AGENDA

Wednesday

January 20, 2016

TOWN OF EASTHAM
AGENDA
BOARD OF SELECTMEN
Wednesday, January 20, 2016
3:00 p.m.

Location: *Earl Mountain Room***

I. Water Quality/Wastewater Workshop: (No Votes will be taken)

A. Nauset Estuary Water Quality Issues
Liz Moran, Ecologic, LLC & Jane Crowley, Health Agent
- Nauset Estuary MEP
- Water Quality in Salt Pond (Pilot Project)

B. 208 Process and the Town's Responsibilities
Cape Cod Commission
- Process & Deliverables

II. Administrative Matters

A. Plan future agendas

B. Review & Approve Minutes:
- January 4, 2016 – Regular
- January 6, 2016 – Work

Upcoming Meetings

Monday, February 1, 2016	*5:00 p.m.*	*Regular Session*
Wednesday, February 3, 2016	*3:00 p.m.*	*Work Session*

The listing of matters includes those reasonable anticipated by the Chair which may be discussed at the meeting. Not all items listed may in fact be discussed and other items not listed may also be brought up for discussion to the extent permitted by law.

This meeting will be recorded and broadcast over Channel 18

EcoLogic, LLC

#1

Technical Memorandum

TO: Town of Eastham
FROM: Liz Moran, EcoLogic LLC
RE: Overview and Implications of the Nauset Harbor Estuary TMDL
DATE: November 5, 2015 *revised January 6, 2016*

Objective and Scope

At the request of Ms. Jane Crowley, Town of Eastham Health Agent, EcoLogic environmental scientists have reviewed the May 2012 Revised Draft report "*Watershed Embayment Approach to Determine Critical Nitrogen Loading Thresholds for the Nauset Estuary Embayment System, Towns of Orleans and Eastham, Massachusetts*" along with water quality monitoring data (2003-2014), other technical reports, and draft technical memoranda from GHD regarding wastewater planning.

The objective of our assignment was to provide a framework for local officials and other stakeholders to understand current water quality conditions, the modeling and assumptions of the Massachusetts Estuary Project (MEP) report on the Nauset Harbor Embayment System—including findings of a third-party technical review—and how a Total Maximum Daily Load (TMDL) allocation for nitrogen affects local decisions related to wastewater management. In particular, we have focused on the following:

- Overview of the Massachusetts Estuary Project
- The 2012 MEP report on the Nauset Harbor estuary system and nitrogen TMDL allocation
- The November 27, 2012 review of the Nauset Harbor estuary system report prepared by Craig Swanson and Jennifer Cragan of RPS/asa and the response by the MEP technical team
- Data sets used to develop the Nauset Harbor estuary system TMDL, including spatial and temporal coverage
- Current water quality and aquatic habitat status of Eastham's Salt Pond with respect to MEP guidelines and TMDL target levels.
- Trends in water quality and habitat conditions at Salt Pond

This brief technical memorandum was prepared as background material to be presented in a forum with Town of Eastham officials and other interested parties to discuss the technical information and its implications. The workshop is scheduled for January 20, 2016.

The Massachusetts Estuary Project (MEP)

The MEP began in 2003 as a collaborative effort among coastal communities, the Mass. Department of Environmental Protection, the School of Marine Science and Technology at UMass Dartmouth (SMAST), EPA, the Mass. Executive Office of Environmental Affairs, and the Cape Cod Commission. The overarching goal of the MEP is to "provide technical data on the sources of nitrogen and the maximum amount of nitrogen (nitrogen threshold) that each estuary can tolerate without adversely changing its

character and use. In other words, the MEP will set the target to be achieved in order to protect and restore the health of estuaries." [i]

Each of the 89 estuaries included in the MEP is unique, and will have its own calculated maximum nitrogen load to protect and restore its ecological health, known as a Total Maximum Daily Load (TMDL). The allocation of acceptable nitrogen loading to each estuary and sub-embayment depends on its physical characteristics (size, depth, tidal flushing, hydrodynamics), current and target chemical characteristics (current water quality conditions, especially related to nitrogen concentrations and other indicators of the state of enrichment or eutrophication), and current and target biological characteristics (extent of eelgrass beds and benthic community structure). In addition to characterizing the nature of the receiving water, the MEP developed quantitative tools that link watershed land uses, including wastewater management, to nitrogen export. A combination of monitoring and modeling was used to develop the quantitative information needed to complete nitrogen TMDL allocations for the estuaries and embayments.

The MEP developed an approach termed the "Linked Watershed-Embayment Management Modeling Approach" and applied it to the many estuaries and embayments of southeastern MA. According to the report for the Nauset Harbor Embayment System (Howes et al 2012[ii]), the Linked Model Approach can be parameterized to reflect site-specific conditions and is a robust tool for management applications (what-if scenarios). The Linked Model Approach identifies the watershed sources of N and distributes the load spatially. A two-dimensional hydrodynamic model system circulates water within the estuary and simulates tidal exchange with the ocean. Water quality modeling routines within the estuary account for the attenuation (loss) of nitrogen from the water column, as well as its addition via sediment regeneration. The modeling protocol requires calibration and validation (testing) with measured field data before any what-if scenarios are run.

This sophisticated approach and rigorous protocol has led to development of a technically-defensible set of tools for estuary management. An independent scientific peer review of the approach, sponsored by the Cape Cod Water Protection Collaborative, was completed in 2011.[iii] A group of technical experts was tasked with a detailed program review and analysis. They were asked to offer their professional opinion on whether the Linked Model Approach was scientifically sound, representative of Cape Cod conditions, and appropriate for use as a basis for wastewater and nutrient management planning and implementation.

Overall, the peer review panel found that the MEP modeling approach is scientifically credible and consistent with the current understanding of existing conditions for Cape Cod estuaries. Moreover, each component of the Linked Model Approach is well-established and incorporates site-specific data. The panel found that the level of detail of the model is compatible with the management questions it is designed to address. Moreover, the panel concluded that the Linked Model Approach is well-designed to address conditions on Cape Cod, where groundwater delivery of wastewater is a major source of nitrogen to estuaries and embayments. The MEP approach was found to be appropriate and useful for evaluating alternatives, and is consistent with existing nationwide TMDL practices.

A key recommendation arose from the scientific peer review: that the towns and other stakeholders use an adaptive management approach to wastewater management planning. That is, continue monitoring, data analysis, and modeling in order to improve scientific understanding of the physical, chemical and biological processes in the watersheds and estuaries.

In addition to the expert scientific review of the Linked Model Approach, scientists from the consulting group RPS ASA completed a technical review of the Nauset Harbor estuary system under contract to the Town of Orleans; the report is dated November 27, 2012[iv]. The RPS ASA review, while concurring that the Linked Model Approach is technically sound and adequate for the Nauset Harbor estuary system, cited several concerns. These concerns include how groundwater is assumed to enter the estuary, unit loading rates from septic systems, the length of the data record available, and that the model does not accommodate potential impacts of changes in the physical layout of the beaches, inlet, and bathymetry. The reviewers noted that monitoring data from 2001 – 2005 were used for calibrating the model, and that data from only one year (2003) were used to evaluate the trophic state condition of Salt Pond, Town Cove, and Mill Pond.

The MEP technical team responded quickly to the RPS ASA review in a technical memorandum dated December 4, 2012[v] and clarified and justified the assumptions embedded in the Linked Model for the Nauset Harbor estuary system. All of the issues raised by the RPS ASA reviewers were responded to with data and citations to the most recent literature.

Nauset Harbor Estuary System Nitrogen Loading Analysis

The Linked Watershed-Model for the Nauset Harbor estuary system in Orleans and Eastham was issued as a revised draft in May 2012 (Howes et al. 2012). As stated in the report, the major product of this effort is quantitative nitrogen loading thresholds to guide the towns of Orleans and Eastham in comprehensive wastewater management planning. The Nauset Harbor estuary system is a complex estuary with three types of basin: tidal embayments, salt marsh ponds, and salt marsh creeks within the large salt marsh. These environments differ in their current water quality and habitat conditions, as well as in how they respond to nitrogen loading (a property termed assimilative capacity). As a consequence of these differences in current conditions and assimilative capacity, the calculated threshold nitrogen limits differ across the Nauset Harbor estuary.

The target nitrogen management goal for the Nauset Harbor estuary system is to expand eelgrass habitat by approximately 80 acres. Resource managers concluded that reducing nitrogen loading to a level that will enable an expansion of eelgrass will also improve the habitat for benthic organisms; animals including shellfish are more tolerant than eelgrass to elevated nitrogen and the associated algal abundance.

A site-specific nitrogen level to support high quality, sustainable eelgrass within the Nauset Harbor estuary system was selected after reviewing paired water quality and habitat data. Eelgrass is abundant

where nitrogen concentrations average 0.36 mg/L, but absent where nitrogen concentrations average 0.50 mg/L. The target nitrogen level was set at 0.45 mg/L considering the Nauset data along with work on other MEP systems.

Because of the complex circulation patterns typical of salt marsh estuaries, the MEP technical team identifies a sentinel station to serve as a long-term monitoring site to assess progress toward meeting target water quality conditions. In the Nauset Harbor estuary system, the sentinel site is in Orleans's Town Cove (site WMO-27) located at the edge of where eel grass was well-established historically. The target nitrogen concentration of 0.45 mg/L is adopted as a threshold for Salt Pond restoration as well.

Current Nitrogen Loads

The 2012 report summarizes the estimated annual nitrogen loads to the Nauset Harbor estuary system from existing land uses and land cover (surface runoff), septic systems (which enter via groundwater seepage), atmospheric deposition, and benthic flux. Benthic flux, defined as the release of nitrogen from the sediments to the overlying water, is the net of multiple chemical processes affecting nitrogen cycling within the ecosystem. The estimate for the rate of benthic flux was determined by sampling and analysis of sediment cores at various locations in the estuary. The data are summarized in **Table 1**.

Table 1. Summary of estimated nitrogen load to Nauset Harbor estuary system and sub-embayments under current conditions of land use and wastewater management

Sub-embayments	Surface Runoff kg N/day	Groundwater Seepage from Septic Systems kg N/day	Atmospheric Deposition kg N/day	Net Benthic Flux from sediments kg N/day	Total Current Load kg N/day
Nauset Marsh	2.5	8.2	11.3	46.8	68.8
Salt Pond	0.9	4.2	0.3	19.6	24.9
Woods Cove	0.1	0.6	0.2	4.7	5.6
Mill Pond	0.9	4.0	1.1	3.2	9.2
Rachel Cove	0.0	0.1	0.2	0.0	0.3
Town Cove	5.4	26.2	5.2	59.7	96.6
System Total	9.9	43.3	18.3	134.1	205.5

Source: Howes et al. 2012: Excerpted from Table ES-1 and rounded

Target Nitrogen Loads (TMDL Allocation)

The technical team applied the completed water quality/hydrodynamic model of the Nauset Harbor embayment system to estimate the capacity of each sub embayment and the system as a whole to assimilate nitrogen. "Assimilation" of nitrogen is a technical term that refers to the capacity of a waterbody to receive a pollutant while still maintaining water quality and habitat conditions that support the designated use.

The challenge was to estimate the total nitrogen load to the estuary, considering the spatial variability of the loads and circulation patterns, which would result in attaining the target water column nitrogen

concentration (0.45 mg/L). The technical team assumed that the atmospheric deposition rate would remain the same as it is currently (since reductions are beyond local control). Further, they assumed that the rate of net benthic flux (which is an internal loading term) would be reduced in approximate proportion to the reduction in external loading. Thus, a 10% reduction in N load from land use and septic leachate will reduce the rate of nitrogen loss from the sediments to the water column by 10%.

The results of the analysis are summarized in **Table 2**. Note that all of the reduction in nitrogen loading is allocated to the watersheds that discharge to the two deeper impoundments, Town Cove and Salt Pond.

Sub-embayments	Current Total Load , kg N/day	Calculated TMDL kg N/day	Required Load Reduction
Nauset Marsh	68.8	68.8	0%
Salt Pond	24.9	15.4	38%
Woods Cove	5.6	5.6	0%
Mill Pond	9.2	9.2	0%
Rachel Cove	0.3	0.3	0%
Town Cove	96.6	58.7	39%
System Total	**205.5**	**158.1**	**23%**

Source: Howes et al. 2012: Excerpted from Table ES-2, and rounded

Salt Pond Water Quality, Current Conditions and Trends

EcoLogic reviewed data files from the SMAST program, 2003 – 2014. The sampling program varied over the years; the major change was the deletion of many stations following the intensive surveys in 2003 and 2004. Since 2006, three stations have been routinely sampled in the Nauset Harbor estuary system. As shown in **Figure 1** (monitoring locations) the three sites that have been included in water quality monitoring over the entire 2003 – 2014 interval are embayments: Salt Pond (WMO38), Town Cove (WMO27) and Mill Pond (WM034).

Table 3. Summary of metadata, water quality monitoring within the Nauset Harbor estuary system, 2003-2014

Year	Stations	Number of Events	Frequency and Schedule	Parameters
2003	25 - 41 (41 is ocean)	6	biweekly, June 4-Aug18	Secchi, salinity, DO, PO4, N series, POC, algal pigments, fecal coliform
2004	25-40 except 28,31,37	5	biweekly, June22-Aug20	as 2003, dropped fecal coliform
2005	25,27,34,38	7	biweekly, June13-Aug24	as 2004
2006	27,34,38	6	biweekly, June29-Sept12	as 2004 (+total pigment, calculated)
2007	27 (4 events), 34,38	5	biweekly, July5-Sept17	as 2006
2008	27,34,38	5	biweekly, July7-Sept4	as 2006
2009	27,34,38	5	biweekly, July13-Sept9	as 2006
2010	27, 34, 38	5	biweekly, July15-Sept13	as 2006
2011	27,34,38	4	biweekly July, once Aug & Sept (7/6 and9/19)	as 2006
2012	27,34,38	5	biweekly, 7/9-9/6	as 2006
2013	27,34,38	5	biweekly, 7/11-9/10- no 34 last date	as 2006
2014	27,34,38	5	biweekly, 7/16-9/11	as 2006

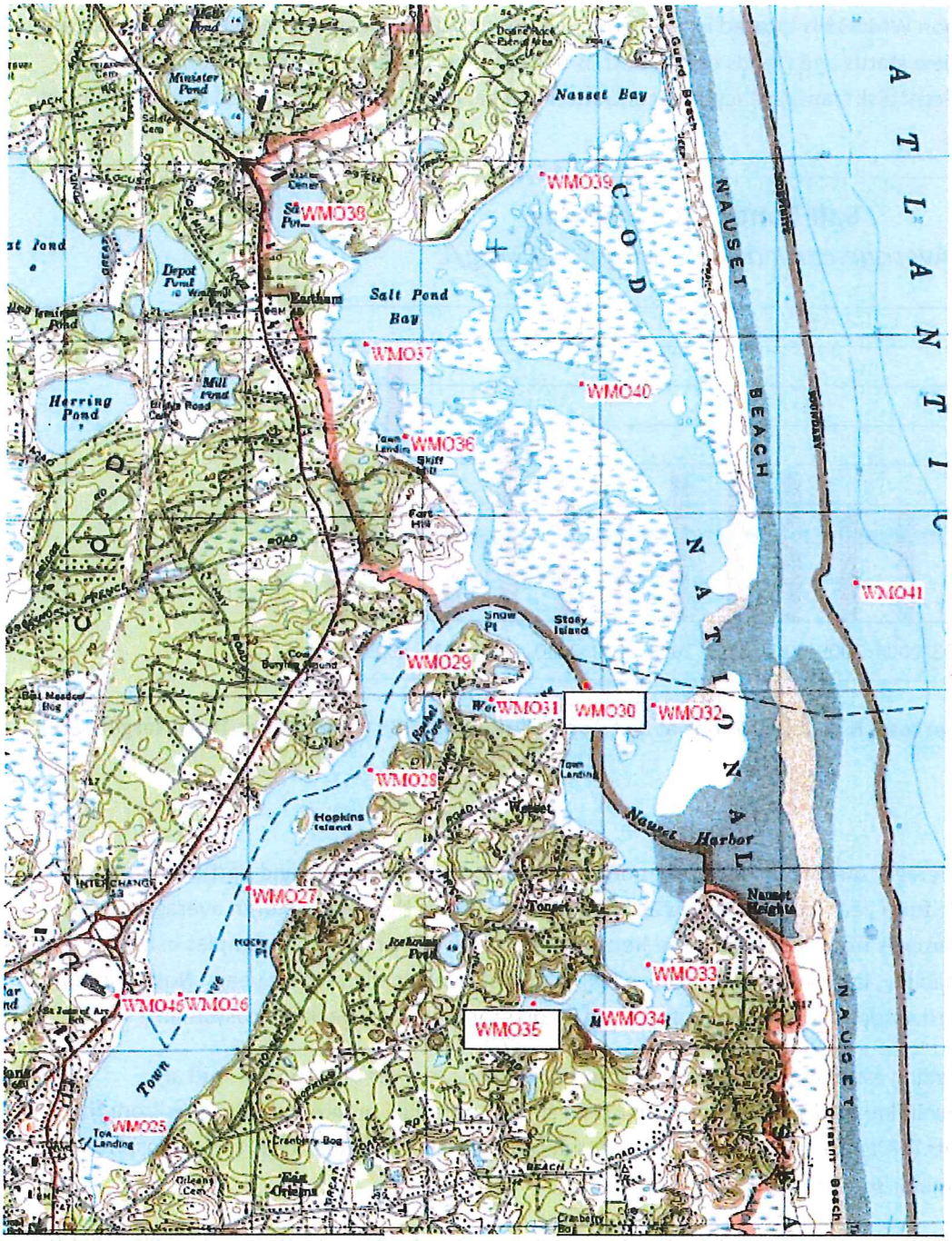


Figure 1. Water quality monitoring stations in Nauset Harbor estuary system

Monitoring station WMO38 is located in Eastham's Salt Pond. Data from annual monitoring efforts were compiled to review status and trends of key metrics related to eutrophication: total N concentrations, water clarity (Secchi disk transparency), concentration of algal pigments, and dissolved oxygen status of the deep waters.

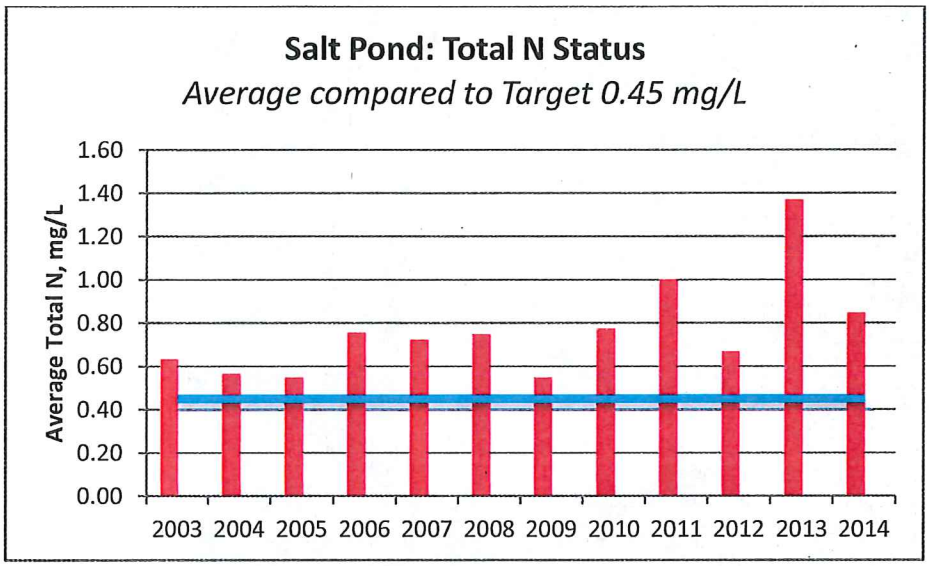


Figure 2. Average total N concentrations at Salt Pond station WMO38 compared to TMDL target, 0.45 mg/L total N

Note that the average total N (which includes organic and inorganic, dissolved and particulate fractions) is highly variable from year-to-year (**Figure 2**). The data plotted are the water column average values, which include samples from the surface and bottom waters as well as mid-depth samples in most years. Despite the variability, later years tend to have higher average values than earlier years. Note also that all years of record exceed the threshold of 0.45 mg/L corresponding to a healthy ecosystem.

Based on the loading estimates presented in **Table 1**, the major sources of N to Salt Pond are groundwater flux influenced by septic systems (17%) and benthic flux, or internal N loading from the pond's sediments (78%). Surface runoff contributes another 4% of the annual load, and atmospheric deposition is a minor source at 1%.

Nitrogen is the limiting nutrient for phytoplankton growth in this estuarine ecosystem, meaning that the abundance of phytoplankton is regulated by the supply of nitrogen. The elevated N concentrations in Salt Pond support abundant plankton growth. As shown in **Figure 3**, algal pigments (a measure of phytoplankton abundance) are also highly variable from year-to-year. Note the logarithmic scale of the graph; this is to accommodate the high concentrations measured during bloom conditions, defined as algal pigment concentrations greater than 30 µg/L. Blooms of harmful algae (e.g., red tide) have become common in regions of the Nauset Estuary, including Salt Pond.

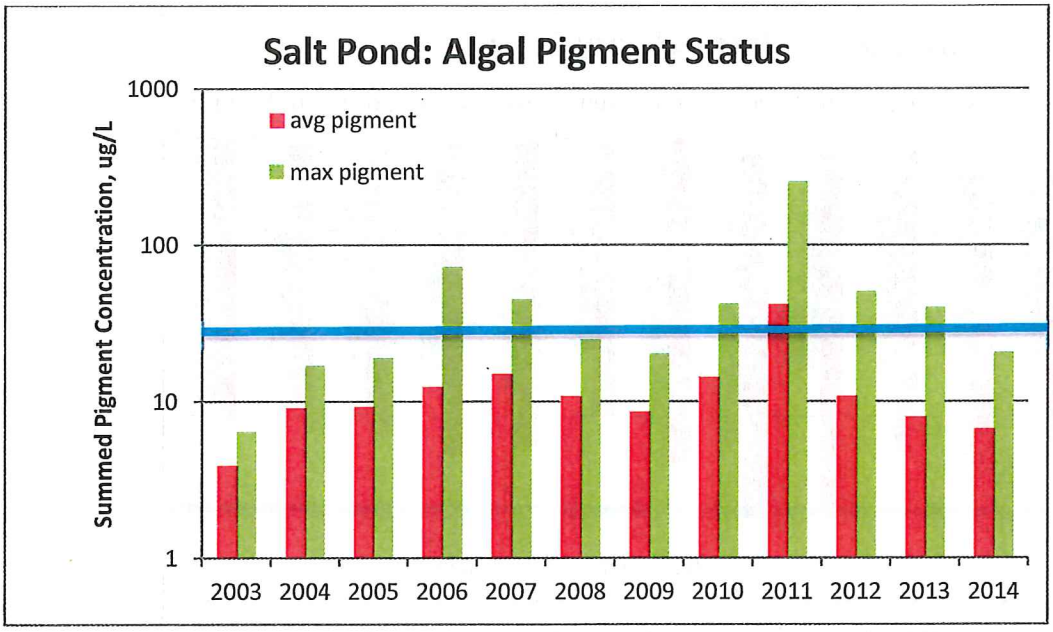


Figure 3. Average and maximum concentrations of algal pigments, Salt Pond station WMO38 compared to a bloom threshold of 30 µg/L.

Elevated algal pigment concentrations lead to diminished water clarity, affecting the aesthetic quality of the resource as well as limiting light penetration needed to support eelgrass. The average and minimum Secchi disk transparency of Salt Pond is displayed in **Figure 4**. Note that the pond depth is approximately 9.4 m (+/- 30 ft). A Secchi disk reading of 2 m or more is generally indicative of low phytoplankton abundance and clear water.

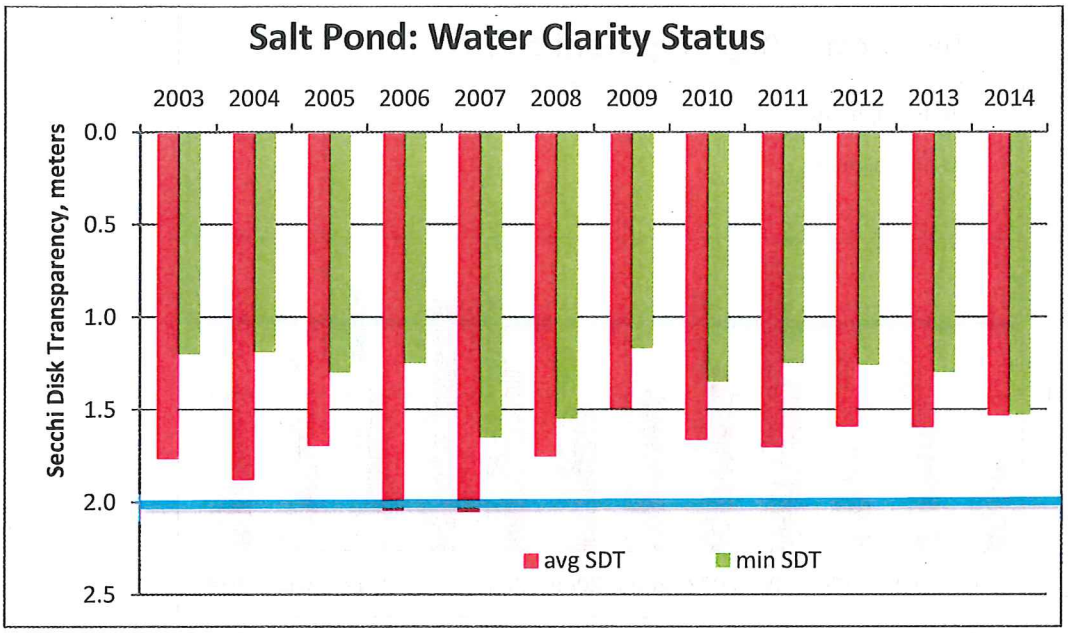


Figure 4. Average and minimum Secchi disk transparency (SDT), Salt Pond station WMO38 compared to a 2 m target water clarity.

The final important metric related to nitrogen enrichment is the dissolved oxygen status of the lower waters. As shown in Figure 5, the deep waters of Salt Pond are subject to hypoxia (low concentrations of dissolved oxygen, DO). This condition is a direct effect of the pond's depth; Salt Pond develops thermal stratification during the summer, isolating the deeper waters from the two sources of oxygen in the water: exchange with the atmosphere and photosynthesis. The average concentration of DO is less significant, however, than the minimum concentration. In Massachusetts, the ambient water quality standard for protection of aquatic life is set at 6.0 mg/L. The percentages included in Figure 5 refer to the percent of observations that do not meet this standard. The trend in deep water oxygen status of Salt Pond is clearly in decline.

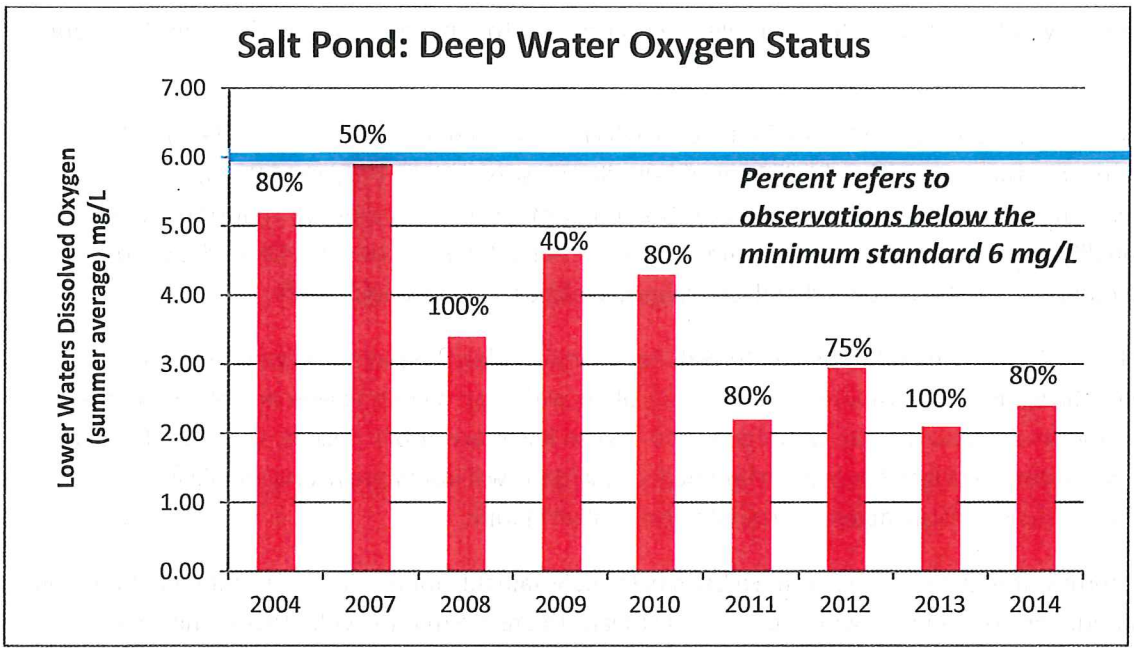


Figure 5. Average dissolved oxygen (DO) of Salt Pond station WMO38 lower waters, plus percent of observations below 6 mg/L, ambient water quality standard for aquatic life protection

Summary and Conclusions

Every model is an imperfect representation of actual conditions. That said, independent experts have reviewed the Massachusetts Estuary Project's Linked Watershed-Embayment Management Model of the Nauset Harbor estuary system and concluded that it is an appropriate planning tool based on current understanding on nutrient dynamics, groundwater flux, and hydrodynamic modeling. Additional site-specific monitoring and analysis may help refine the TMDL allocations. The findings and implications for the Town of Eastham are clear with regard to the need to take effective actions to reduce external N loading to the high priority subwatersheds.

Results of annual water quality monitoring of Eastham's Salt Pond indicate that the pond is enriched with nutrients (eutrophic). The concentrations of nitrogen (limiting nutrient for algal production) in Salt Pond are well above the threshold considered to represent a healthy estuarine ecosystem (0.45 mg/L total N).

As a consequence of the elevated N concentrations, Salt Pond supports abundant algal growth, with periodic bloom conditions. Blooms of red tide, *Alexandrium fundyense,* the alga linked to paralytic shellfish poisoning (PSP) have become a regular occurrence. According to a 2008 report by biologist Don Anderson of Woods Hole Oceanographic Institute, PSP occurred in Salt Pond in eight of 17 years (48 percent) from 1975 to 1991 and in 16 of the next 17 years (94 percent).[vi] The risk of harm from red tide

may extend beyond Salt Pond if the algal cells are transported to other areas within the Nauset estuary system.

Algal blooms reduce the water clarity of Salt Pond, which in turn reduces habitat available for eelgrass as less light reaches the sediment surface. As algal cells die and settle to the bottom of the pond, decomposition of the organic material depletes the supply of dissolved oxygen which further diminishes habitat quality. Under current conditions, the deep waters of Salt Pond routinely violate the state's ambient water quality standard for dissolved oxygen, in place to protect aquatic life.

The 2003 – 2014 SMAST monitoring data for Salt Pond indicate declining trends in water quality conditions. Nitrogen concentrations are increasing, along with algal pigment levels and bloom intensity. Water clarity has decreased. Deep water dissolved oxygen levels are also in decline. Without effective controls on external nitrogen loading, water quality conditions will not improve and are likely to continue to decline, with an increasing risk of harmful algal blooms.

The long-term water quality data sets have been extremely valuable for assessing current conditions and trends. Continued coordination with the Town of Orleans to ensure that the volunteer monitoring efforts are supported will be part of the overall adaptive management approach to assessing the health of the Nauset Harbor estuary system.

Citations and Links to Documents

[i] Massachusetts Department of Environmental Protection. 2003. The Massachusetts Estuary Project: Embayment Restoration and Guidance for Implementation Strategies
http://www.oceanscience.net/estuaries/pdf/mepmain.pdf

[ii] Howes, B., S. Kelley, J. S. Ramsey, E. Eichner, R. Saminy, D. Schlezinger, P. Detjens. 2012 (revised). Massachusetts Estuary Program Linked Watershed-Embayment Approach to Determine Critical Nitrogen Loading Thresholds for the Nauset Harbor Embayment System, Towns of Orleans and Eastham, Massachusetts. Massachusetts Department of Environmental Protection. Boston MA.
http://www.town.orleans.ma.us/sites/orleansma/files/file/file/nauset_mep_revised_draft.pdf

[iii] Scientific Peer Review Panel Report. 2011. Massachusetts Estuary Project.
http://www.capecodcommission.org/resources/waterresources/MEP_Panel_Report_12302011.pdf

[iv] Swanson, C. and J. Cragan. November 2012. Technical review of the Massachusetts Estuary Project Nauset Harbor Embayment System Report for the Town of Orleans. ASA project number 2012-218. 15 pages.
http://www.town.orleans.ma.us/sites/orleansma/files/file/file/asa-mepnauset-112712.pdf

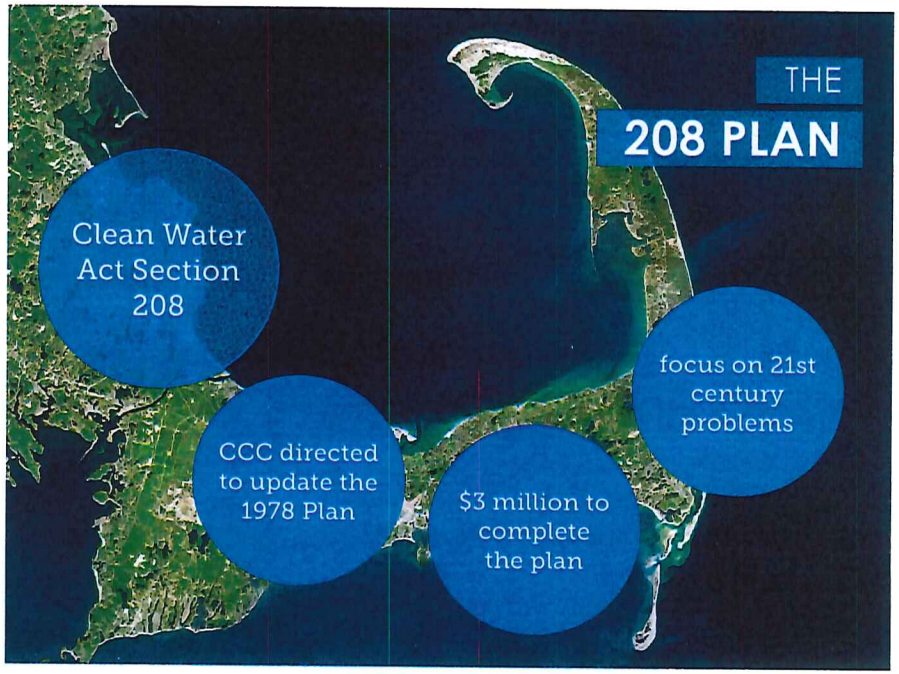
[v] Howes, B., R. Samimy, E. Eichner, J. Ramsey and S. Kelley. December 2012. Technical Memorandum: Massachusetts Estuary Program. 9 pages. http://www.town.orleans.ma.us/sites/orleansma/files/file/file/mep-response-to-asa.pdf

[vi] http://seagrant.mit.edu/2ifbysea/issues/fall08/blooms.html

IMPLEMENTING THE 208 PLAN UPDATE ON

CAPE COD

Patty Daley
Cape Cod Commission
November 17, 2015

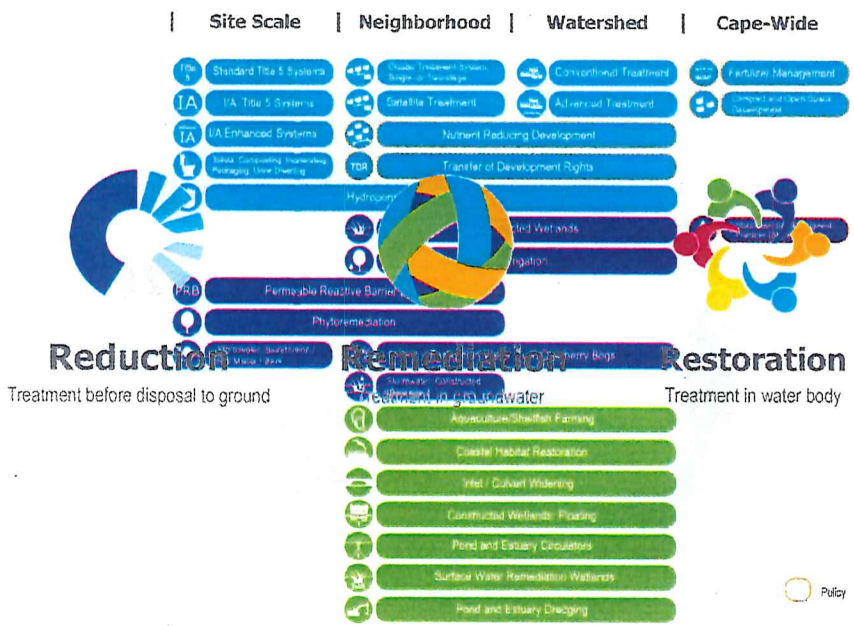


DESIGNATION OF TOWNS AS WMAs
- 12 months to complete watershed reports

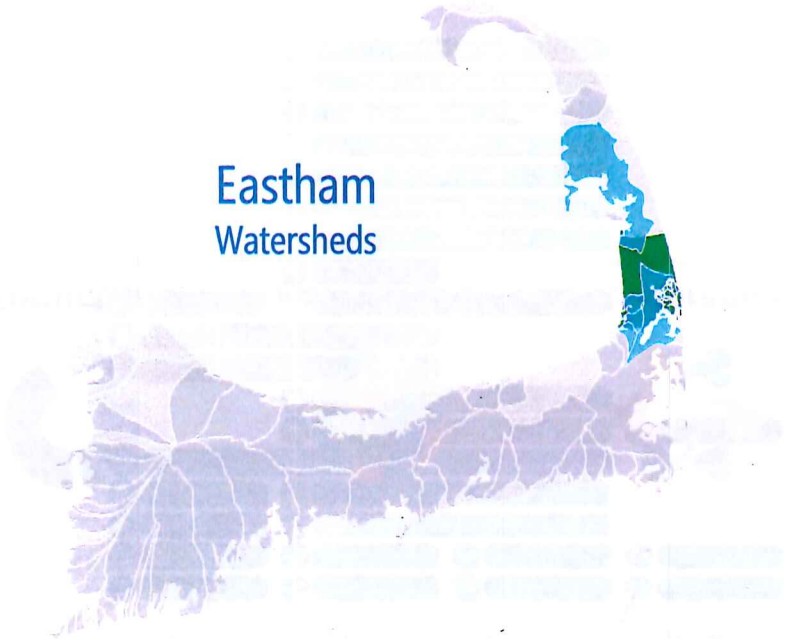
WATERSHED REPORTS
- Collection Scenario
- Non-Collection Scenario
- Hybrid Scenario

DEFAULT WATERSHED REPORT
- Prepared by CCC if not completed by WMA

IMPLEMENTATION REPORT
- Post 12 month period
- Reporting WMA actions


Site Scale
Neighborhood
Watershed
Cape-Wide
Standard Title 5 Systems
I/A Title 5 Systems
I/A Enhanced Systems
Hydroponic
Permeable Reactive Barrier
Phytoremediation
Conventional Treatment
Advanced Treatment
Fertilizer Management
Satellite Treatment
Nutrient Reducing Development
Transfer of Development Rights
Aquaculture/Shellfish Farming
Coastal Habitat Restoration
Inlet / Culvert Widening
Constructed Wetlands: Floating
Pond and Estuary Circulators
Surface Water Remediation Wetlands
Pond and Estuary Dredging
Policy
Reduction
Treatment before disposal to ground
Remediation
Restoration
Treatment in water body

Eastham


Eastham
Watersheds


Eastham
Shared Watersheds

Eastl
Shared

Eastham Watersheds
BOAT MEADOW RIVER [2,346 load]
96% Eastham | 4% Orleans
HERRING RIVER [2,556 load]
100% Eastham
ROCK HARBOR [2,557 load]
21% Eastham | 79% Orleans
NAUSET MARSH [4,923 load]
77% Eastham | 23% Orleans
NAUSET STREAM [1,238 load]
100% Eastham
SALT POND [1,989 load]
100% Eastham
TOWN COVE [10,287 load]
25% Eastham | 74% Orleans | 1% Brewster
WELLFLEET HARBOR [33,032 load]
11% Eastham | 2% Truro | 88% Wellfleet

Regulatory Streamlining

strategies to successfully implement established water quality goals

TARGETED

Targeted watershed plans reduce upfront planning time, lower cost & focus attention where most needed

N+P+K MGMT

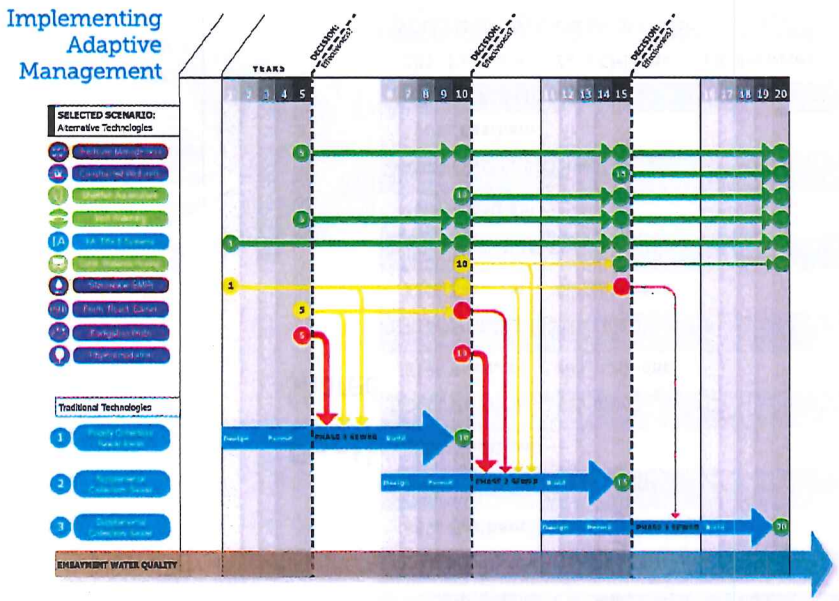
BMPs

Reductions in fertilizer use and stormwater runoff, supported by performance monitoring, should lower nitrogen reduction targets

REDUCTION CREDITS

WATERSHED PERMIT

WMAs allocate nitrogen loads on a watershed basis. The watershed permit lists technology options identified for implementation by stakeholders & each permittee's specified annual discharge limit.



Stakeholder Process

strategies for establishing consensus in a regional planning process

OBJECTIVE
Facilitation to build collaboration & agreement

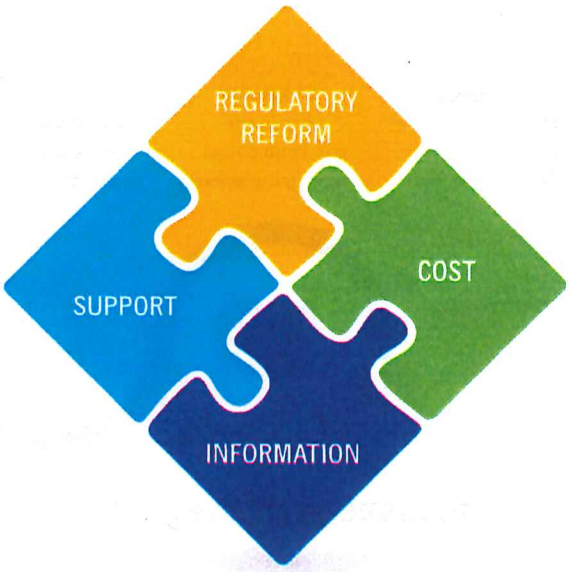
ON SCHEDULE
Oversight kept the process on time & on track

AGREEMENT
Built consensus to identify solutions at the watershed level

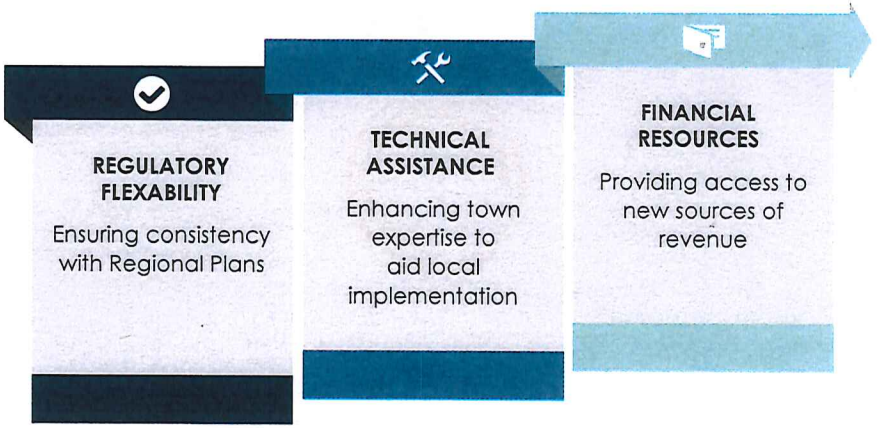
AFFORDABLE
Financial impact on homeowners considered in every watershed solution

FLEXIBLE
Ensure regulatory flexibility in planning & permitting

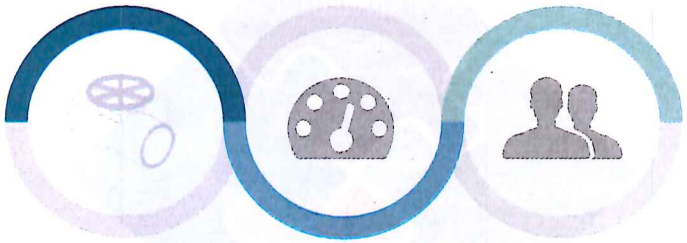
ENGAGING
Involve the broader community through web-based engagement initiatives



Simplifying the Process



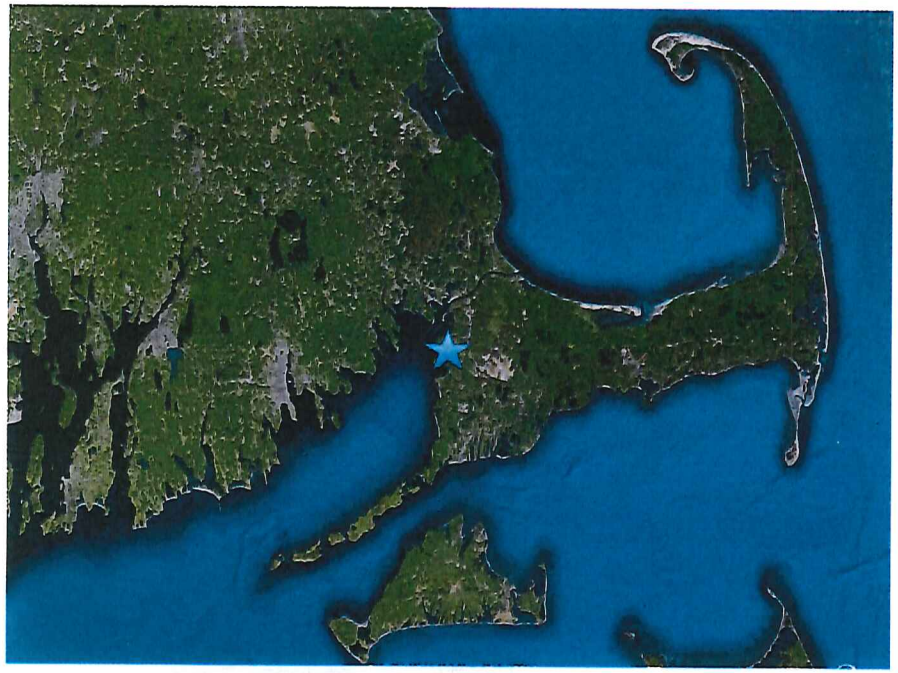
Cost Saving Measures



Considering collection and treatment in areas where it's most appropriate

Broadening the use of remediation and restoration technologies

Cost sharing results in a lower cost for residents and affordable scenarios



KINGMAN YACHT CENTER

KINGMAN YACHT CENTER

Site location

(Source: Horsley Witten Group)

KINGMAN YACHT CENTER

Phase II Wastewater Service Areas

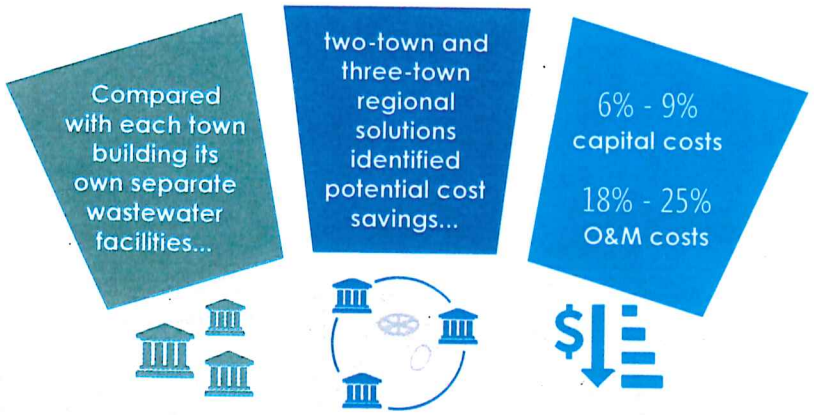
(Source: Horsley Witten Group)

NITROGEN LOADING REDUCTIONS
KINGMAN YACHT CENTER

LOCATION	SEPTIC SYSTEMS 35 mg/l (lbs n/yr)[1]	WASTEWATER TREATMENT 5 mg/l (lbs n/yr)[2]	NITROGEN REDUCTION (lbs n/yr)
PHASE 1			
Project Site[3]	70	54	-16
Kingman Yacht Center	1,020	146	-874
SUBTOTAL PHASE 1	**1,090**	**200**	**-890**
PHASE 2			
Cedar Point: 52 Homes	**1,841**	**263**	**-1,578**
TOTAL	**2,931**	**463**	**-2,468**

[1] Nitrogen load calculated at 35 ppm for septic systems.
[2] Nitrogen load calculated at 5 ppm for advanced wastewater treatment.
[3] Site currently has two houses with six bedrooms on septic systems generating 70 lbs N/yr; would be replaced with 32 bedrooms on advanced treatment, generating 54 lbs N/yr.

Cost Saving Measures
Eastham, Brewster & Orleans



Wastewater Regionalization Study: Orleans-Brewster-Eastham (Wright-Pierce 2009)

WATER THREAT LEVEL:
LOW / MODERATE / HIGH

WATERSHED REPORT SUB REGION
Watershed Name

The Problem

Description of the problem

- MEP TECHNICAL REPORT STATUS: Status
- TMDL STATUS: Status
- TOTAL WASTEWATER FLOW: XX (million gal per year)
- TREATED WW FLOW: XX MGY
- SEPTIC FLOW: XX MGY
- UNATTENUATED TOTAL NITROGEN LOAD (MEP): XX
- ATTENUATED TOTAL NITROGEN LOAD (MEP): XX
- SOURCES OF CONTROLLABLE NITROGEN (MEP):
  - XX% Septic Systems
  - XX% Lawn Fertilizer
  - XX% Stormwater from Impervious Surfaces
  - XX% Wastewater Treatment Facilities

CONTRIBUTING TOWNS

- CONTRIBUTING TOWN1
- CONTRIBUTING TOWN2

THE MEP RESTORATION SCENARIO:

- WATERSHED TOTAL NITROGEN REDUCTION TARGET: XX%
- WATERSHED SEPTIC REDUCTION TARGET: XX%
  (The scenario represents the aggregated sub-embayment percent removal targets from the MEP technical report)

ESTUARY

- EMBAYMENT AREA: XX
- EMBAYMENT VOLUME: XX
- 2012 INTEGRATED LIST STATUS:
  - Status by waterbody
  - Status by waterbody
  - Status by waterbody
  - www.mass.gov/eea/docs/dep/water/resources/07v5/12list2.pdf

WATERSHED

- ACRES: XX
- PARCELS: XX
- % DEVELOPED RESIDENTIAL PARCELS: XX%
- PARCEL DENSITY: XX acres per parcel
- WASTEWATER TREATMENT FACILITIES: XX
  - Treatment Facility Name
  - Treatment Facility Name

Freshwater Sources

PONDS

- IDENTIFIED SURFACE WATERS: XX

< < Introduction and description of the watershed location > >

WATERSHED REPORT: Watershed Name

- NUMBER OF NAMED FRESHWATER PONDS: XX
- PONDS WITH PRELIMINARY TROPHIC CHARACTERIZATION: XX
- 2012 INTEGRATED LIST STATUS: XX
- DISCUSSION:

STREAMS

- SIGNIFICANT FRESHWATER STREAM OUTLETS: 0
  - Stream1:
    - Average Flow: XX cubic meters per day (m3/d)
    - Average Nitrate Concentrations: XX milligrams per liter (mg/L)
  - Stream2:
    - Average Flow: XX m3/d
    - Average Nitrate Concentrations: XX mg/L
  - Stream3:
    - Average Flow: XX m3/d
    - Average Nitrate Concentrations: XX mg/L
- DISCUSSION:

DRINKING WATER SOURCES

- WATER DISTRICTS: XX
  - Water District Name
  - Water District Name
- GRAVEL PACKED WELLS: XX
  - X have nitrate concentrations between 0 and 0.5 mg/L
  - X have nitrate concentrations between 0.5 and 1 mg/L
  - X have nitrate concentrations between 2.5 and 5 mg/L
  - X have no nitrate concentration data
- SMALL VOLUME WELLS: XX
- DISCUSSION:

Degree of Impairment and Areas of Need

Discussion on nitrogen reduction targets.

ECOLOGICAL CHARACTERISTICS AND WATER QUALITY

- OVERALL ECOLOGIC CONDITION: XX
- Waterbody Quality Status
- Waterbody Quality Status
- SENTINEL STATION:
  - Total Nitrogen Concentration Threshold: XX mg/L
  - Total Nitrogen Concentration Existing: XX mg/L (As reported at the MEP sentinel water-quality monitoring station)

IMAGE PLACEHOLDER
Subwatersheds with Total Nitrogen Removal Targets

IMAGE PLACEHOLDER
Subwatersheds with Septic Nitrogen Removal Targets

0.1% - 9%
9.1% - 38%
38.1% - 62%
62.1% - 86%
86.1% - 100%

Subwatersheds with Total Nitrogen Removal Targets
(Figure 3.1.2)

Subwatersheds with Septic Nitrogen Removal Targets
(Figure 3.1.3)

WATERSHED REPORT: Sub Region

Nitrogen Management Approaches

Description of scenario planning approaches.

TRADITIONAL APPROACH

Description of approach taken in scenario development.

NON-TRADITIONAL APPROACH

Description of approach taken in scenario development.

HYBRID APPROACH

Description of approach taken in scenario development.

LOCAL PROGRESS

TOWN1
Description of local efforts.

TOWN2
Description of local efforts.

Potential Watershed Scenarios

SCENARIO: Centralized Disposal In Watershed	SCENARIO: Centralized Disposal Out of Watershed	SCENARIO: Non-Traditional	SCENARIO: Hybrid
			

Credits

- Stormwater
- Fertilizer

Scenario Details

- Scenario Detail - i.e. number of properties sewered
- Scenario Detail - i.e. flow collected
- Scenario Detail- i.e. acres of aquaculture
- Scenario Detail- i.e. linear feet of PRB
- Scenario Detail- i.e. number of eco-toilets
- Scenario Detail- i.e. cubic feet of constructed wetlands

Cost

- Collection
- Transport
- Treatment & Disposal
- Operations and Maintenance
- Annual