemical, and biological (Chapters IV, VII, and VIII) data were collected and evaluated. The primary water quality objective was represented by conditions that:

- 1) Restore the natural distribution of eelgrass because it provides valuable habitat for shellfish and finfish;
- 2) Prevent algal blooms;
- 3) Protect benthic communities from impairment or loss; and
- 4) Maintain dissolved oxygen concentrations that are protective of the estuarine communities.

The details of the data collection, modeling and evaluation are presented and discussed in Chapters IV, V, VI, VII and VIII of the MEP Technical Report. The main aspects of the data evaluation and modeling approach of this study are summarized below.

The core analytical method of the Massachusetts Estuaries Project is the Linked Watershed-Embayment Management Modeling Approach. It fully links watershed inputs with embayment circulation and N characteristics and is characterized as follows:

- Requires site specific measurements within the watershed and each sub-embayment;
- Uses realistic “best-estimates” of N loads from each land-use (as opposed to loads with built-in “safety factors” like Title 5 design loads);
- Spatially distributes the watershed N loading to the embayment;

- Accounts for N attenuation during transport to the embayment;
- Includes a 2D or 3D embayment circulation model depending on embayment structure;
- Accounts for basin structure, tidal variations, and dispersion within the embayment;
- Includes N regenerated within the embayment;
- Is validated by both independent hydrodynamic, N concentration, and ecological data;
- Is calibrated and validated with field data prior to generation of “what if” scenarios.

The Linked Model has previously been applied to watershed N management in numerous embayments throughout Southeastern Massachusetts. In these applications it became clear that the model can be calibrated and validated and has use as a management tool for evaluating watershed N management options.

The Linked Model, when properly calibrated and validated for a given embayment, becomes a N management planning tool as described in the model overview below. The model can assess solutions for the protection or restoration of nutrient-related water quality and allows testing of management scenarios to support cost/benefit evaluations. In addition, once a model is fully functional it can be refined for changes in land-use or embayment characteristics at minimal cost. Also, since the Linked Model uses a holistic approach that incorporates the entire watershed, embayment and tidal source waters, it can be used to evaluate all projects as they relate directly or indirectly to water quality conditions within its geographic boundaries. It should be noted that this approach includes high-order, watershed and sub-watershed scale modeling necessary to develop critical nitrogen targets for each major sub-embayment. The models, data and assumptions used in this process are specifically intended for the purposes stated in the MEP Technical Report, upon which this TMDL is based. As such, the Linked Model process does not contain the type of data or level and scale of analysis necessary to predict the fate and transport of nitrogen through groundwater from specific sources. In addition, any determinations related to direct and immediate hydrologic connection to surface waters are beyond the scope of the MEP’s Linked Model process.

The Linked Model provides a quantitative approach for determining an embayment's: (1) N sensitivity; (2) N threshold loading levels (TMDL); and (3) response to changes in loading rate. The approach is fully field validated and unlike many approaches, accounts for nutrient sources, attenuation, and recycling and variations in tidal hydrodynamics (Figure I-3 of the MEP Technical Report). This methodology integrates a variety of field data and models, specifically:

- Monitoring - multi-year embayment nutrient sampling;
- Hydrodynamics;
  - Embayment bathymetry (depth contours throughout the embayment)
  - Site-specific tidal record (timing and height of tides)
  - Water velocity records (in complex systems only)

- Hydrodynamic model
- Watershed N Loading;
  - Watershed delineation
  - Stream flow (Q) and N load
  - Land-use analysis (GIS)
  - Watershed N model
- Embayment TMDL – Synthesis;
  - Linked Watershed-Embayment N Model
  - Salinity surveys (for linked model validation)
  - Rate of N recycling within embayment
  - Dissolved oxygen record
  - Macrophyte survey
  - Eelgrass and Infaunal surveys

### **Application of the Linked Watershed-Embayment Model**

The approach developed by the MEP for applying the linked model to specific embayments for the purpose of developing target threshold N loading rates includes:

- 1) Selecting one or two sub-embayments within the embayment system located close to the inland-most reach or reaches which typically has/have the poorest water quality within the system. These are called “sentinel” stations;
- 2) Using site-specific information and a minimum of three years of sub-embayment-specific data to select target threshold N concentrations for each sub-embayment. This is done by refining the draft target threshold N concentrations that were developed as the initial step of the MEP process. The target threshold N concentrations that were selected generally occur in higher quality waters near the mouth of the embayment system;
- 3) Running the calibrated water quality model using different watershed N loading rates, to determine the loading rate which will achieve the target threshold N concentration at the sentinel station. Differences between the modeled N load required to achieve the target threshold N concentration, and the present watershed N load represent N management goals for restoration and protection of the embayment system as a whole.

Previous sampling and data analyses and the modeling activities described above resulted in four major outputs that were critical to the development of the TMDL.

Two outputs are related to N **concentration**:

- the present N concentrations in the sub-embayments;
- site-specific target threshold N concentrations.

Two outputs are related to N **loadings**:

- the present N loads to the sub-embayments;
- load reductions necessary to meet the site specific target threshold N concentrations.

In summary, meeting the water quality standards by reducing the N concentration (and thus the N load) at the sentinel station(s), the water quality goals will be met throughout the entire system.

A brief overview of each of the outputs follows.

### **Nitrogen concentrations in the embayment**

a) Observed “present” conditions:

Table 4 presents the average concentrations of N measured in this system from data collected at three stations during the period 2001 - 2007. Nitrogen concentrations range from 0.301 – 0.447 mg/L with the lowest average concentration found in the Lower Basin (Station MV-2) and the highest average within the Upper Basin (MV-5). See Figure 5 for station locations. The overall means and standard deviations of the averages are presented in Appendix B, Table B-1 (reprinted from Table VI-1 of the MEP Technical Report).

**Table 4: Observed Present Nitrogen Concentrations and Sentinel Station Threshold Nitrogen Target Concentration for Lake Tashmoo.**

Lake Tashmoo	Observed Nitrogen Concentration <sup>1</sup> (mg/L)	Sentinel Station <sup>2</sup> Target Threshold Nitrogen Concentration (mg/L)
Lower Basin (Stations MV21, MV1, MV2)	0.301-0.314	
Mid-Upper Basin (Stations MV3, MV4)	0.343,0.360	
Upper Basin (Station MV5)	0.447	0.360
Vineyard Sound (boundary condition)	0.270	

<sup>1</sup>Concentrations shown as range of annual means from 2001- 2007 from the six water quality monitoring stations within Lake Tashmoo

<sup>2</sup>Sentinel Station Channel at Brown Point shown in Figure 5.

b) Modeled site-specific target threshold N concentrations:

A major component of TMDL development is the determination of the maximum concentrations of N (based on field data) that can occur without causing unacceptable impacts to the aquatic environment. This is called the *target threshold nitrogen concentration*. Prior to conducting the analytical and modeling activities described above, SMAST selected appropriate nutrient-related environmental indicators and tested the qualitative and quantitative relationship between those indicators and N concentrations. The Linked Model was then used to determine site-specific target threshold N concentrations by using the specific physical, chemical and biological characteristics of each sub-embayment.

The approach for determining nitrogen loading rates which will maintain acceptable habitat quality throughout an embayment system is to first identify a sentinel location within the embayment and second to determine the nitrogen concentration within the water column which will restore that location to the desired habitat quality. The sentinel location is selected such that the restoration of that one site will necessarily bring the other regions of the system to acceptable habitat quality levels. Once the sentinel site and its target threshold nitrogen concentration are determined, the MEP study modeled nitrogen loads until the targeted nitrogen concentration was achieved.

Determination of the critical nitrogen threshold for maintaining high quality habitat within Lake Tashmoo is based primarily on the nutrient and oxygen levels, temporal trends in eelgrass distribution and benthic community indicators. The N threshold for Lake Tashmoo is based upon the goal of restoring eelgrass habitat with the parallel goal of restoring benthic habitat for infaunal animals.

As listed in Table 3 above, the site-specific target threshold N concentration is 0.36 mg/L at the sentinel station established in Brown Point Channel (Figure 5). The findings of the analytical and modeling investigations to determine this target threshold nitrogen concentration for the estuarine system are discussed below.



**Figure 5: Lake Tashmo Long Term Monitoring Stations. Sentinel Station is located within the channel at Brown Point between stations MV4 and MV5**

The Lake Tashmoo Embayment System presently shows a moderate impairment to eelgrass habitat. At present eelgrass beds exist mainly within the mid-upper basin of the Lake Tashmoo Estuary with smaller beds in the lower portion of the system closest to the inlet. It appears that eelgrass is generally present at depths less than 2.5-3.0 meters, consistent with observed light penetration data from the water quality monitoring program (MEP Technical Report Ch. VIII). The persistence of beds in the mid basin suggests that nitrogen enrichment is moderate and that the system is just over its nitrogen threshold (ie the level of nitrogen the system can tolerate without impairment), which is also consistent with the observed chlorophyll-*a* levels. However, the losses of eelgrass beds from 1995- 2006 indicate that nitrogen enrichment is continuing. Eelgrass in Lake Tashmoo appears to support relatively stable beds in the upper/mid basin at a TN level of 0.36 mg/L. At slightly higher nitrogen levels at the uppermost edge of the 1995 eelgrass coverage where eelgrass has been subsequently lost, the TN was found to currently be 0.386 mg/L. The MEP Technical Report concluded that that habitat restoration must lower TN level to less than 0.386 mg/L within the channel adjacent to Brown Point to restore eelgrass lost between 1995 and 2001. (MEP Technical Report Ch. VIII, P. 131)

As eelgrass within the Lake Tashmoo Embayment System is a critical habitat structuring the productivity and resource quality of the entire system, and given that it is presently showing moderate impairment, restoration of this resource is the primary target for overall restoration of this system. Therefore, to restore eelgrass habitat in Lake Tashmoo the nitrogen concentration (tidally averaged TN) must be lowered to 0.36 mg/L at the sentinel location in the channel at Brown Point. This TN level is currently supportive of stable eelgrass habitat within the lower basin of Lake Tashmoo.

This threshold is only slightly higher than that for the slightly shallower basins of West Falmouth Harbor and Phinneys Harbor (TN at 0.35 mg/L) to account for the increased depth in Lake Tashmoo. Lowering the level of nitrogen enrichment at the sentinel station will lower nitrogen levels within the lower portion of the Lake Tashmoo Estuarine system with the parallel effect of improving impaired infaunal habitat. Based on documented 1995 eelgrass coverage, the MEP study predicted eelgrass coverage could increase by a minimum of 113 acres if this target threshold N concentration at the sentinel station is achieved, with parallel restoration of the significantly impaired and degraded benthic animal habitat.

### **Nitrogen loadings to the embayment**

#### a) Present loading rates:

In the Lake Tashmoo System overall the highest N loading from *controllable* sources is from on-site wastewater treatment systems. The septic system loading is 18.80 kg N/day within the Lake Tashmoo watershed. The total N loading from all sources is 45.43 kg N/day. A further breakdown of N loading by source is presented in Table 5. The data on which Table 5 is based can be found in Table ES-1 of the MEP Technical Report.

**Table 5: Present Nitrogen Loadings to Lake Tashmoo System**

Lake Tashmoo sub-embayments	Present Land Use Load <sup>1</sup> (kg N/day)	Present WWTF Load (kg N/day)	Present Septic System Load (kg N/day)	Present Direct Atmospheric Deposition <sup>2</sup> (kg N/day)	Present Load from Sediments (kg N/day)	Present Total Nitrogen Load <sup>3</sup> (kg N/day)
Drew Cove	1.548	--	2.885	0.504	7.765	12.702
Main Basin	4.490	0.294	15.416	3.304	8.75	31.961
Upper Basin	0.268	--	0.496	--	--	0.764
System Total	6.307	0.294	18.797	3.808	16.515	45.427

<sup>1</sup> Includes fertilizers, runoff, and atmospheric deposition to lakes and natural surfaces (non-wastewater loads)

<sup>2</sup> Includes atmospheric deposition to the estuary surface only.

<sup>3</sup> Sum of all N sources; natural background, fertilizer, WWTF, runoff, septic systems, landfill, agricultural animals, impervious surface, water body surface area and natural surfaces, atmospheric deposition and sediment flux loadings.

As previously indicated, the present N loadings to Lake Tashmoo must be reduced in order to restore conditions and to avoid further nutrient-related adverse environmental impacts. The critical final step in the development of the TMDL is modeling and analysis to determine the loadings required to achieve the target threshold N concentrations.

b) Nitrogen loads necessary for meeting the site-specific target threshold N concentrations:

The target threshold nitrogen concentration developed by SMAST (Section VIII.2 in the MEP Technical Report) and summarized above was used to determine the amount of total nitrogen mass loading reduction required for restoration of eelgrass and infaunal habitats in the Lake Tashmoo system. Tidally averaged total nitrogen concentrations were used to calibrate the water quality model (Section VI in the MEP Technical Report). Modeled watershed nitrogen loads were sequentially lowered using reductions in septic effluent discharges only until the nitrogen levels reached the threshold level at the sentinel station chosen for Lake Tashmoo (WH-1).

Table 6 includes the present and target threshold watershed N loadings to Lake Tashmoo and the percentage reduction necessary to meet the target threshold N concentration at the sentinel station (from Table ES-2 of the MEP Technical Report).

It is very important to note that load reductions can be produced through a variety of strategies: reduction of any or all sources of N; increasing the natural attenuation of N within the freshwater systems; and/or modifying the tidal flushing through inlet reconfiguration (where appropriate). This scenario establishes the general degree and spatial pattern of reduction that will be required for restoration of the N impaired portions of this system. The towns in the study area should take any reasonable actions to reduce the controllable N sources.

**Table 6: Present Watershed Nitrogen Loading Rates (Attenuated), Calculated Loading Rates that are Necessary to Achieve Target Threshold Nitrogen Concentrations and the Percent Reductions of the Existing Loads Necessary to Achieve the Target Threshold Loadings**

Lake Tashmoo Sub-embayment	Present Total Watershed Load <sup>1</sup> (kg N/day)	Target Threshold Watershed Load <sup>2</sup> (kg N/day)	Watershed Load Reductions Needed to Achieve Threshold Loads	
			kg N/day	% change
Drew Cove	4.433	4.144	0.289	-6.5%
Main Basin	19.907	12.199	7.708	-38.7%
Upper Basin	0.764	0.764	0	0%
System Total	25.104	17.107	7.997	-31.9%

<sup>1</sup> Composed of fertilizer, runoff from impervious surfaces, septic systems, agriculture, landfill, WWTF and atmospheric deposition to natural surfaces.

<sup>2</sup> Target threshold watershed load is the maximum load from the watershed to meet the embayment target threshold N concentration identified in Table 4 above.

## Total Maximum Daily Loads

As described in EPA guidance, a total maximum daily load (TMDL) identifies the loading capacity of a water body for a particular pollutant. EPA regulations define loading capacity as the greatest amount of loading that a water body can receive without violating water quality standards. The TMDLs are established to protect and/or restore the estuarine ecosystem, including eelgrass, the leading indicator of ecological health, thus meeting water quality goals for aquatic life support. Because there are no “numerical” water quality standards for N, the TMDL for the Lake Tashmoo system is aimed at determining the loads that would correspond to specific N concentrations determined to be protective of the water quality and ecosystems.

The effort includes detailed analyses and mathematical modeling of land use, nutrient loads, water quality indicators and hydrodynamic variables (including residence time) for each sub-embayment. The results of the mathematical model are correlated with estimates of impacts on water quality including negative impacts on eelgrass (the primary indicator), as well as dissolved oxygen, chlorophyll and benthic infauna.

The TMDL can be defined by the equation:

$$TMDL = BG + WLAs + LAs + MOS$$

Where:

TMDL = loading capacity of receiving water

BG = natural background

WLAs = portion allotted to point sources

LAs = portion allotted to (cultural) non-point sources

MOS = margin of safety

## **Background Loading**

Natural background N loading is included in the loading estimates. It is accounted for in this study but not defined as a separate component. Background loading was calculated on the assumption that the entire watershed is forested with no anthropogenic sources of N. Readers are referred to Table ES-1 of the MEP Technical Report for estimated loading due to natural conditions.

## **Waste Load Allocations**

Waste load allocations identify the portion of the loading capacity allocated to existing and future point sources of wastewater. EPA interprets 40 CFR 130.2(h) to require that allocations for NPDES regulated discharges of storm water be included in the waste load component of the TMDL. For purposes of the Lake Tashmoo TMDL, there are no NPDES regulated areas for the discharges of stormwater in the watershed. However, MassDEP also considered the nitrogen load reductions from impervious areas adjacent to the waterbody necessary to meet the target nitrogen concentrations in the WLA. Since the majority of the N loading from the watershed comes from septic systems and, to a lesser extent, the WWTF, fertilizer, the landfill and storm water that infiltrates into the groundwater, the allocation of N for any stormwater pipes that discharge directly to this embayment is insignificant but is estimated here for completeness.

In estimating the nitrogen loadings from impervious sources, MassDEP considered that most stormwater runoff from impervious surfaces in the watershed is not discharged directly into surface waters, but, rather, percolates into the ground. The geology on Cape Cod and the Islands consists primarily of glacial outwash sands and gravels, and water moves rapidly through this type of soil profile. A systematic survey of stormwater conveyances on the Islands has never been undertaken. Nevertheless, most catch basins on the Islands are known to MassDEP to have been designed as leaching catch basins in light of the permeable overburden. MassDEP, therefore, recognized that most stormwater that enters a catch basin in these areas will percolate into the local groundwater table rather than directly discharge to a surface waterbody.

As described in the Methodology Section (above), the Linked Model accounts for storm water loadings and groundwater loading in one aggregate allocation as a non-point source. However, MassDEP also considered that some stormwater may be discharged directly to surface waters through outfalls. In the absence of specific data or other information to accurately quantify stormwater discharged directly to surface waters, MassDEP assumed that all impervious surfaces within 200 feet of the shoreline, as calculated from MassGIS data layers, would discharge directly to surface waters, whether or not it in fact did so. MassDEP selected this approach because it considered it unlikely that any stormwater collected farther than 200 feet from the shoreline would be directly discharged into surface waters. Although the 200 foot approach provided a gross estimate, MassDEP considered it a reasonable and conservative approach given the lack of pertinent data and information about stormwater collection systems on Martha's Vineyard. For Lake Tashmoo this calculated stormwater WLA based on the 200 foot buffer is 0.16% of the total N load or 0.04 kg N/day as compared to the overall watershed N load of 25.1 kg N/day to the embayment (see Appendix C for details). This conservative load is a negligible amount of the total nitrogen load to the embayment when compared to other sources.

## Load Allocations

Load allocations identify the portion of loading capacity allocated to existing and future nonpoint sources. In the case of the Lake Tashmoo system, the nonpoint source loadings are primarily from on-site subsurface wastewater disposal systems (Figure 4, above, and Figure 6, below). Additional N sources include: stormwater runoff (except from impervious cover within 200 feet of the waterbody which is defined above as part of the waste load), fertilizers, WWTF, landfill and farm animals. In addition, there are nonpoint sources of N that are not feasibly controllable from nutrient-rich sediments, atmospheric deposition and natural background

Storm water that is subject to the EPA Phase II Program would be considered a part of the waste load allocation rather than the load allocation. As presented in Chapters IV, V, and VI of the MEP Technical Report, on Cape Cod and the Islands, the vast majority of stormwater percolates into the aquifer and enters the embayment system through groundwater. As a result, the TMDL accounts for stormwater loadings and groundwater loadings in one aggregate allocation as a non-point source.

The sediment loading rates incorporated into the TMDL are lower than the existing sediment flux rates in Table 4 above, because projected reductions of N loadings from the watershed will result in reductions of nutrient concentrations in the sediments, and therefore, over time, reductions in loadings from the sediments will occur. Benthic flux of nitrogen from bottom sediments is a critical (but often overlooked) component of nitrogen loading to the shallow estuarine systems, therefore determination of the site specific magnitude of this component was also performed (see Section VI of the the MEP Report). Benthic N flux is a function of N loading and particulate organic N (PON). Projected benthic fluxes are based upon projected PON concentrations and watershed N loads and are calculated by multiplying the present N flux by the ratio of projected PON to present PON using the following formulae:

$$\text{Projected N flux} = (\text{present N flux}) (\text{PON projected} / \text{PON present})$$

$$\text{When: } \text{PON projected} = (R_{load}) (D_{PON}) + \text{PON}_{\text{present offshore}}$$

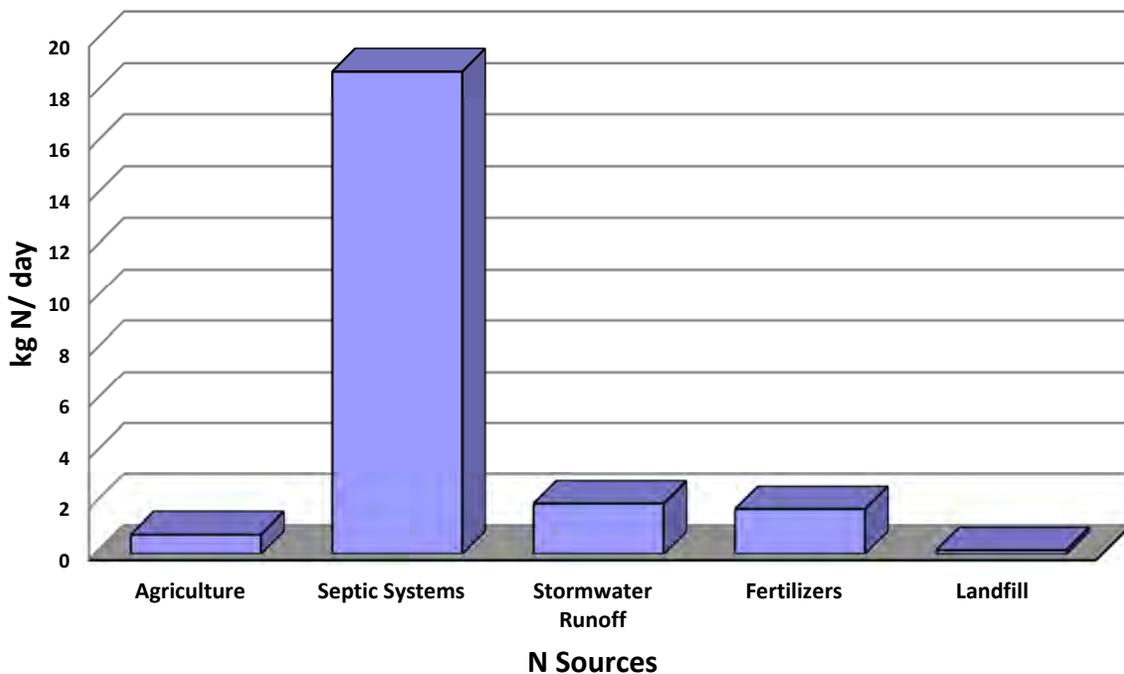
$$\text{When } R_{load} = (\text{projected N load}) / (\text{Present N load})$$

And  $D_{PON}$  is the PON concentration above background determined by:

$$D_{PON} = (\text{PON}_{\text{present embayment}} - \text{PON}_{\text{present offshore}})$$

Benthic loading is affected by the change in watershed load. The benthic flux modeled for the Lake Tashmoo system is reduced from existing conditions based on the load reduction from controllable sources.

The loadings from atmospheric sources incorporated into the TMDL are the same rates presently occurring because, as discussed above, significant control of atmospheric loadings at the local level is not considered feasible.



**Figure 6: Controllable Unattenuated Nitrogen Loading Sources to the Lake Tashmoo Estuarine System** (Table IV-2, MEP Technical Report)

### Margin of Safety

Statutes and regulations require that a TMDL include a margin of safety (MOS) to account for any lack of knowledge concerning the relationship between load and wasteload allocations and water quality [CWA para 303 (d)(20)©, 40C.G.R. para 130.7©(1)]. The MOS must be designed to ensure that any uncertainties in the data or calculations used to link pollutant sources to water quality impairment modeling will be accounted for in the TMDL and ensure protection of the beneficial uses. The EPA’s 1991 TMDL Guidance explains that the MOS may be implicit, i.e., incorporated into the TMDL through conservative assumptions in the analysis, or explicit, i.e., expressed in the TMDL as loadings set aside for the MOS. An explicit MOS quantifies an allocation amount separate from other Load and Wasteload Allocations. An explicit MOS can incorporate reserve capacity for future unknowns, such as population growth or effects of climate change on water quality. An implicit MOS is not specifically quantified but consists of statements of the conservative assumptions used in the analysis. The MOS for the Lake Tashmoo Estuarine System TMDL is implicit. MassDEP used conservative assumptions to develop numeric model applications that account for the MOS. These assumptions are described below, and they account for all sources of uncertainty, including the potential impacts of changes in climate.

While the general vulnerabilities of coastal areas to climate change can be identified, specific impacts and effects of changing estuarine conditions are not well known at this time (<http://www.mass.gov/eea/waste-mgmt-recycling/air-quality/green-house-gas-and-climate-change/climate-change-adaptation/climate-change-adaptation-report.html>). Because the science is

not yet available, MassDEP is unable to analyze climate change impacts on streamflow, precipitation, and nutrient loading with any degree of certainty for TMDL development. In light of these uncertainties and informational gaps, MassDEP has opted to address all sources of uncertainty through an implicit MOS. MassDEP does not believe that an explicit MOS approach is appropriate under the circumstances or will provide a more protective or accurate MOS than the implicit MOS approach, as the available data simply does not lend itself to characterizing and estimating loadings to derive numeric allocations within confidence limits. Although the implicit MOS approach does not expressly set aside a specific portion of the load to account for potential impacts of climate change, MassDEP has no basis to conclude that the conservative assumptions that were used to develop the numeric model applications are insufficient to account for the lack of knowledge regarding climate change.

Conservative assumptions that support an implicit MOS:

1. Use of conservative data in the linked model

The watershed N model provides conservative estimates of N loads to the embayment. Nitrogen transfer through direct groundwater discharge to estuarine waters is based upon studies indicating negligible aquifer attenuation and dilution, i.e. 100% of load enters embayment. This is a conservative estimate of loading because studies have also shown that in some areas less than 100% of the load enters the estuary. In this context, “direct groundwater discharge” refers to the portion of fresh water that enters an estuary as groundwater seepage into the estuary itself, as opposed to the portion of fresh water that enters as surface water inflow from streams, which receive much of their water from groundwater flow. Nitrogen from the upper watershed regions which travel through ponds or wetlands almost always enters the embayment via stream flow and is directly measured (over 12-16 months) to determine attenuation. In these cases, the land-use model has shown a slightly higher predicted N load than the measured discharges in the streams/rivers that have been assessed to date. Therefore, the watershed model as applied to the surface water watershed areas again presents a conservative estimate of N loads because the actual measured N in streams was lower than the modeled concentrations.

The hydrodynamic and water quality models have been assessed directly. In the many instances where the hydrodynamic model predictions of volumetric exchange (flushing) have also been directly measured by field measurements of instantaneous discharge, the agreement between modeled and observed values has been between 85%-90%. For the water quality model, it was possible to conduct a quantitative assessment of the model results as fitted to a baseline dataset - computed root mean squared (RMS) error is less than 0.022 mg/l, which demonstrates a good fit between modeled and measured data for this system. Since the water quality model incorporates all of the outputs from the other models, this excellent fit indicates a high degree of certainty in the final result. The high level of accuracy of the model provides a high degree of confidence in the output so less of a margin of safety is required.

Similarly, the water column N validation dataset was also conservative. The model is calibrated to measured water column N and validated to salinity. However, the model predicts average summer N concentrations. The very high or low measurements are marked as outliers. The effect is to make the N threshold more accurate and scientifically defensible. If a single measurement two

times higher than the next highest data point in the series raises the average 0.05 mg N/L, this would allow for a higher “acceptable” load to the embayment. Marking the very high outlier is a way of preventing a single and rare bloom event from changing the N threshold for a system. This effectively strengthens the data set so that a higher margin of safety is not required.

Finally, the predicted reductions of the amount of N released from the sediments are most likely underestimates, i.e. conservative. The reduction is based solely on a reduced deposition of PON due to lower primary production rates under the reduced N loading in these systems. As the N loading decreases and organic inputs are reduced it is likely that rates of coupled remineralization-nitrification, denitrification and sediment oxidation will increase.

Benthic regeneration of N is dependent upon the amount of PON deposited to the sediments and the percentage that is regenerated to the water column versus being denitrified or buried. The regeneration rate projected under reduced N loading conditions was based upon two assumptions:(1) PON in the embayment in excess of that of inflowing tidal water (boundary condition) results from production supported by watershed N inputs; and (2) Presently enhanced production will decrease in proportion to the reduction in the sum of watershed N inputs and direct atmospheric N input. The latter condition would result in equal embayment versus boundary condition production and PON levels if watershed N loading and direct atmospheric deposition could be reduced to zero (an impossibility of course). This proportional reduction assumes that the proportion of remineralized N will be the same as under present conditions, which is almost certainly an underestimate. As a result, future N regeneration rates are overestimated which adds to the margin of safety.

## 2. Conservative sentinel station/target threshold nitrogen concentration

Conservatism was used in the selection of the sentinel station and target threshold N concentration. The threshold concentration was based on the currently stable eelgrass habitat in the upper basin of Lake Tashmoo coupled with evaluation of similar systems with stable eelgrass and benthic animal (infaunal) communities. The sentinel stations are selected such that meeting the target threshold N concentration at those locations will result in reestablishment of eelgrass and benthic habitat throughout the rest of the system.

## 3. Conservative approach

The target loads were based on tidally averaged N concentrations on the outgoing tide which is the worst case condition because that is when the N concentrations are the highest. The N concentrations will be lower on the flood tides; therefore, this approach is conservative.

The linked model accounted for all stormwater loadings and groundwater loadings in one aggregate allocation as a nonpoint source and this aggregate load is accounted for in the load allocation. The method of calculating the WLA in the TMDL for impervious cover within the 200 foot buffer area of the waterbody was conservative as it did not disaggregate this negligible load from the modeled stormwater LA, hence this approach further enhances the MOS.

In addition to the margin of safety within the context of setting the N threshold levels described above, a programmatic margin of safety also derives from continued monitoring of this embayment to support adaptive management. This continuous monitoring effort provides the ongoing data to evaluate the improvements that occur over the multi-year implementation of the N management plan. This will allow refinements to the plan to ensure that the desired level of restoration is achieved.

### **Seasonal Variation**

Since the TMDLs for the waterbody segments are based on the most critical time period, i.e. the summer growing season, the TMDLs are protective for all seasons. The daily loads can be converted to annual loads by multiplying by 365 (the number of days in a year). Nutrient loads to the embayment are based on annual loads for two reasons. The first is that primary production in coastal waters can peak in both the late winter-early spring and in the late summer-early fall periods. Second, as a practical matter, the types of management necessary to control the N load do not lend themselves to intra-annual manipulation since a considerable portion of the N is from non-point sources. Thus, calculating annual loads is most appropriate, since it is difficult to control non-point sources of N on a seasonal basis and N sources can take considerable time to migrate to impacted waters.

### **TMDL Values for the Lake Tashmoo System**

As outlined above, the total maximum daily loadings of N that would provide for the restoration and protection of the embayment were calculated by considering all sources of N grouped by natural background, point sources and non-point sources. A more meaningful way of presenting the loadings data from an implementation perspective is shown in Table 7.

In this table N loadings from the atmosphere and from nutrient rich sediments are listed separately from the target watershed threshold loads. The watershed load is composed of atmospheric deposition to freshwater and natural surfaces along with locally controllable N from on-site subsurface wastewater disposal systems, storm water runoff, and fertilizer sources. In the case of the Lake Tashmoo System, the TMDL was calculated by projecting reductions in locally controllable septic systems. Once again the goal of this TMDL is to achieve the identified target threshold N concentration at the identified sentinel station.

**Table 7: The Nitrogen Total Maximum Daily Load for the Lake Tashmo System**

Lake Tashmo Sub-embayment	Target Threshold Watershed Load <sup>1</sup> (kg N/day)	Atmospheric Deposition (kg N/day)	Sediment Flux Net <sup>2</sup> (kg N/day)	TMDL <sup>3</sup> (kg N/day)
Drew Cove	4.144	0.504	6.837	11.486
Main Basin	12.199	3.304	7.792	23.295
Upper Basin	0.764	--	--	0.764
<b>System Total</b>	<b>17.107</b>	<b>3.808</b>	<b>14.630</b>	<b>35.546</b>

<sup>1</sup> Target threshold watershed load is the load from the watershed needed to meet the embayment target threshold nitrogen concentration identified in Table 4.

<sup>2</sup> Projected future benthic flux (present rates reduced approximately proportional to watershed load reductions).

<sup>3</sup> Sum of target threshold watershed load, atmospheric deposition load and sediment (benthic) load.

## Implementation Plans

The critical element of this TMDL process is achieving the sentinel station specific target threshold N concentration presented in Table 4. This is necessary for the restoration and protection of water quality, benthic invertebrate habitat, and eelgrass within the Lake Tashmo System. In order to achieve these target threshold N concentrations, N loading rates must be reduced throughout the Lake Tashmo system. Table 6 lists the target threshold watershed N load for this system.

### Septic Systems:

Table 8 (from Table VIII-2 of the MEP Technical Report) summarizes the present loadings from septic systems and the reduced loads that would be necessary to achieve the target threshold N concentration in the Lake Tashmo system under the scenario modeled here. A 42.5% reduction in present septic loading achieved the target threshold N concentration of 0.36 mg/L at the sentinel station (to be located in Brown Point Channel), time averaged over the summer period. This septic load change will result in a 31.9% decrease in the total watershed N load to the Lake Tashmo Estuary.

Because the vast majority of controllable N load is from individual septic systems for private residences, the Comprehensive Wastewater Management Plan (CWMP) should assess the most cost-effective options for achieving the target threshold N watershed loads, including but not limited to, sewerage and treatment for N control of sewage and septage at either centralized or decentralized locations, and denitrifying systems for all private residences. The CWMP should include a schedule of the selected strategies and estimated timelines for achieving those targets. However, the MassDEP realizes that an adaptive management approach may be used to observe implementation results over time and allow for adjustments based on those results. If a community chooses to implement TMDL measures without a CWMP it must demonstrate that these measures will achieve the target threshold N concentration. (Note: Communities that choose to proceed without a CWMP will not be eligible for State Revolving Fund 0% loans.)

As previously noted, there is a variety of loading reduction scenarios that could achieve the target threshold N concentrations. It must be demonstrated however, that any alternative implementation strategies will be protective of the entire embayment system.

**Table 8: Summary of the Present Septic System Loads (Attenuated) and the Loading Reductions that would be Necessary to Achieve the TMDL by Reducing Septic System Loads Alone.**

Lake Tashmoo Sub-embayment	Present Septic N Load (kg N/day)	Threshold Septic load (kg N/day)	Threshold Septic Load % Change
Drew Cove	2.885	2.596	-10%
Main Basin	15.416	7.708	-50%
Upper Basin	0.496	0.496	0%
System Total	18.797	10.801	-42.5%

The above modeling results provide one scenario of achieving the threshold level for the sentinel site within the estuarine system. This example does not represent the only method for achieving this goal. The watershed communities are encouraged to evaluate other load reduction scenarios and take any reasonable steps to reduce the controllable N sources.

All of the towns on Martha’s Vineyard adopted identical fertilizer regulations in the spring of 2014. This regulation provides for a reduction of nitrogen and phosphorus going into the Island’s Water Resources by means of an organized system of education, licensure, regulation of practice, and enforcement. The regulation is intended to contribute to the island’s ability to protect, maintain, and ultimately improve the water quality in all its water resources and assist in achieving compliance with any applicable water quality standards relating to controllable nitrogen and phosphorus.

<http://mvboh.org/fertilizer.html>

It should be noted that although the Lake Tashmoo watershed contains no Phase II stormwater communities, the Tisbury Board of Health has adopted “Stormwater Management Regulations” that have the same intentions as the Phase II Stormwater Regulations by providing adequate protection against pollutants, flooding, siltation, and other drainage problems.

**Climate Change:**

MassDEP recognizes that long-term (25+ years) climate change impacts to southeastern Massachusetts, including the area of this TMDL, are possible based on known science. Massachusetts Executive Office of Energy and Environmental Affairs 2011 Climate Change Adaptation Report: <http://www.mass.gov/eea/waste-mgmt-recycling/air-quality/green-house-gas-and-climate-change/climate-change-adaptation/climate-change-adaptation-report.html> predicts that by 2100 the sea level could be from 1 to 6 feet higher than the current position and precipitation rates in the Northeast could increase by as much as 20 percent. However, the details of how climate change will affect sea level rise, precipitation, streamflow, sediment and nutrient loading in specific locations are generally unknown. The ongoing debate is not about whether climate change will occur, but the rate at and the extent to which it will occur and the adjustments needed to address its

impacts. EPA's 2012 Climate Change Strategy ([http://water.epa.gov/scitech/climatechange/upload/epa\\_2012\\_climate\\_water\\_strategy\\_full\\_report\\_final.pdf](http://water.epa.gov/scitech/climatechange/upload/epa_2012_climate_water_strategy_full_report_final.pdf)) states: "Despite increasing understanding of climate change, there still remain questions about the scope and timing of climate change impacts, especially at the local scale where most water-related decisions are made." For estuarine TMDLs in southeastern Massachusetts, MassDEP recognizes that this is particularly true, where water quality management decisions and implementation actions are generally made and conducted at the municipal level on a sub-watershed scale.

EPA's Climate Change Strategy identifies the types of research needed to support the goals and strategic actions to respond to climate change. EPA acknowledges that data are missing or not available for making water resource management decisions under changing climate conditions. In addition, EPA recognizes the limitation of current modeling in predicting the pace and magnitude of localized climate change impacts and recommends further exploration of the use of tools, such as atmospheric, precipitation and climate change models, to help states evaluate pollutant load impacts under a range of projected climatic shifts.

In 2013, EPA released a study entitled, "Watershed modeling to assess the sensitivity of streamflow, nutrient, and sediment loads to potential climate change and urban development in 20 U.S. watersheds." (National Center for Environmental Assessment, Washington D.C.; EPA/600/R-12/058F). The closest watershed to southeastern Massachusetts that was examined in this study is a New England coastal basin located between Southern Maine and Central Coastal Massachusetts. These watersheds do not encompass any of the watersheds in the Massachusetts Estuary Project (MEP) region, and it has vastly different watershed characteristics, including soils, geography, hydrology and land use – key components used in a modeling analysis. The initial "first order" conclusion of this study is that, in many locations, future conditions, including water quality, are likely to be different from past experience. However, most significantly, this study did not demonstrate that changes to TMDLs (the water quality restoration targets) would be necessary for the region. EPA's 2012 Climate Change Strategy also acknowledges that the Northeast, including New England, needs to develop standardized regional assumptions regarding future climate change impacts. EPA's 2013 modeling study does not provide the scientific methods and robust datasets needed to predict specific long-term climate change impacts in the MEP region to inform TMDL development.

MassDEP believes that impacts of climate change should be addressed through TMDL implementation with an adaptive management approach in mind. Adjustments can be made as environmental conditions, pollutant sources, or other factors change over time. Massachusetts Coastal Zone Management (CZM) has developed a StormSmart Coasts Program (2008) to help coastal communities address impacts and effects of erosion, storm surge and flooding which are increasing due to climate change. The program, [www.mass.gov/czm/stormsmart](http://www.mass.gov/czm/stormsmart) offers technical information, planning strategies, legal and regulatory tools to communities to adapt to climate change impacts.

As more information and tools become available, there may be opportunities to make adjustments in TMDLs in the future to address predictable climate change impacts. When the science can

support assumptions about the effects of climate change on the nitrogen loadings to Lake Tashmoo the TMDL can be reopened, if warranted.

The watershed communities of Tisbury, West Tisbury and Oak Bluffs are urged to meet the target threshold N concentrations by reducing N loadings from any and all sources, through whatever means are available and practical, including reductions in on-site subsurface wastewater disposal system loadings as well as reductions in stormwater runoff and/or fertilizer use within the watershed through the establishment of local by-laws and/or the implementation of stormwater Best Management Practices (BMPs).

MassDEP's "MEP Embayment Restoration Guidance for Implementation Strategies," available at: <http://www.mass.gov/eea/agencies/massdep/water/watersheds/coastal-resources-and-estuaries.html> provides N loading reduction strategies that are available to Tisbury that could be incorporated into the implementation plans. The following topics related to N reduction are discussed in the Guidance:

- Wastewater Treatment;
  - On-Site Treatment and Disposal Systems
  - Cluster Systems with Enhanced Treatment
  - Community Treatment Plants
  - Municipal Treatment Plants and Sewers
- Tidal Flushing;
  - Channel Dredging
  - Inlet Alteration
  - Culvert Design and Improvements
- Stormwater Control and Treatment\*;
  - Source Control and Pollution Prevention
  - Stormwater Treatment
- Attenuation via Wetlands and Ponds;
- Water Conservation and Water Reuse;
- Management Districts;
- Land Use Planning and Controls;
  - Smart Growth
  - Open Space Acquisition
  - Zoning and Related Tools
- Nutrient Trading.

\*The Towns of Tisbury, West Tisbury and Oak Bluffs are not currently covered by the Phase II storm water program requirements in Massachusetts.

The appropriateness of any of the alternatives will depend on local conditions, and will have to be determined on a case-by-case basis, using an adaptive management approach.

## **Monitoring Plan**

MassDEP is of the opinion that there are two forms of monitoring that are useful to determine progress towards achieving compliance with the TMDL. MassDEP's position is that implementation will be conducted through an iterative process where adjustments may be needed in the future. The two forms of monitoring include: 1) tracking implementation progress as approved in the town CWMP plan (as appropriate); and 2) monitoring ambient water quality conditions, including but not limited to, the sentinel station identified in the MEP Technical Report.

If necessary to achieve the TMDL, the CWMP will evaluate various options to achieve the goals set out in the TMDL and Technical Report. It will also make a final recommendation based on existing or additional modeling runs, set out required activities and identify a schedule to achieve the most cost effective solution that will result in compliance with the TMDL. Once approved by MassDEP, tracking progress on the agreed-upon plan will, in effect, also be tracking progress towards water quality improvements in conformance with the TMDL.

Relative to water quality, MassDEP believes that an ambient monitoring program, much reduced from the data collection activities needed to properly assess conditions and to populate the model, will be important to determine actual compliance with water quality standards. Although the TMDL load values are not fixed, the target threshold N concentrations at the sentinel stations are. Through discussions amongst the MEP it is generally agreed that existing monitoring programs which were designed to thoroughly assess conditions and populate water quality models can be substantially reduced for compliance monitoring purposes. Although more specific details need to be developed on a case by case basis, MassDEP's current thinking is that about half the current effort (using the same data collection procedures) would be sufficient to monitor compliance over time and to observe trends in water quality changes. In addition, the benthic habitat and communities would require periodic monitoring on a frequency of about every 3-5 years. Finally, in addition to the above, existing monitoring conducted by MassDEP for eelgrass should continue into the future to observe any changes that may occur to eelgrass populations as a result of restoration efforts.

The MEP will continue working with the Town of Tisbury to develop and refine monitoring plans that remain consistent with the goals of the TMDL. Through the adaptive management approach ongoing monitoring will be conducted and will indicate if water quality standards are being met. If this does not occur other management activities would have to be identified and considered to reach to goals outlined in this TMDL. It must be recognized however that development and implementation of a monitoring plan will take some time, but it is more important at this point to focus efforts on reducing existing watershed loads to achieve water quality goals.

## **Reasonable Assurances**

MassDEP possesses the statutory and regulatory authority, under the water quality standards and/or the State Clean Water Act (CWA), to implement and enforce the provisions of the TMDL through its many permitting programs, including requirements for N loading reductions from on-site subsurface wastewater disposal systems. However, because most non-point source controls are voluntary, reasonable assurance is based on the commitment of the locality involved. Tisbury has

demonstrated this commitment through the comprehensive wastewater planning that they initiated well before the generation of the TMDL as well as proceeding with construction of a larger culvert to improve flushing within the embayment. The town expects to use the information in this TMDL to generate support from their citizens to take the necessary steps to remedy existing problems related to N loading from on-site subsurface wastewater disposal systems, stormwater, and runoff (including fertilizers) and to prevent any future degradation of these valuable resources.

Moreover, reasonable assurances that the TMDL will be implemented include enforcement of regulations, availability of financial incentives and local, state and federal programs for pollution control. Stormwater NPDES permit coverage will address discharges from municipally owned stormwater drainage systems. Enforcement of regulations controlling non-point discharges include local implementation of the Commonwealth's Wetlands Protection Act and Rivers Protection Act; Title 5 regulations for on-site subsurface wastewater disposal systems and other local regulations such as the Town of Rehoboth's stable regulations.

Financial incentives include federal funds available under Sections 319, 604 and 104(b) programs of the CWA, which are provided as part of the Performance Partnership Agreement between MassDEP and EPA. Other potential funds and assistance are available through Massachusetts' Department of Agriculture's Enhancement Program and the United States Department of Agriculture's Natural Resources Conservation Services. Additional financial incentives include income tax credits for Title 5 upgrades and low interest loans for Title 5 on-site subsurface wastewater disposal system upgrades available through municipalities participating in this portion of the state revolving fund program.

As the towns implement this TMDL, the TMDL values (kg/day of N) will be used by MassDEP as guidelines for permitting activities and should be used by local communities as a management tool.

## **Public Participation**

Public meetings to present the results of and answer questions on this TMDL were held on May 24, 2017 in the Katharine Cornell Theatre, Tisbury. Patti Kellogg and Barbara Kickham (MassDEP) summarized the Mass Estuaries Project and described the Draft Nitrogen TMDL Report findings. Public comments received at the public meetings and comments received in writing within a 30-day comment period following the public meeting were considered by the Department. This final version of the TMDL report includes both a summary of the public comments together with the Department's response to the comments and scanned images of the attendance sheet from the meeting (Appendix E). MEP representatives at the public meeting included Patti Kellogg, Barbara Kickham and Brian Dudley.

## References

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MassDEP (2007). *Massachusetts Surface Water Quality Standards (314 CMR 4.00)*. Massachusetts Department of Environmental Protection, 1 Winter Street, Boston, MA.

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Environmental Protection Agency (2001). *Nutrient Criteria Technical Guidance Manual: Estuarine and Coastal Waters (EPA-822-B-01-003)*. The United States Environmental Protection Agency, Washington D.C.. Available at: <http://www2.epa.gov/nutrient-policy-data/nutrient-criteria-technical-guidance-manual-estuarine-and-coastal-waters>

## Appendix A Overview of Applicable Water Quality Standards

Water quality standards of particular interest to the issues of cultural eutrophication are dissolved oxygen, nutrients, bottom pollutants or alterations, aesthetics, excess plant biomass, and nuisance vegetation. The Massachusetts water quality standards (314 CMR 4.0) contain numeric criteria for dissolved oxygen, but have only narrative standards that relate to the other variables. This brief summary does not supersede or replace 314 CMR 4.0 Massachusetts Water Quality Standards, the official and legal standards. A complete version of 314 CMR 4.0 Massachusetts Water Quality Standards is available online at <http://www.mass.gov/eea/agencies/massdep/water/regulations/314-cmr-4-00-mass-surface-water-quality-standards.html>

### Applicable Narrative Standards

314 CMR 4.05(5)(a) states “Aesthetics – All surface waters shall be free from pollutants in concentrations that settle to form objectionable deposits; float as debris, scum, or other matter to form nuisances, produce objectionable odor, color, taste, or turbidity, or produce undesirable or nuisance species of aquatic life.”

314 CMR 4.05(5)(b) states “Bottom Pollutants or Alterations. All surface waters shall be free from pollutants in concentrations or combinations or from alterations that adversely affect the physical or chemical nature of the bottom, interfere with the propagation of fish or shellfish, or adversely affect populations of non-mobile or sessile benthic organisms.”

314 CMR 4.05(5)(c) states, “Nutrients –Unless naturally occurring, all surface waters shall be free from nutrients in concentrations that would cause or contribute to impairment of existing or designated uses and shall not exceed the site specific criteria developed in a TMDL or as otherwise established by the Department pursuant to 314 CMR 4.00. Any existing point source discharge containing nutrients in concentrations that would cause or contribute to cultural eutrophication, including the excessive growth of aquatic plants or algae, in any surface water shall be provided with the most appropriate treatment as determined by the Department, including, where necessary, highest and best practical treatment (HBPT) for POTWs and BAT for non POTWs, to remove such nutrients to ensure protection of existing and designated uses. Human activities that result in the nonpoint source discharge of nutrients to any surface water may be required to be provided with cost effective and reasonable best management practices for nonpoint source control.”

### Description of Coastal and Marine Classes and Numeric Dissolved Oxygen Standards

*Excerpt from 314 CMR 4.05(4) (a):*

- (4) Class SA. These waters are designated as an excellent habitat for fish, other aquatic life and wildlife, including for their reproduction, migration, growth and other critical functions, and for primary and secondary contact recreation. In certain waters, excellent habitat for fish, other aquatic life and wildlife may include, but is not limited to, seagrass. Where designated in the tables to 314 CMR 4.00 for shellfishing, these waters shall be suitable for shellfish harvesting without depuration (Approved and Conditionally Approved Shellfish Areas). These waters shall have excellent aesthetic value.
4. Dissolved Oxygen. Shall not be less than 6.0 mg/l. Where natural background conditions are lower, DO shall not be less than natural background. Natural seasonal and daily variations that are necessary to protect existing and designated uses shall be maintained.

*Excerpt from 314 CMR 4.05(4) (b):*

(b) Class SB. These waters are designated as a habitat for fish, other aquatic life and wildlife, including for their reproduction, migration, growth and other critical functions, and for primary and secondary contact recreation. In certain waters, habitat for fish, other aquatic life and wildlife may include, but is not limited to, seagrass. Where designated in the tables to 314 CMR 4.00 for shellfishing, these waters shall be suitable for shellfish harvesting with depuration (Restricted and Conditionally Restricted Shellfish Areas). These waters shall have consistently good aesthetic value.

4. Dissolved Oxygen. Shall not be less than 5.0 mg/l. Seasonal and daily variations that are necessary to protect existing and designated uses shall be maintained. Where natural background conditions are lower, DO shall not be less than natural background.

### **Waterbodies Not Specifically Designated in 314 CMR 4.06 or the tables to 314 CMR 4.00**

Note many waterbodies do not have a specific water quality designation in 314 CMR 4.06 or the tables to 314 CMR 4.00. Coastal and Marine Classes of water are designated as Class SA and presumed High Quality Waters as described in 314 CMR 4.06 (4).

*314 CMR 4.06(4):*

(4) Other Waters. Unless otherwise designated in 314 CMR 4.06 or unless otherwise listed in the tables to 314 CMR 4.00, other waters are Class B, and presumed High Quality Waters for inland waters and Class SA, and presumed High Quality Waters for coastal and marine waters. Inland fisheries designations and coastal and marine shellfishing designations for unlisted waters shall be made on a case-by-case basis as necessary.

### **Applicable Antidegradation Provisions**

Applicable antidegradation provisions are detailed in 314 CMR 4.04 from which an excerpt is provided:

*Excerpt from 314 CMR 4.04:*

4.04:Antidegradation Provisions

(4) Protection of Existing Uses. In all cases existing uses and the level of water quality necessary to protect the existing uses shall be maintained and protected.

(2) Protection of High Quality Waters. High Quality waters are waters whose quality exceeds minimum levels necessary to support the national goal uses, low flow waters, and other waters whose character cannot be adequately described or protected by traditional criteria. These waters shall be protected and maintained for their existing level of quality unless limited degradation by a new or increased discharge is authorized by the Department pursuant to 314 CMR 4.04(5). Limited degradation also may be allowed by the Department where it determines that a new or increased discharge is insignificant because it does not have the potential to impair any existing or designated water use and does not have the potential to cause any significant lowering of water quality.

(3) Protection of Outstanding Resource Waters. Certain waters are designated for protection under this provision in 314 CMR 4.06. These waters include Class A Public Water Supplies (314 CMR 4.06(1)(d)1.) and their tributaries, certain wetlands as specified in 314 CMR 4.06(2) and other waters as determined by the Department based on their outstanding socio-economic, recreational, ecological and/or aesthetic values. The quality of these waters shall be protected and maintained.

(a) Any person having an existing discharge to these waters shall cease said discharge and connect to a Publicly Owned Treatment Works (POTW) unless it is shown by said person that such a connection is not reasonably available or feasible. Existing discharges not connected to a POTW shall be provided with the highest and best practical method of waste treatment determined by the Department as necessary to protect and maintain the outstanding resource water.

(b) A new or increased discharge to an Outstanding Resource Water is prohibited unless:

1. the discharge is determined by the Department to be for the express purpose and intent of maintaining or enhancing the resource for its designated use and an authorization is granted as provided in 314 CMR 4.04(5). The Department's determination to allow a new or increased discharge shall be made in agreement with the federal, state, local or private entity recognized by the Department as having direct control of the water resource or governing water use; or

4. the discharge is dredged or fill material for qualifying activities in limited circumstances, after an alternatives analysis which considers the Outstanding Resource Water designation and further minimization of any adverse impacts. Specifically, a discharge of dredged or fill material is allowed only to the limited extent specified in 314 CMR 9.00 and 314 CMR 4.06(1)(d). The Department retains the authority to deny discharges which meet the criteria of 314 CMR 9.00 but will result in substantial adverse impacts to the physical, chemical, or biological integrity of surface waters of the Commonwealth

(4) Protection of Special Resource Waters. Certain waters of exceptional significance, such as waters in national or state parks and wildlife refuges, may be designated by the Department in 314 CMR 4.06 as Special Resource Waters (SRWs). The quality of these waters shall be maintained and protected so that no new or increased discharge and no new or increased discharge to a tributary to a SRW that would result in lower water quality in the SRW may be allowed, except where:

(a) the discharge results in temporary and short term changes in the quality of the SRW, provided that the discharge does not permanently lower water quality or result in water quality lower than necessary to protect uses; and

(b) an authorization is granted pursuant to 314 CMR 4.04(5).

(5) Authorizations.

(a) An authorization to discharge to waters designated for protection under 314 CMR 4.04(2) may be issued by the Department where the applicant demonstrates that:

1. The discharge is necessary to accommodate important economic or social development in the area in which the waters are located;
2. No less environmentally damaging alternative site for the activity, receptor for the disposal, or method of elimination of the discharge is reasonably available or feasible;
3. To the maximum extent feasible, the discharge and activity are designed and conducted to minimize adverse impacts on water quality, including implementation of source reduction practices; and
4. The discharge will not impair existing water uses and will not result in a level of water quality less than that specified for the Class.

(b) An authorization to discharge to the narrow extent allowed in 314 CMR 4.04(3) or 314 CMR 4.04(4) may be granted by the Department where the applicant demonstrates compliance with 314 CMR 4.04(5)(a)2. Through 314 CMR 4.04(5)(a)4.

(c) Where an authorization is at issue, the Department shall circulate a public notice in accordance with 314 CMR 2.06. Said notice shall state an authorization is under consideration by the Department, and indicate the Department's tentative determination. The applicant shall have the burden of justifying the authorization. Any authorization granted pursuant to 314 CMR 4.04 shall not extend beyond the expiration date of the permit.

(d) A discharge exempted from the permit requirement by 314 CMR 3.05(4) (discharge necessary to abate an imminent hazard) may be exempted from 314 CMR 4.04(5) by decision of the Department.

(e) A new or increased discharge specifically required as part of an enforcement order issued by the Department in order to improve existing water quality or prevent existing water quality from deteriorating may be exempted from 314 CMR 4.04(5) by decision of the Department.

(6) The Department applies its Antidegradation Implementation Procedures to point source discharges subject to 314 CMR 4.00.

(7) Discharge Criteria. In addition to the other provisions of 314 CMR 4.00, any authorized Discharge shall be provided with a level of treatment equal to or exceeding the requirements of the Massachusetts Surface Water Discharge Permit Program (314 CMR 3.00). Before authorizing a discharge, all appropriate public participation and intergovernmental coordination shall be conducted in accordance with Permit Procedures (314 CMR 2.00).

## Appendix B Measured Total Nitrogen Concentrations

**Table B-1: Summary of the Nitrogen Concentrations for the Lake Tashmoo Estuarine System**  
(Reprinted from Table VI-1 of the accompanying MEP Technical Report)

Measured data and modeled Nitrogen concentrations for the Lake Tashmoo estuarine system. All concentrations are given in mg/L N. "Data mean" values are calculated as the average of the separate yearly means. Data represented in this table were collected in the summers of 2001 through 2007.							
Sub-Embayment	MEP monitoring station	data mean	s.d. all data	N	model min	model max	model average
Lower Basin	MV21	0.314	0.047	29	0.279	0.327	0.300
Lower Basin	MV1	0.306	0.068	28	0.283	0.343	0.311
Lower Basin	MV2	0.301	0.069	28	0.294	0.356	0.329
Mid-Upper Basin	MV3	0.343	0.071	38	0.356	0.379	0.369
Mid-Upper Basin	MV4	0.360	0.065	37	0.379	0.391	0.385
Upper Basin	MV5	0.447	0.087	37	0.418	0.428	0.423
Offshore	MV6	0.270	0.065	60	-	-	-

## Appendix C Estimated Waste Load Allocation

**Table C-1: The Lake Tashmoo Estuarine System estimated waste load allocation (WLA) from runoff of all impervious areas within 200 feet of its waterbodies.**

Lake Tashmoo Sub-embayment	Watershed Impervious Area in 200 ft Buffer of Embayment Waterbody (acres) <sup>1</sup>	Total Watershed Impervious Area (acres) <sup>2</sup>	Total Watershed Area (acres)	% Impervious of Total Watershed Area	Watershed Impervious Area in 200 ft buffer as % of Total Watershed Impervious Area	MEP Total Unattenuated Watershed Impervious Load (kg N/day) <sup>3</sup>	MEP Total Unattenuated Watershed Load (kg N/day) <sup>4</sup>	Watershed Impervious buffer (200 ft) WLA (kg N/day) <sup>5</sup>	Watershed buffer area WLA as % of MEP Total Unattenuated Watershed Load <sup>6</sup>
Drew Cove	0.88	54.78	658.49	8.3%	1.6%	0.31	4.43	0.005	0.11%
Main Basin	5.20	231.91	2132.34	10.9%	2.2%	1.59	19.91	0.035	0.18%
Upper Basin	0	9.70	126.59	7.7%	0.0%	0.06	0.76	0.0	0.0%
System Total	6.08	296.39	2917.42	10.2%	2.1%	1.96	25.1	0.04	0.16%

<sup>1</sup>The entire impervious area within a 200 foot buffer zone around all waterbodies as calculated from GIS. Due to the soils and geology of Martha's Vineyard it is unlikely that runoff would be channeled as a point source directly to a waterbody from areas more than 200 feet away. Some impervious areas within approximately 200 feet of the shoreline may discharge storm water via pipes directly to the waterbody. For the purposes of the wasteload allocation (WLA) it was assumed that all impervious surfaces within 200 feet of the shoreline discharge directly to the waterbody.

<sup>2</sup>Total impervious surface for the watershed was obtained from SMAST N load data files.

<sup>3</sup>From Table IV-2 of the MEP Technical Report.

<sup>4</sup>From Table IV-2 of the MEP Technical Report. This includes the unattenuated nitrogen loads from wastewater from septic systems, fertilizer, farm animals, WWTF, landfill, runoff from both natural and impervious surfaces, and atmospheric deposition to freshwater waterbodies. This does not include direct atmospheric deposition to the estuary surface.

<sup>5</sup>The impervious subwatershed 200 ft buffer area (acres) divided by total watershed impervious area (acres) then multiplied by total impervious subwatershed load (kg N/day).

<sup>6</sup>The impervious subwatershed buffer area WLA (kg N/day) divided by the total subwatershed load (kg N/day) then multiplied by 100.

## Appendix D TMDLs

**Table D-1: Lake Tashmoo Estuarine System Total Nitrogen TMDL**

<b>Embayment</b>	<b>Segment ID</b>	<b>Description</b>	<b>TMDL (kg N/day)</b>
Lake Tashmoo (Main Basin)			23.30
Drew Cove			11.49
Lake Tashmoo (Upper Basin)			0.76
<b>Lake Tashmoo (System Total)</b>	<b>MA97-12</b>	Waters including Drew Cove and Rhoda Pond to confluence with Vineyard Sound at channel south of Herring Creek Road, Tisbury, Martha's Vineyard.	<b>35.55</b>

## Appendix E Massachusetts Estuaries Project (MEP) Response to Comments

DRAFT TOTAL MAXIMUM DAILY LOAD (TMDL) REPORT FOR  
LAKE TASHMOO ESTUARINE SYSTEM (CONTROL #353.0)  
(REPORT DATED APRIL 2017)  
PUBLIC MEETING ON MAY 24, 2017  
KATHARINE CORNELL THEATRE, TISBURY, MA

Questions and comments:

- 1. What if the estuary is cleaned up before we complete the proposed implementation plan? What is we don't restore the estuary even after completing the implementation plan? Will we change the threshold concentration?**

*MassDEP Response: The goal of the Lake Tashmoo TMDL is to restore the estuarine habitat for eelgrass and benthic macroinvertebrate. The modeling predicts that if the target threshold concentration is met at the sentinel station, then eelgrass habitat restoration will be supported below the sentinel station. In addition, the benthic macroinvertebrate habitat will also be restored. If the target concentrations are achieved and restoration of eelgrass and benthic habitat is not observed, then through the process of adaptive management, other interventions may need to be implemented. This may include the re-evaluation of the target N threshold concentration. Improvement in habitat health of the estuary will take some time. However, if the estuarine habitat is restored before completion of the implementation plan, changes to the implementation plan will be evaluated accordingly.*

- 2. Tisbury isn't the only community in the watershed. How do we get West Tisbury to work with us to restore the estuary? Especially since they are only a small percentage of the total load.**

*MassDEP Response: An example of neighboring towns working on a regional plan is the Pleasant Bay Alliance which consists of Orleans, Brewster, Harwich, and Chatham. Harwich, Dennis and Yarmouth are in discussions regarding a shared wastewater treatment plant. If the watershed contribution from a given town is a small percentage of the total load, the high cost of sewerage may not justify construction of a separate sewerage project. Instead, the town might consider contributing to the sewerage project of a neighboring town for the rights to connect some portion of the town to municipal sewers. MassDEP encourages resource sharing between municipalities, particularly where it results in increased efficiency and cost savings.*

- 3. Is this TMDL document enforceable? What will happen if we don't implement the recommendations?**

*MassDEP Response: MassDEP prefers to work cooperatively with communities to protect and restore impaired waters. This is especially true when pollution comes from nonpoint sources such as stormwater runoff and on-site wastewater disposal, and where solutions are less straightforward than additional treatment of a point source discharge.*

*As long as a plan is developed and actions are being taken at a reasonable pace to achieve the goals of the TMDL, MassDEP will use discretion in taking enforcement steps. However, in the event that reasonable progress is not being made, MassDEP can take enforcement action through the broad authority granted by the Massachusetts Clean Waters Act and the Massachusetts Water Quality Standards.*

*As a means to allow municipalities to incorporate non-traditional nitrogen removal strategies, that are not otherwise required to get a surface water or groundwater discharge permit, MassDEP is piloting watershed permits. Watershed permits would include implementation timetables, standards to be achieved, and long-term monitoring to evaluate water quality improvements.*

**4. Where does Lake Tashmoo fall in the list of estuaries studied as part of the MEP? Is the observed impairment worse than most, or not as bad, or somewhere in the middle?**

*MassDEP Response: The impairment observed in Lake Tashmoo is significant. That being said, it is somewhere in the middle compared to other estuaries studied in the MEP. The uppermost headwater basin shows signs of moderate to significant habitat impairment based on major indicators (eelgrass, DO, chlorophyll a, benthic fauna, and macroalgae; Table 2 in the TMDL). The lower basin experiences more ocean mixing and consequently the major indicators of habitat impairment indicate healthy to moderately impairment.*

*From the MEP Technical Report: At present, the Lake Tashmoo estuary is showing nitrogen enrichment and impairment of both eelgrass and infaunal habitats, indicating that nitrogen management of this system will be for restoration rather than for protection or maintenance of an unimpaired system. The system is showing some nitrogen related habitat impairment throughout its tidal reaches. The upper basin and lower basin are relatively deep and this structure allows periodic weak salinity stratification (weak vertical mixing), which makes these basins sensitive to the negative effects of nitrogen enrichment. The result is periodic hypoxia in the upper basin and oxygen depletion in the lower basin as a result of in situ phytoplankton production and deposition. In addition, the increased phytoplankton biomass decreases light penetration to the bottom colonizing eelgrass adding further stress and accelerating bed loss. It is almost certain that the observed periodic hypoxia in the uppermost headwater basin resulted in the loss of the beds observed between 1995 and 2001. The pattern of loss is consistent with nitrogen enrichment, following the gradient of increasing nitrogen and chlorophyll-a levels from the inlet to the headwaters.*

**5. How many years of data will we have to collect for the TMDL? Who will do the monitoring and who will pay for it? Do we have to continue to monitor all the stations that were monitored for the Technical Report?**

*MassDEP Response: As stated in the TMDL, MassDEP believes that about half of the monitoring effort required to develop the Technical Report will be required to monitor compliance over time and to observe trends. Ideally, the towns would continue to monitor the water quality in the estuaries until the nitrogen reduction strategies have been implemented and habitat restoration is observed. MassDEP would like to see monitoring continued at the sentinel stations bi-monthly, May-September in order to determine compliance with the TMDL. However, ideally, it would be good to continue monitoring all of the stations, if possible. MassDEP has committed to continued mapping of the extent of eelgrass in*

*Massachusetts coastal waters. Responsibility for benthic sampling (to be conducted every 3-5 years) will vary between communities.*

## **6. What is the Margin of Safety discussed in the TMDL?**

*MassDEP Response: Statutes and regulations require that a TMDL include a margin of safety (MOS) to account for any lack of knowledge concerning the relationship between load and wasteload allocations and water quality [CWA para 303 (d)(20)(C), 40C.G.R. para 130.7(1)]. The MOS must be designed to ensure that any uncertainties in the data or calculations used to link pollutant sources to water quality impairment modeling will be accounted for in the TMDL and ensure protection of the beneficial uses. The EPA's 1991 TMDL Guidance explains that the MOS may be implicit, i.e., incorporated into the TMDL through conservative assumptions in the analysis, or explicit, i.e., expressed in the TMDL as loadings set aside for the MOS. An implicit MOS is not specifically quantified but consists of statements of the conservative assumptions used in the analysis. The MOS for the Lake Tashmoo Estuarine System TMDL is implicit. MassDEP used conservative assumptions to develop numeric model applications that account for the MOS.*

## **7. Is the TMDL presented today different than the TMDL loads presented in the Technical Report?**

*MassDEP Response: In the case of Lake Tashmoo the TMDL is the same as the TMDL values presented in the Technical Report. In some of the estuaries studied in the MEP, the Technical Report predicted that the benthic or sediment flux would be negative. Since it is not realistic to include a negative load in the TMDL, negative flux was set to zero. This was not necessary in the Lake Tashmoo TMDL.*

## **8. How will DEP support us in the future after the TMDL is approved?**

*MassDEP Response: MassDEP is available as a technical resource and will work with the towns to prepare and implement Comprehensive Water Resources Management Plans to direct nitrogen removal strategies. Grant funding for stormwater Best Management Practices is available under the 319 Program. Low interest loans are available through the State Revolving Fund for infrastructure construction projects. MassDEP will support long term monitoring of eelgrass in coastal areas. MassDEP will monitor the Town's progress towards meeting restoration of benthic and eelgrass habitats in Lake Tashmoo.*

## **9. If we achieve the TMDL, it will take time for the estuary to recover. How do we manage people's expectations for seeing improvements in the estuary?**

*MassDEP Response: Implementation of nitrogen removal strategies will take place in phases over a number of years. The public should be made aware of the long-term implementation schedule. One recommendation is to remove nitrogen from areas closest to the embayments, where travel time is shortest and improvements will be observed more quickly than those implemented in the head waters. Supplemental nitrogen removal strategies, for example, Permeable Reactive Barriers, if determined appropriate and effective, could be installed closer to the effected estuaries, thus reducing travel time for removal.*

**10. Isn't there another Technical Report for an estuary on Martha's Vineyard due soon?**

*MassDEP Response: MassDEP received the Draft Technical Report for Menemsha and Squibnocket Ponds from SMAST on June 30, 2017.*

**General Frequently Asked Questions:**

**1. Can a Comprehensive Water Resources Management Plan (CWRMP) include the acquisition of open space, and if so, can State Revolving Funds (SRF) be used for this?**

*MassDEP Response: State Revolving funds can be used for open space preservation if a specific watershed property has been identified as a critical implementation measure for meeting the TMDL. The SRF solicitation should identify the land acquisition as a high priority project for this purpose which would then make it eligible for the SRF funding list. However, it should be noted that preservation of open space will only address potential future nitrogen sources (as predicted in the build-out scenario in the MEP Technical report) and not the current situation. The town will still have to reduce existing nitrogen sources to meet the TMDL.*

**2. Do we expect eelgrass to return if the nitrogen goal is higher than the concentration that can support eelgrass?**

*MassDEP Response: There are a number of factors that can control the ability of eelgrass to re-establish in any area. Some are of a physical nature (such as boat traffic, water depth, or even sunlight penetration) and others are of a chemical nature like nitrogen. Eelgrass decline in general has been directly related to the impacts of eutrophication caused by elevated nitrogen concentrations. Therefore, if the nitrogen concentration is elevated enough to cause symptoms of eutrophication to occur, eelgrass growth will not be possible even if all other factors are controlled and the eelgrass will not return until the water quality conditions improve.*

**3. Who is required to develop the CWRMP? Can it be written in-house if there is enough expertise?**

*MassDEP Response: The CWRMP can be prepared by the town. There are no requirements that it must be written by an outside consultant; however, the community should be very confident that its in-house expertise is sufficient to address the myriad issues involved in the CWRMP process. MassDEP would strongly recommend that any community wishing to undertake this endeavor on its own should meet with MassDEP to develop an appropriate scope of work that will result in a robust and acceptable plan.*

**4. Have others written regional CWRMPs (i.e. included several neighboring towns)?**

*MassDEP Response: The Cape Cod Commission prepared a Regional Wastewater Management Plan or RWMP which formed a framework and set of tools for identifying several solutions for restoring water*

quality for each watershed on the Cape. The Section 208 Plan Update (or 208 Plan) is an area-wide water quality management plan and in general each town then prepared or is preparing it's own CWRMP. An example of neighboring towns working on a regional plan is the Pleasant Bay Alliance which consists of Orleans, Brewster, Harwich, and Chatham. Harwich, Dennis and Yarmouth are in discussions regarding a shared wastewater treatment plant.

Joint Comprehensive Wastewater Management Plans (CWMPs) have been developed by multiple Towns particularly where Districts are formed for purposes of wastewater treatment. Some examples include the Upper Blackstone Water Pollution Abatement District that serve all or portions of the towns Holden, Millbury, Rutland West Boylston and the City of Worcester and the Greater Lawrence Sanitary District that serves the greater Lawrence area including portions of Andover, N. Andover, Methuen and Salem NH.. There have also been recent cases where Towns have teamed up to develop a joint CWMP where districts have not been formed. The most recent example are the Towns discharging to the Assabet River. They include the Towns of Westboro and Shrewsbury, Marlboro and Northboro, Hudson, and Maynard. The reason these towns joined forces was because as a group, they received more priority points in the State Revolving Fund application process than they otherwise would have as individual towns.

**5. Does nitrogen entering the system close to shore impair water quality more? If we have to sewer, wouldn't it make sense to sewer homes closer to the shore?**

*MassDEP Response: Homes closer to the waterbody allow nitrogen to get to that waterbody faster (shorter travel times). Those further away may take longer but still get there over time and are dependent upon the underlying geology. However, what is more important is the density of homes. Larger home density means more nitrogen being discharged thus the density typically determines where to sewer to maximize reductions. Also there are many factors that influence water quality such as flushing and morphology of the water body.*

**6. Do you take into account how long it takes groundwater to travel?**

*MassDEP Response: Yes, the MEP Technical report has identified long term (greater than 10 years) and short term time of travel boundaries in the ground-watershed.*

**7. What if a town can't meet its TMDL?**

*MassDEP Response: A TMDL is simply a nutrient budget that determines how much nitrogen reduction is necessary to meet water quality goals as defined by state Water Quality Standards. It is unlikely that the TMDL cannot be achieved however in rare occasions it can happen. In those rare cases the Federal Clean Water Act provides an alternative mechanism which is called a Use Attainability Analysis (UAA). The requirements of that analysis are specified in the Clean Water Act but to generalize the process, it requires a demonstration would have to be made that the designated use cannot be achieved. Another way of saying this is that a demonstration would have to be made that the body of water cannot support its designated uses such as fishing, swimming or protection of aquatic biota. This demonstration is very difficult and must be approved by the U.S. Environmental Protection Agency. As long as a plan is developed and actions are being taken at a reasonable pace to achieve the goals of the TMDL, MassDEP will use discretion in taking enforcement steps. However, in the event that reasonable*

*progress is not being made, MassDEP can take additional regulatory action through the broad authority granted by the Massachusetts Clean Waters Act, the Massachusetts Water Quality Standards, and through point source discharge permits.*

**8. What is the relationship between the linked model and the CWRMP?**

*MassDEP Response: The model is a tool that was developed to assist the Town to evaluate potential nitrogen reduction options and determine if they meet the goals of the TMDL at the established sentinel station in each estuary. The CWRMP is the process used by the Town to evaluate your short and long-term needs, define options, and ultimately choose a recommended option and schedule for implementation that meets the goals of the TMDL. The models can be used to assist the Towns during the CWRMP process.*

**9. Is there a federal mandate to reduce fertilizer use?**

*MassDEP Response: No, it is up to the states and/or towns to address this issue. However, the Massachusetts Department of Agricultural Resources (MassDAR) passed plant nutrient regulations (330 CMR 31.00) in June 2015, which requires specific restrictions for agricultural and residential fertilizer use, including seasonal restrictions, on nutrient applications and set-backs from sensitive areas (public water supplies and surface water) and Nutrient Management Plans. Compliance with the MassDAR regulations will result in reductions in future N loading from agricultural sources.*

**10. Will monitoring continue at all stations or just the sentinel stations?**

*MassDEP Response: At a minimum, MassDEP would like to see monitoring continued at the sentinel stations bi-monthly, May-September in order to determine compliance with the TMDL. However, ideally, it would be good to continue monitoring all of the stations, if possible. The benthic stations can be sampled every 3-5 years since changes are not rapid. The towns may want to sample additional locations if warranted. MassDEP intends to continue its program of eelgrass monitoring.*

**11. What is the state's expectation with CWRMPs?**

*MassDEP Response: The CWRMP is intended to provide the Towns with potential short and long-term options to achieve water quality goals and therefore provides a recommended plan and schedule for sewerage/infrastructure improvements and other nitrogen reduction options necessary to achieve the TMDL. The state also provides a low interest loan program called the state revolving fund or SRF to help develop these plans. Towns can combine forces to save money when they develop their CWRMPs.*

**12. Can we submit parts of the plan as they are completed?**

*MassDEP Response: Submitting part of a plan is not recommended because absent a comprehensive plan, a demonstration cannot be made that the actions will meet the requirements of the TMDL. With that said however the plan can contain phases using an adaptive approach if determined to be reasonable and consistent with the TMDL.*

**13. How do we know the source of the bacteria (septic vs. cormorants, etc.)?**

*MassDEP Response: This was not addressed because this is a nitrogen TMDL and not a bacteria TMDL.*

**14. Is there a push to look at alternative new technologies?**

*MassDEP Response: MassDEP recommends communities consider all feasible alternatives to develop the most effective and efficient plans to meet water quality goals. The 208 Plan Update includes an analysis of a wide range of traditional and alternative approaches to nutrient reduction, remediation, and restoration. If a CWRMP relies on such alternative technologies and approaches, the plan must include demonstration protocols, including monitoring, that will confirm that the proposed reduction credits and, when appropriate, removal efficiencies are met. The implementation schedule is in the demonstration protocol for each alternative technology or approach, at which time a determination must be made as to whether the alternative technology/approach meets the intended efficacy goal. MassDEP is also developing a Watershed Permit Pilot program, which includes but is not limited to Under Ground Injection Control (UIC) and groundwater discharge permits and provides a permitting mechanism to approve nontraditional methods of wastewater management and/or impact mitigation that could not otherwise be approved by MassDEP under a typical wastewater management and discharge permit.*

*The Massachusetts Septic System Test Center, located on Cape Cod and operated by the Barnstable County Department of Health and Environment, tests and tracks advanced innovative and alternative septic system treatment technologies. In addition MassDEP evaluates pilot studies for other alternative technologies; however, absent a CWRMP and Watershed Permit, MassDEP will not approve a system for general use unless it has been thoroughly studied and documented to be successful.*

**15. How about using shellfish to remediate and reduce nitrogen concentrations?**

*MassDEP Response: The use of shellfish to remediate and reduce nitrogen concentrations is an alternative approach that has been utilized and is being evaluated in some areas of Long Island Sound (LIS), Wellfleet, and Chesapeake Bays. More recently, some Cape communities have been evaluating this method, including Falmouth, Mashpee and Orleans. While this approach has demonstrated promise for reducing nitrogen concentrations, there remain questions regarding the effectiveness and circumstances where it can be successfully utilized. MassDEP recommends communities considering this option discuss such plans with the Department, and evaluate the results from ongoing efforts on the Cape and on other states.*

**16. The TMDL is a maximum number, but we can still go lower.**

*MassDEP Response: The state's goal is to achieve designated uses and water quality criteria. There is nothing however that prevents a Town from implementing measures that go beyond that goal. It should also be noted that the TMDL is developed conservatively with a factor of safety included.*

**17. Isn't it going to take several years to reach the TMDL?**

*MassDEP Response: It is likely that several years will be necessary to achieve reductions and to see a corresponding response in the estuary. However, the longer it takes to implement solutions, the longer it is going to take to achieve the goals.*

**18. The TMDL is based on current land use but what about future development?**

*MassDEP Response: The MEP Study and the TMDL also take buildout into account for each community.*

**SIGN IN SHEET 5/24/2017**  
**Lake Tashmoo TMDL Public Meeting**

Print Name	Affiliation
1. Ada Turner	MNC
2. Shari Caselan	NY Commission
3. MIKE GIGGEY	WRIGHT-PIERCE
4. Danielle Fwart	Tisbury Shellfish
5. PAUL ERNST	TISBURY WASTEWATER
6. Gerry Holmson	TISBURY WATERWAYS INC
7. Melinda Heberg	Tisbury BOS
8. Maura Valley	Tisbury BOH
9. Doug Reece	Lagoon Pond Assoc / Tisbury Wastewater Planning
10. Mike Alberice	Tisbury Wastewater
11. James Stinavire	Tisbury Wastewater
12.	