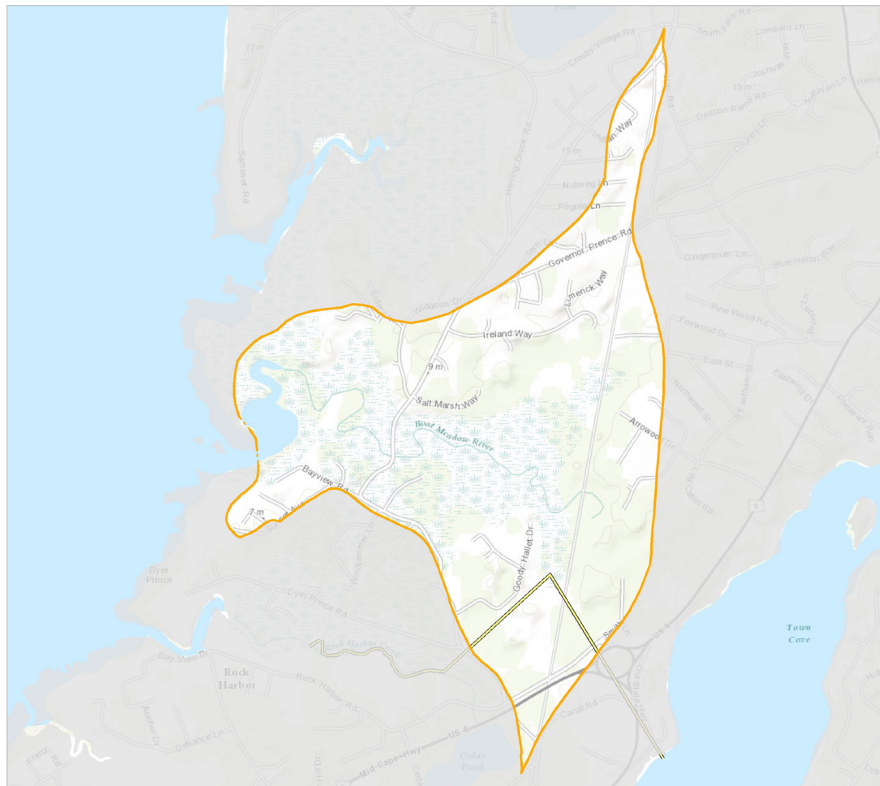
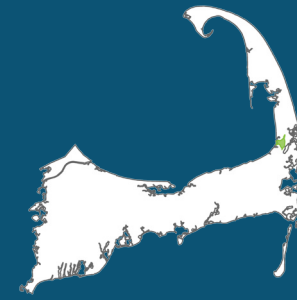


Boat Meadow River

EASTHAM & ORLEANS

LOW



Boat Meadow River Watershed

Introduction to the Watershed Reports

In 2001, the Massachusetts Estuaries Project (MEP) was established to evaluate the health of 89 coastal embayment ecosystems across southeastern Massachusetts. A collaboration between coastal communities, the Massachusetts Department of Environmental Protection (MassDEP), the School of Marine Science and Technology (SMASST) at the University of Massachusetts-Dartmouth, the US Environmental Protection Agency (US EPA), the United States Geological Survey (USGS), the Massachusetts Executive Office of Energy and Environmental Affairs (EEA), and the Cape Cod Commission, the purpose of the MEP is to identify nitrogen thresholds and necessary nutrient reductions to support healthy ecosystems.

The Cape Cod 208 Plan Update, certified and approved by the Governor of the Commonwealth of Massachusetts and the US EPA in 2015, provides an opportunity and a path forward to implement responsible plans for the restoration of the waters that define Cape Cod.

On Cape Cod there are 53 embayment watersheds with physical characteristics that make them susceptible to nitrogen impacts. In its 2003 report, “The Massachusetts Estuaries Project – Embayment Restoration and Guidance for Implementation Strategies”, MassDEP identifies the 46 Cape Cod embayments included in the

MEP. Thirty-three embayments studied to date require nitrogen reduction to achieve healthy ecosystem function. A Total Maximum Daily Load (TMDL) has been established (or a draft load has been identified and is under review) for these watersheds. For those embayments not studied, the 208 Plan Update recommends planning for a 25% reduction in nitrogen, as a placeholder, until information becomes available.

The 208 Plan Update directs Waste Treatment Management Agencies (WMAs) to develop watershed reports within 12 months of certification of the Plan Update. The Watershed Reports outline potential “bookend” scenarios for each watershed that include two scenarios to meet water quality goals in the watershed – a traditional scenario, which relies completely on the typical collection and centralized treatment of wastewater, and a non-traditional scenario, which uses remediation, restoration, and on-site reduction techniques to remove nutrients from raw and treated wastewater, groundwater and affected waterbodies.

The intent of the Watershed Reports is to outline two distinct approaches for addressing the nutrient problem. The reports are not intended to identify preferred and detailed plans for each watershed, but to facilitate discussions regarding effective and efficient solutions, particularly in watersheds shared by more than one town. In some cases, towns have provided information on collection areas and non-traditional technologies that have been specifically considered by that town.

The 208 Update developed a regionally consistent database of the nitrogen load entering each watershed. This data set includes estimates of wastewater, stormwater and fertilizer loads - similar to methodologies used by the MEP. Using this regionally consistent database, the Watershed MVP tool (wMVP) was developed so that different strategies (i.e., bookend scenarios) to reduce excess nitrogen load

could be evaluated. The Watershed Reports use the MEP recommendations for the required nitrogen load reductions necessary to meet the threshold loads (that serve as the basis for nitrogen management), and then use the wMVP and the regionally consistent database values to develop bookend scenarios. There are variations of load between the MEP and wMVP, primarily due to differences in comparing older and newer databases.

Terms Defined

Total nitrogen load: the nitrogen load from the watershed contributed by septic, wastewater, fertilizer, stormwater, golf course, landfill, and natural sources.

Attenuated nitrogen load: the nitrogen load from the watershed that reaches the embayment after the effect of natural attenuation in wetlands, ponds or streams.

Threshold: the amount of nitrogen that a water body can receive from its watershed and still meet water quality goals; this number is based on MEP technical reports or Total Maximum Daily Load (TMDL) reports.

Reduction target: an approximation of the amount of nitrogen that needs to be removed from the watershed to achieve the threshold; this number is calculated by subtracting the threshold number from the attenuated total watershed load, and is for planning purposes only.

Percent contribution: the percent of attenuated nitrogen load that a town contributes to the watershed.

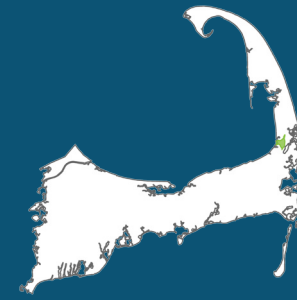
Kilogram responsibility: is calculated by applying the percent contribution to the reduction target and indicates the amount of nitrogen, in kg, that a community is responsible for addressing.

Total Maximum Daily Load: a regulatory term in the Clean Water Act, describing a value of the maximum amount of a pollutant that a body of water can receive while still meeting water quality standards. Establishing a TMDL is necessary when a water body has been listed on the 303D list of impaired waters.

Boat Meadow River

EASTHAM & ORLEANS

LOW



The Boat Meadow River embayment system has shoreline located entirely in the Town of Eastham. It is a small tidal creek that empties into Cape Cod Bay and extends about a mile to its drainage headwaters, which is comprised of extensive marsh. Most of the watershed is located in Eastham, with a small portion located in Orleans near the Route 6 rotary. The estuary supports a variety of recreational uses including kayaking, swimming, shell fishing and fin fishing.

The Problem

For the purposes of the Section 208 Plan Update, areas of wastewater need are primarily defined by the amount of nitrogen reduction required as defined by the Total Maximum Daily Load (TMDL) and/or Massachusetts Estuaries Project (MEP) technical report. An MEP report has not been developed for the Boat Meadow River watershed and other Cape watersheds where nitrogen is not believed to be a critical issue due to tidal flushing, low intensity development, or geomorphology.

- **MEP TECHNICAL REPORT STATUS:** Not Being Studied
- **TMDL STATUS:** Not Being Studied

The Commission compiled the following updated water use and nitrogen loads using the regional wMVP database (see page 2), enabling a current estimate of nitrogen loading.

- **TOTAL WASTEWATER FLOW:** 19 MGY (million gal per year)
- **TOTAL UNATTENUATED NITROGEN LOAD:** 2,251 Kg/Y (kilograms per year)
- **ATTENUATED NITROGEN LOAD:** Not Assessed; the Boat Meadow River watershed has ample opportunity for natural attenuation, most of which is achieved

through the marsh in the upper reaches of the watershed.

CONTRIBUTING TOWNS

Percent contributions listed below are the aggregate sub-embayment contributions identified in Appendix 8C of the Cape Cod Section 208 Plan Update (contributions are based on attenuated load where available). See Appendix 8C for detailed town allocations by sub-embayment.

- **EASTHAM:** 96%
- **ORLEANS:** 4%

BOAT MEADOW RIVER ESTUARY

- **EMBAYMENT AREA:** 17 acres
- **EMBAYMENT VOLUME:** Unknown
- **2014 INTEGRATED LIST STATUS:** Category 5 for fecal coliform and estuarine bioassessments
 - Category 5: requires a TMDL
 - www.mass.gov/eea/docs/dep/water/resources/07v5/14list2.pdf

BOAT MEADOW RIVER WATERSHED

General watershed characteristics according to the current wMVP regional database (see figure on page 1 for watershed boundary) follow.

■ WATERSHED CHARACTERISTICS

- Acres: 623
- Parcels: 390
- % Developed Residential Parcels: 81%
- Parcel Density: 1.6 acres per parcel (approx.)

Freshwater Sources

PONDS

- IDENTIFIED SURFACE WATERS: 1
- NUMBER OF NAMED FRESHWATER PONDS: 0
- PONDS WITH PRELIMINARY TROPHIC CHARACTERIZATION: 0
- 2014 INTEGRATED LIST STATUS: None listed

Eastham and Orleans have participated in the Pond and Lake Stewardship (PALS) program that has helped establish baseline water quality.

STREAMS

- SIGNIFICANT FRESHWATER STREAM OUTLETS:
Freshwater streams in the Boat Meadow River watershed are small marsh drainage segments without any quantitative information on flow.

Nitrate concentrations higher than 0.05 mg/L background concentrations, evident in public supply wells located in pristine areas, provide evidence of the impact of non-point source pollution on the aquifer and receiving coastal water bodies.

DRINKING WATER SOURCES

- WATER DISTRICTS: 0
- GRAVEL PACKED WELLS: 0
- SMALL VOLUME WELLS: 3
 - There are three non-community small volume wells in the watershed belonging to the Whale Walk Inn and Youth Hostel. There is no available water quality data. All residents are currently served by private wells. Implementation of a town-wide water system is underway.

Drinking water data from Cape Cod Commission and MassDEP data sources.

Degree of Impairment and Areas of Need

Since there is no evidence of water quality impairment at this time, wastewater needs are determined based upon other factors, such as Title5 compliance.

The 2014 Integrated List of Impaired Waters lists Boat Meadow River as being a Category 5 impaired water body for fecal coliform and estuarine bioassessments.

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Town of Eastham Local Progress

The town of Eastham completed a town-wide needs assessment in March 2009. The needs assessment concluded that a new public water supply system to protect public health was an overriding concern.

The spring 2014 Town Meeting approved \$45.8 million to fund a scaled back version of the full town-wide water system. The Cape Cod Commission approved this project as a Development of Regional Impact (DRI) in February 2015.

In May 2015 Eastham staff, along with their consultant (GHD), met with Commission staff to discuss the 208 planning process, decision support tools, and scenario development for their watersheds, the beginnings of a shift toward wastewater planning after a necessary focus on securing a clean drinking water supply for residents.

Eastham shares the watershed to the Nauset estuary with the town of Orleans and is willing to have further discussions about potential opportunities to share the wastewater treatment facility proposed in the approved Orleans Comprehensive Wastewater Management Plan (CWMP). The town has sent a representative to each of the Orleans Water Quality Advisory Panel meetings, as they discussed potential scenarios in 2014 and early 2015. The town of Eastham is actively pursuing the protection and restoration of its freshwater ponds. The town completed a town-wide assessment and is pursuing in-pond restoration efforts. Alum

treatments for Herring Pond and Great Pond are complete and others are under consideration.

In the fall of 2014, Eastham adopted local nitrogen-oriented fertilizer management regulations consistent with the Cape-wide Fertilizer Management District of Critical Planning Concern (DCPC).

Eastham is a member of the Orleans, Brewster and Eastham Ground Water Protection District which, until June 1, 2016, operated the Tri-Town Septage Treatment Facility in Orleans. The member towns voted to decommission and remove the facility, which is expected to take place in 2017.

In addition, Eastham staff are working with the Commission and the Cape Cod National Seashore on a number of other projects to address nitrogen in their watersheds. The Commission is assisting the town to modify a design for stormwater management along Route 6 and to conduct hydrogeologic modeling at a previously identified site for a permeable reactive barrier.

Eastham submitted conceptual watershed scenarios based on discussions with the Commission, use of available decision support tools, and ongoing local water quality planning efforts. Those scenarios are included in this report.

The Town of Eastham has not developed a nitrogen management approach for this watershed since there is no evidence of water quality impairment at this time.

At the Spring 2017 Town Meeting, Eastham voted to fund wastewater planning and pilot projects in the amount of \$150,000, as part of their Capital Plan.

Town of Orleans Local Progress

The Orleans Comprehensive Wastewater Management Plan (CWMP) was approved by Massachusetts Environmental Policy Act (MEPA) and the Cape Cod Commission in 2011 and provides a strategy for wastewater management to achieve reductions of its share of nitrogen loading to restore and protect Orleans's coastal embayments. The CWMP also addresses freshwater ponds and areas with septic system problems associated with frequent pumping, intensity of use and mounded systems. It provides modest capacity for expanded residential housing in the commercial district and includes an adaptive management approach for its implementation.

The town received its MEPA certificate on the Final Environmental Impact Review (FEIR) and a Development of Regional Impact (DRI) approval in 2011. The town has since engaged independent consultants to review the use of alternative sewer collection technologies and the Massachusetts Estuaries Project findings about the Nauset Marsh. The town received significant input from the community as the board of selectmen considers its appropriate next steps.

The town appropriated \$1.045 million at the spring 2014 Town Meeting for engineering, planning and hydrogeologic studies necessary for the development of septage, wastewater, groundwater and stormwater management plans needed to maintain and protect the water resources of the town by integrating the CWMP with a new Adaptive Management Plan

and components of the Cape-wide Section 208 Water Quality Management Plan.

The town established a Water Quality Advisory Panel (WQAP) that included diverse representation and professional facilitation, consistent with the 208 planning process. The WQAP established a consensus plan for moving forward that includes reduction, remediation, and restoration strategies and is expected to achieve a 40% cost savings over the original CWMP. In 2015, Town Meeting appropriated an additional \$1 million to further investigate potential disposal sites and locations for innovative remediation and restoration solutions identified in the consensus plan. Those investigations are underway. An additional \$691,000 was approved by voters in May 2016 to fund an Amended Water Quality Management Plan and associated Adaptive Management Plan. Development of those plans are in progress. A Preliminary Amended Comprehensive Wastewater Management Plan (ACWMP) was published in January 2017. The preliminary ACWMP provides updates reflecting additional planning and engineering efforts undertaken in 2015 and 2016.

Orleans is a member of the Orleans, Brewster and Eastham Ground Water Protection District which, until June 1, 2016, operated the Tri-Town Septage Treatment Facility in Orleans. The member towns voted to decommission and remove the facility, which took place in May of 2016. Through the Pleasant Bay Alliance, the Town of Orleans has been working with their three neighboring communities in the Pleasant Bay

watershed to assess the combined effect of the four towns' wastewater and nitrogen management plans. This has resulted in the development of the Pleasant Bay Composite Nitrogen Management Analysis.

In the fall of 2014, Orleans added phosphorus to its local fertilizer management regulations consistent with the Cape-wide Fertilizer Management District of Critical Planning Concern (DCPC).

Orleans requested that the Commission use the consensus plan scenarios as its watershed report submission.

In June 2016, Orleans received \$15,000 from the Commission for implementation of shellfish/aquaculture demonstration project in Lonnie's Pond. Funding was part of \$142,149 in local grants made by the Commission in support of 208 Plan implementation.

At the Spring 2017 Town Meeting, Orleans voted to fund continued implementation of its water quality management plan in the amount of \$3,733,660 and demolition of the Tri-Town Facility in the amount of \$870,000.

Traditional & Non-Traditional Scenarios

SCENARIO DEVELOPMENT

Through the 208 Stakeholder process, the Commission developed “bookend” scenarios – one looking at a possible solution using traditional collection and treatment, the other examining a possible suite of non-traditional technologies – to address the nitrogen management needs in each watershed. These bookend scenarios provide guidance for communities as they continue to discuss alternatives, priorities, and opportunities for identifying well-considered solutions that will address communities’ needs and interests.

REGIONAL DATA

In preparation for this effort, the Commission collected regionally consistent data for the purposes of watershed scenario development. Both parcel data and water use data was identified and collected for the entire region. While the scientific basis for planning is the thresholds identified in the MEP technical reports, each report uses data from different years, and in some cases the MEP data used are 10 or more years old. In addition, there are watersheds on Cape Cod without the benefit of an MEP report; therefore, similar data was not available for planning purposes.

The updated regional data set was used to estimate wastewater, stormwater and fertilizer loads, using the same methodologies as the MEP. This approach allows for a reevaluation of existing development, which may have changed

in the last 10 years. Parcel data included in the regional database is from 2010-2012 and water use data is from 2008-2011, depending on the water supplier and based on best available data. This approach allows for regionally consistent watershed scenario development.

WATERSHED SCENARIOS

The watershed scenarios that follow outline possibilities for the watershed. A series of non-traditional technologies that might be applicable are included, as well as the amount of residential load that would need to be collected if a traditional collection system and treatment facility was implemented. The pie charts show the load to be collected for treated effluent disposal both inside and outside the watershed.





Site specific analyses of collection areas may result in the need to collect wastewater from more or fewer parcels to meet the nitrogen reduction target. The scenarios presented are conceptual and are meant to inform discussions regarding effective and efficient solutions; they are not specific recommendations and should be viewed as resource information for additional and more detailed wastewater management planning.

TOTAL UNATTENUATED NITROGEN LOAD VALUES (FROM WMVP)	
Boat Meadow River Nitrogen Sources	Total Unattenuated Watershed Nitrogen Load (kg-N/yr)
Wastewater ¹	1,695
Fertilizer ²	157
Stormwater	282
Other ³	118
TOTAL WATERSHED LOAD	2,251
Total Watershed Threshold ⁴	1,688
TOTAL UNATTENUATED LOAD TO BE REMOVED	563

1. Includes nitrogen loads from septic systems and wastewater treatment facilities.
2. Includes nitrogen loads from lawns, cranberry bogs, and golf courses.
3. Includes nitrogen loads from landfills and atmospheric deposition to vacant land.
4. Assumes 25% reduction is needed, as no MEP report has been completed for this watershed and no threshold has been established.

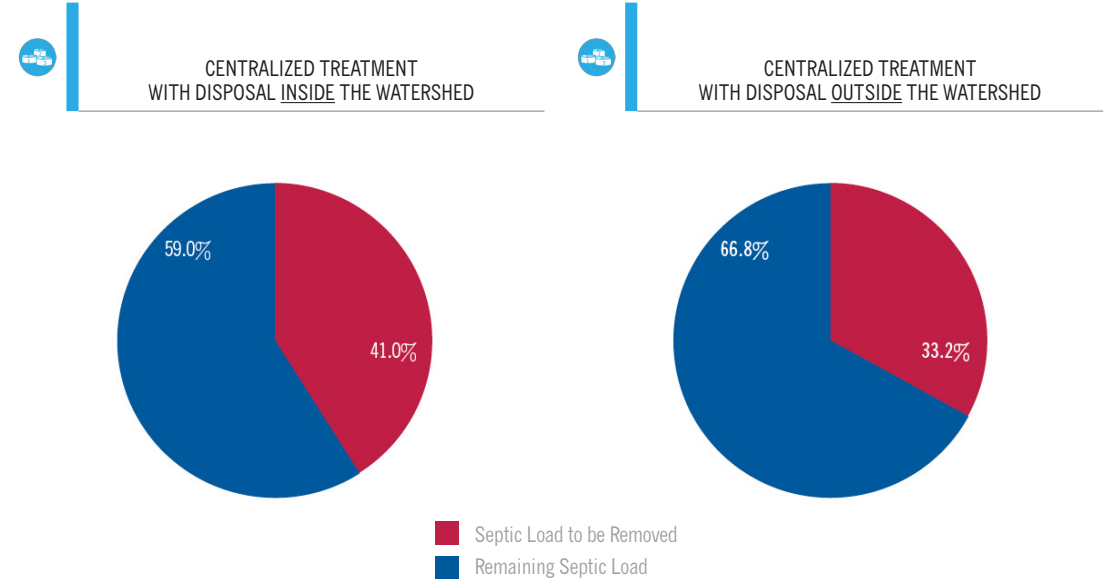
Traditional & Non-Traditional Scenarios

Non-Traditional

UNIT OF APPLIED TECHNOLOGY	ATTENUATED NITROGEN REMOVED IN KG/Y
 25 % Nitrogen Reduction - Fertilizer Management	39
 25 % Nitrogen Reduction - Stormwater Mitigation	70
 700 Linear Feet - Permeable Reactive Barrier (PRB) (Capture load calculated by wMVP: 438.6 kg/Y)	318
 350 Square Feet - Floating Constructed Wetlands	140
TOTAL	567

A summary of the approach and methodology that was applied using non-traditional technologies follows at the end of this report.

Traditional



Assumes load to be collected and treated is disposed in the watershed, requiring additional collection to offset the load.

Assumes that the load to be collected and treated is removed from the watershed so no offset is required.

