Restoring and Preserving Water Quality in the Madaket Harbor and Long Pond Estuarine System

Guided by Nitrogen Control Strategies

MassDEP

November 17, 2011

Information Sources and Participants

- Town of Nantucket
- UMASS Dartmouth School of Marine Science & Technology (SMAST)
- Applied Coastal Research and Engineering, Inc.
- Cape Cod Commission
- USGS
- US EPA
- MA Division of Marine Fisheries
- MassDEP

The Process

Data Collection

Watershed Delineation

Land Use Data

Linked Model & Report:

- Nitrogen Loading
- Hydrodynamic Model
- Water Quality Model
- Thresholds Analysis

TMDL Development

CWMP & more model runs

Implementation!

The Problem:

Declining coastal habitat quality

due to

increased nitrogen loading

resulting from

changes in watershed land uses

Nantucket Resident Population

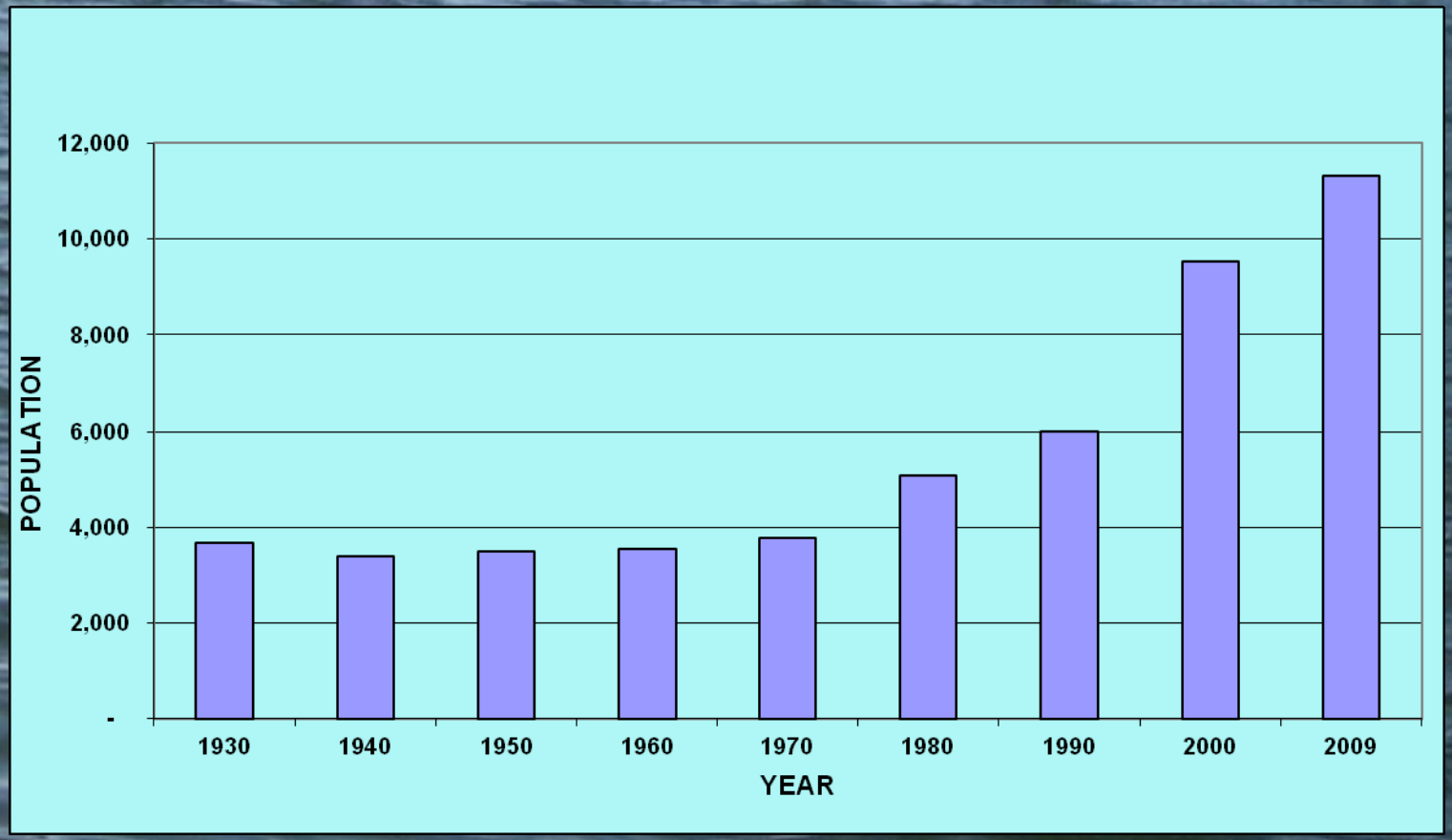
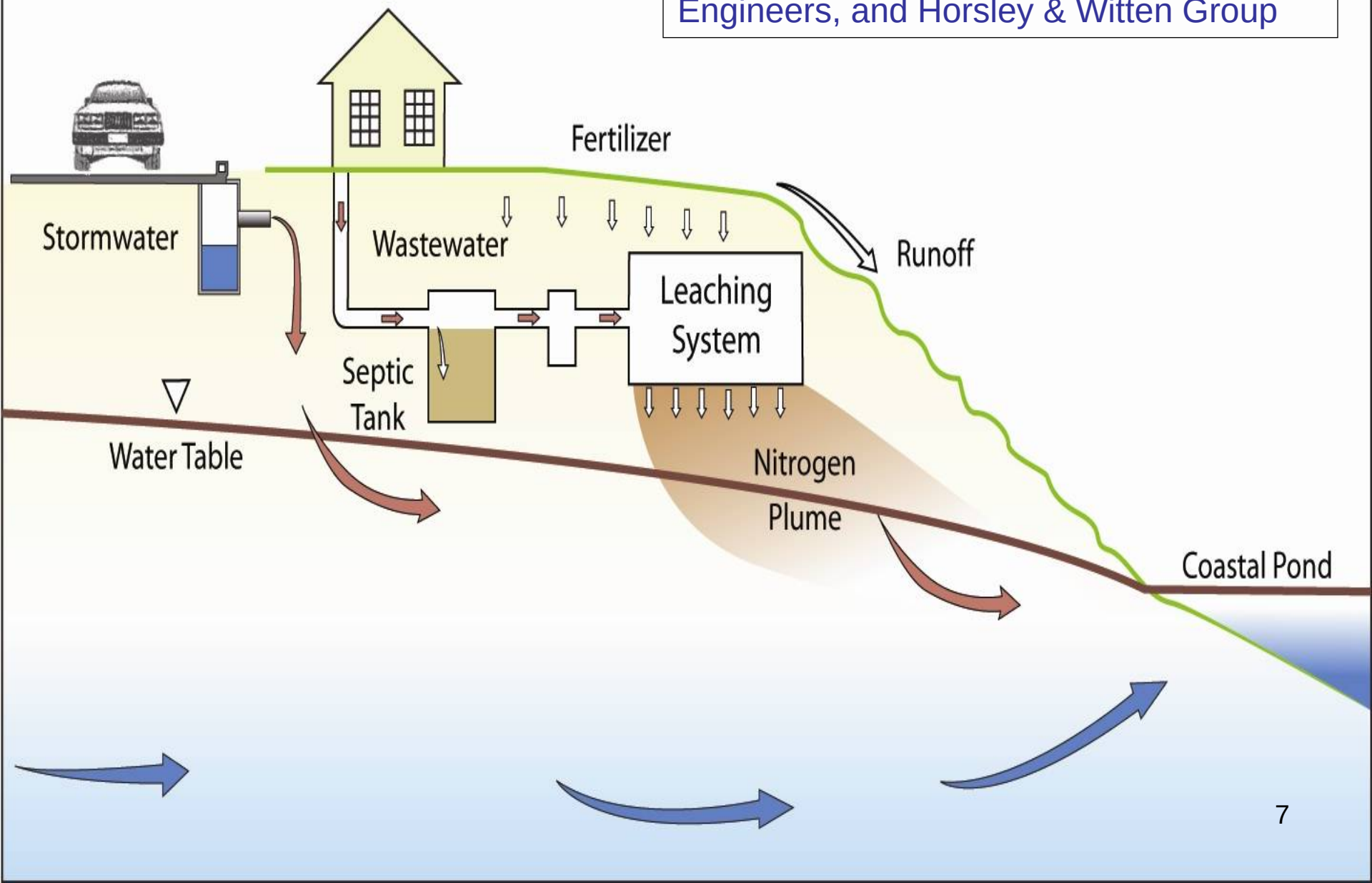


Figure developed by: Three Bays Preservation, Inc, Stearns & Wheler Engineers, and Horsley & Witten Group



Effects of Excess Nitrogen

- Algae Blooms
- Loss of Eelgrass
- Increased Macro-Algae
- Low Dissolved Oxygen
- Organic Enrichment of Sediments
- Lack of Plant & Animal Diversity
- Fish Kills

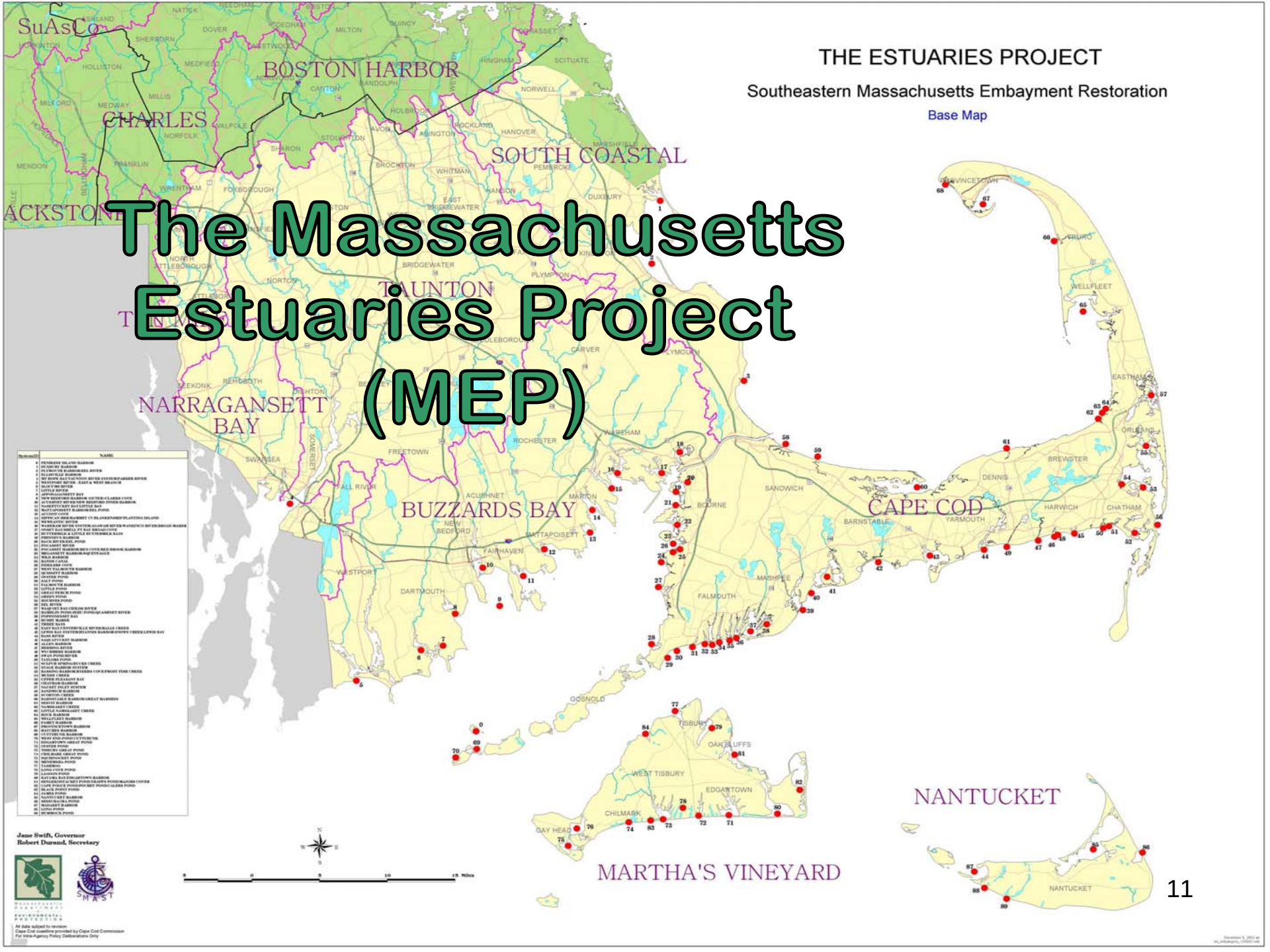
EPA requires states to set limits* on pollutants

* Total Maximum Daily Load (TMDL)

Total Maximum Daily Load:

Maximum amount of a pollutant that can enter a water body and still meet water quality standards

The Massachusetts Estuaries Project (MEP)



MEP Goals

Determine:

- Nitrogen Loading Limits – specific to individual estuarine systems in Southeastern Massachusetts

Recommend:

- Nitrogen Management Strategies

SMAST's Linked Models Approach Establishes:

- Nitrogen Criteria for Each Estuary
- Nitrogen Watershed Loading Limits

Determining Present Conditions

- Nitrogen Loading to Groundwater
- Groundwater Flow to Estuaries
- Estuary Circulation, Tides & Currents
- Nitrogen Concentrations in Estuaries

Target Threshold Concentrations & Loads

N Concentration Targets are Linked to:

- Reduced Algal Blooms (as measured by Chlorophyll-*a*)
- Improved Dissolved Oxygen Concentration
- Healthy Benthic Animal Assemblages
- Eelgrass Restoration

Predicting Target Threshold Concentrations & Loads

- "Target" nitrogen concentration applied to estuary
- Groundwater nitrogen flows to estuaries
- Estuary circulation, tides, & currents
- Nitrogen load (TMDL) to estuary is calculated from the linked model

Modeling the Options for Achieving the Target Threshold

Conventional Approaches:

- Sewering
- Stormwater controls
- Fertilizer use reduction bylaws

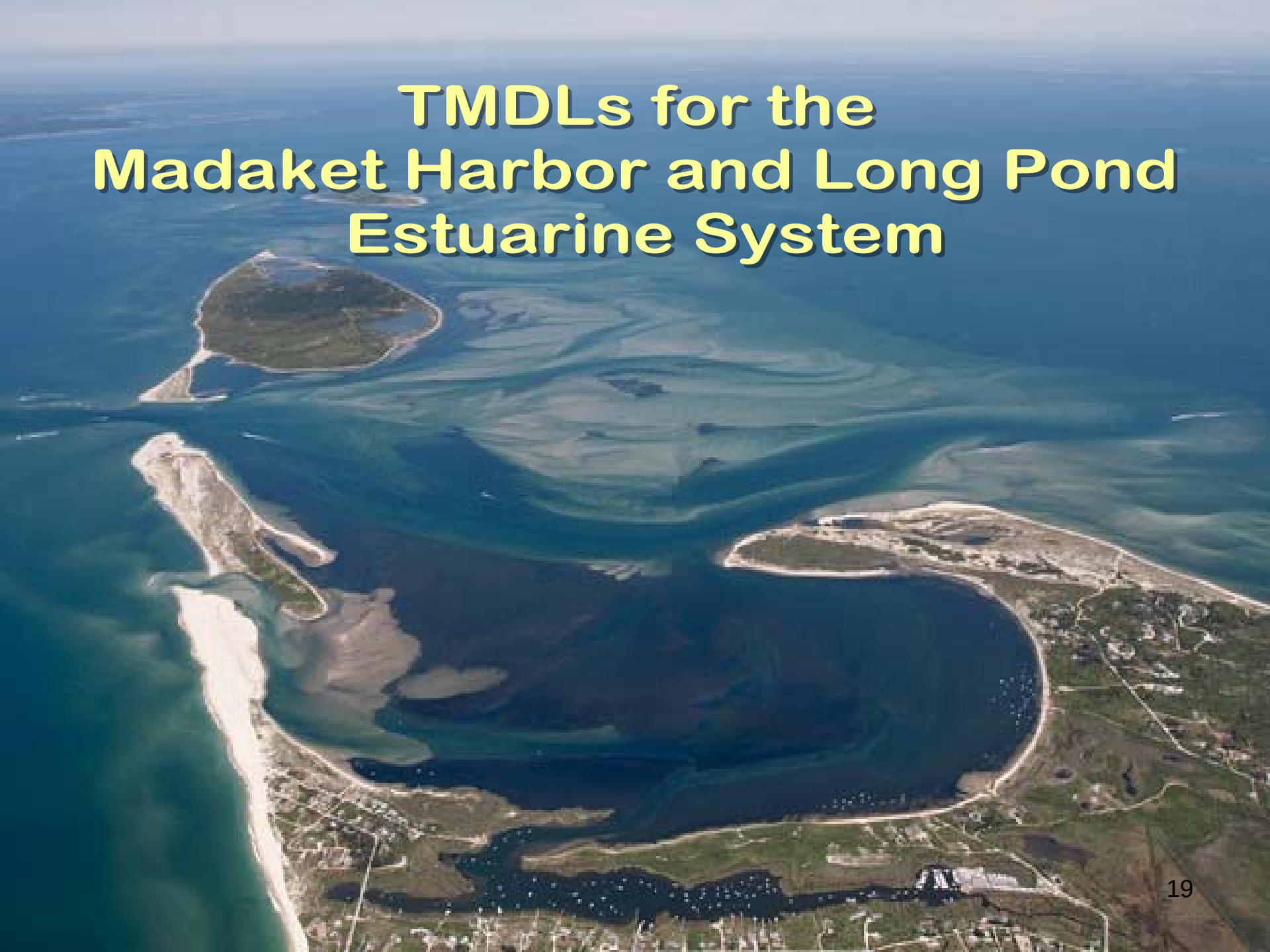
Non-traditional Approaches:

- Improved flushing
- Enhance natural attenuation

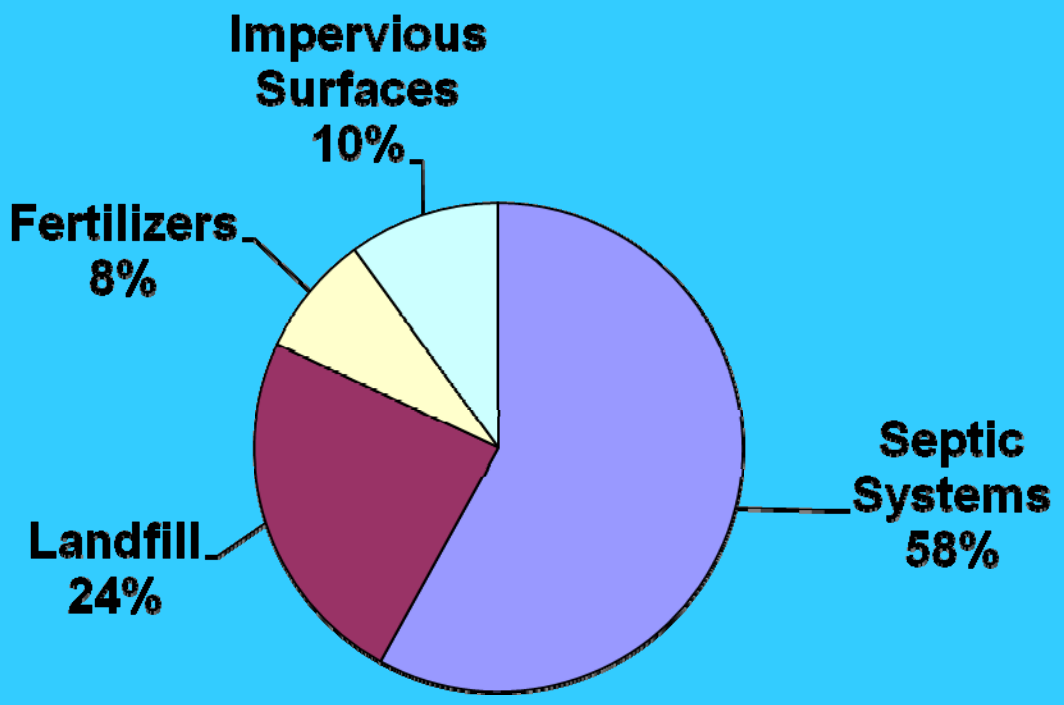
Comprehensive Wastewater Management Planning (CWMP)

- Based on acceptable nitrogen loading
- Identifies wastewater management options
- Schedules implementation
- Watershed-wide approach

TMDLs for the Madaket Harbor and Long Pond Estuarine System



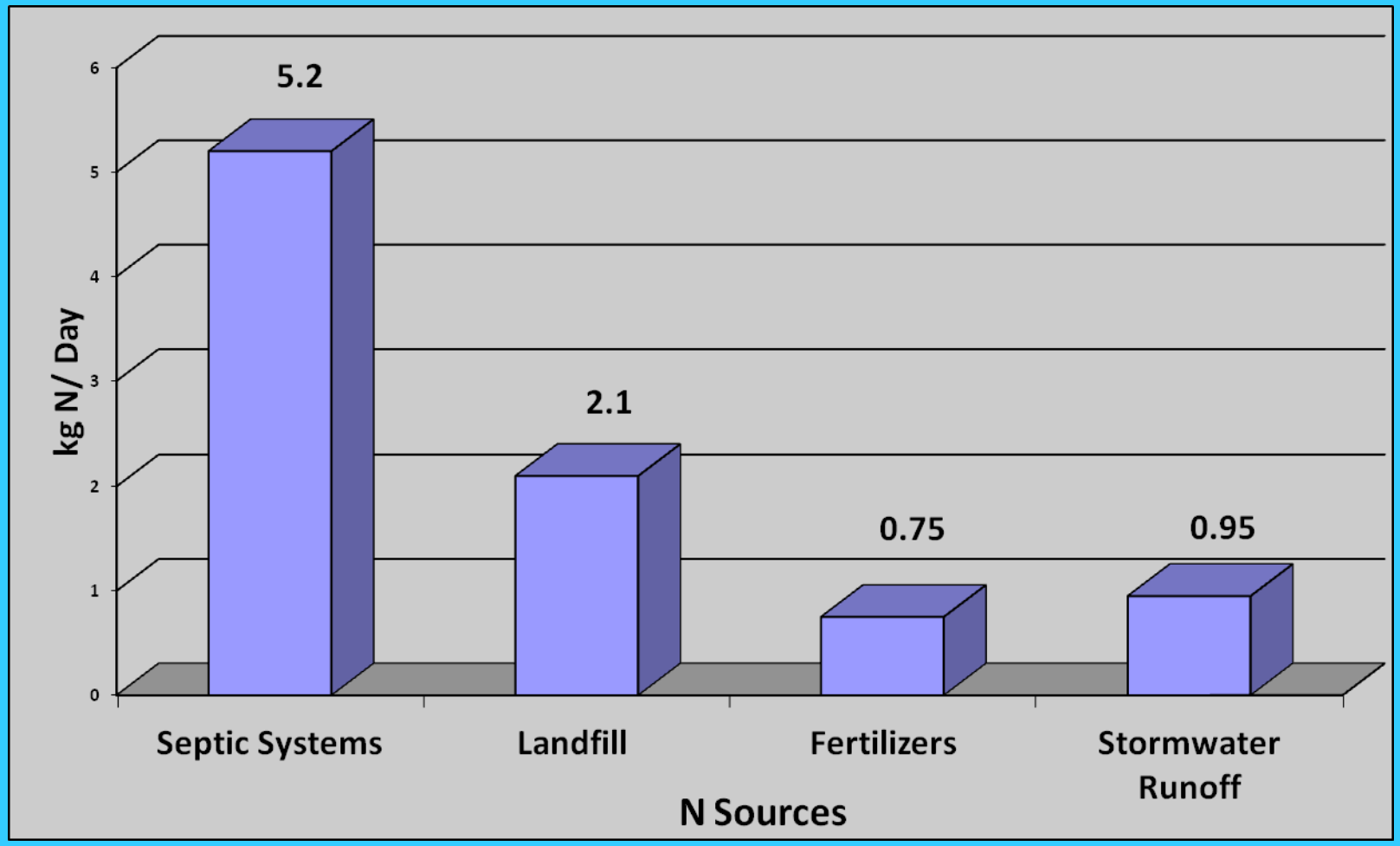
Percent Contributions of Controllable Nitrogen Sources to the Madaket/Long Pond System



Sediment Nitrogen

- Indirectly controlled by watershed nitrogen load
- A "pass through" from other sources
- Will return if other sources are not controlled

Controllable Nitrogen Load (kg/day)



Observed Existing Nitrogen Concentrations and Target Threshold Concentrations for Madaket Harbor and Long Pond

Sub-embayment	Range of Observed Nitrogen Concentration [1] (mg/L)	Target Threshold Nitrogen Concentration (mg/L)
Madaket Harbor	0.336-0.422	
Hither Creek	0.581-0.780	0.45[2]
Long Pond	0.894-1.058	0.80[3]

[1] Average Total N concentrations from present loading based on an average of annual N means from 2002 – 2004

[2] Target threshold N concentration at Hither Creek Sentinel Station M11

[3] Secondary target threshold N concentration for Long Pond (average of stations LOP01, 02, 03, 04)

Water Quality Sampling Stations in the Madaket Harbor and Long Pond Estuarine System

Total Watershed Nitrogen Load, Target Load, and Percent Reduction Needed to Meet the Target Load

Sub-embayment	Present Total Watershed Load [1] (kg/day)	Target Threshold Watershed Load[2] (kg/day)	Percent Watershed Load Reductions Needed to Achieve Target
Madaket Harbor	0.663	0.663	0%
Hither Creek	4.041	1.134	71.9%
Madaket Ditch	2.433	2.433	0%
North Head Long Pond	0.238	0.238	0%
Long Pond	3.230	1.101	65.9%
Total for Madaket Harbor/ Long Pond Estuarine System	10.605	5.570	47.5%

[1] Composed of septic, fertilizer, landfill and runoff loadings

[2] Target threshold watershed load is the N load from the watershed needed to meet the target threshold N concentration

Comparison of sub-embayment watershed septic loads used for modeling of present and threshold loading scenarios in the Madaket Harbor System.

Sub-embayment	Present septic load (kg/day)	Threshold septic load (kg/day)	Threshold septic load % change
Madaket Harbor	0.384	0.384	0.0%
Hither Creek	2.907	0.000	-100.0%
Madaket Ditch	1.510	1.510	0.0%
North Head Long Pond	0.071	0.071	0.0%
Long Pond	0.342	0.342	0.0%
System Total	5.214	2.307	-55.8%

Total Maximum Daily Load

Sub-embayment	Target Threshold Watershed Load (kg N/day)	Atmospheric Deposition (kg N/day)	Nitrogen Load from Sediments (kg N/day)	TMDL[1] (kg N/day)
Madaket Harbor	0.663	8.603	17.952	27.218
Hither Creek	1.134	0.534	0	1.668
Madaket Ditch	2.433	-	0.061	2.494
North Head Long Pond	0.238	0.693	0.995	1.926
Long Pond	1.101	0.975	2.273	4.349
Total for System	5.570	10.805	21.281	37.656

[1] Sum of target threshold watershed load, sediment load and atmospheric deposition load

Implementation

- Watershed-Wide Focus
- Prioritize Efforts
- “Technical” Approaches
- “Institutional” Approaches

Technical Approaches

- Enhanced Wastewater Treatment
- Storm Water Runoff Control & Treatment
- Flushing Enhancements
- Enhanced Nitrogen Attenuation

Institutional Approaches

- Local Zoning (guided development)
- Bylaws
- Creative Financing
  - State Revolving Fund (SRF) can cover planning & construction
  - USDA Rural Development grants
- SRF Points for a Wastewater Management District

Implementation Guidance

DEP has Developed an Implementation Guidance Manual

- Companion to technical reports
- Provides an overview of tools that can be used
- Looks at technical and institutional options

http://www.mass.gov/dep/water/resources/coastalr.htm#general

Where Do We Go From Here?

- DEP: Revise TMDL Document (based on public input)
- Submit TMDL to EPA
- Comprehensive Wastewater Management Planning (CWMP)

For More Information:

EPA

http://www.epa.gov/owow/tmdl

MassDEP

http://www.mass.gov/dep/water/resources/tmdls.htm

- **MA List of Impaired Waters**
  (303d is now the Integrated List)
- **Draft and Final TMDLs**

http://www.mass.gov/dep/water/priosres.htm

- **Estuaries Project**
- **Watershed Assessment Reports**

Questions/Comments on TMDL

By Friday, December 16 at 5:00 pm

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