

Nitrogen Management in Cape Cod:

Considering Alternative Technologies for Reducing Nitrogen Loading

The Problem

The bays and estuarine environments in Cape Cod, Massachusetts, receive more nitrogen than what the waters can naturally assimilate. This excess load has led to eutrophication and degraded water habitats, resulting in the loss of eel grass beds and shellfish growing areas. Nitrogen loading to watersheds in Cape Cod must be reduced in order to restore ecological health.

Overwhelmingly, the greatest source of nitrogen comes from Cape Cod's wastewater. A large percentage of homes on Cape Cod have septic systems, which do not treat for nitrogen and thus allow nitrogen to leach in to the groundwater.

Potential Solutions

The Cape Cod Commission (CCC) is the regional regulatory agency that has been tasked with creating a Water Quality Management Plan for Cape Cod in order to systematically address the nitrogen loading problem. The plan must comply with Section 208 of the Clean Water Act and must be approved by the Massachusetts Department of Environmental Quality.



The CCC is considering two primary solutions in the 208 Water Quality Plan:
 1) Installing sewers
 2) Implementing "alternative technologies"

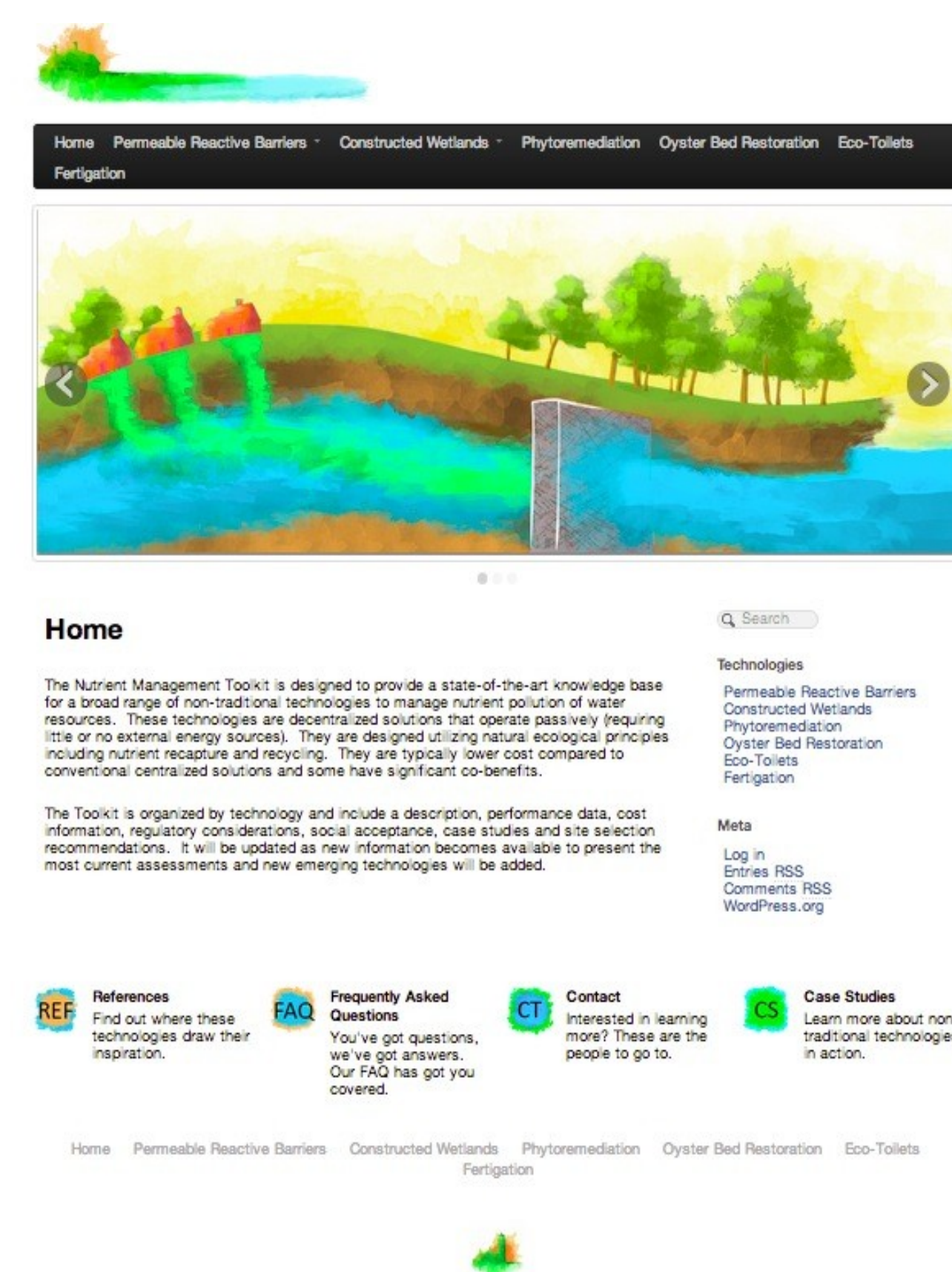
Project Goals

- Research proposed technologies and provide a report to the CCC

The CCC can use information provided in the technology reports directly in the Water Quality Management Plan,

- Enhance public education of the alternative technology options through creation of a website

The website will serve as an accessible tool intended to educate the average citizen on the alternative nitrogen management technologies being considered on Cape Cod. The "Nitrogen Management Toolkit" provides direct access to technology descriptions, performance data, and case studies. By incorporating custom watercolor designs and a simple layout, the website will be both aesthetically pleasing and eas-



Considered Technologies

<p>Constructed Wetlands</p> <p>Constructed wetlands closely mimic the ecosystem of a natural wetland by utilizing water loving plants to filter wastewater through their root zone, a planted medium, and open water zones.</p>	
<p>Phytoremediation</p> <p>Plants with deep tap roots are planted as a buffer to intercept nitrogen enriched groundwater. The plants and microorganisms in their root zone use the nitrogen, removing it from the groundwater and watershed.</p>	
<p>Permeable Reactive Barriers (PRBs)</p> <p>A PRB is a trench filled with a carbon source constructed to intercept groundwater. The microbes in the carbon source uptake the nitrogen, denitrifying the groundwater.</p>	
<p>Fertigation Capture Wells</p> <p>These wells capture nutrient enriched groundwater and recycle it back to irrigate and fertilize turf grass areas (such as golf courses).</p>	
<p>EcoToilets</p> <p>Composting, packaging, and urine diverting toilets deal with nitrogen directly at the source. Instead of connecting to a septic system, EcoToilets independently recycle the nutrients in urine and feces through several alternative mechanisms.</p>	
<p>Oysters</p> <p>Aquaculture and restored oyster reefs remove nitrogen through filtration and bio-deposition.</p>	

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Technology Components

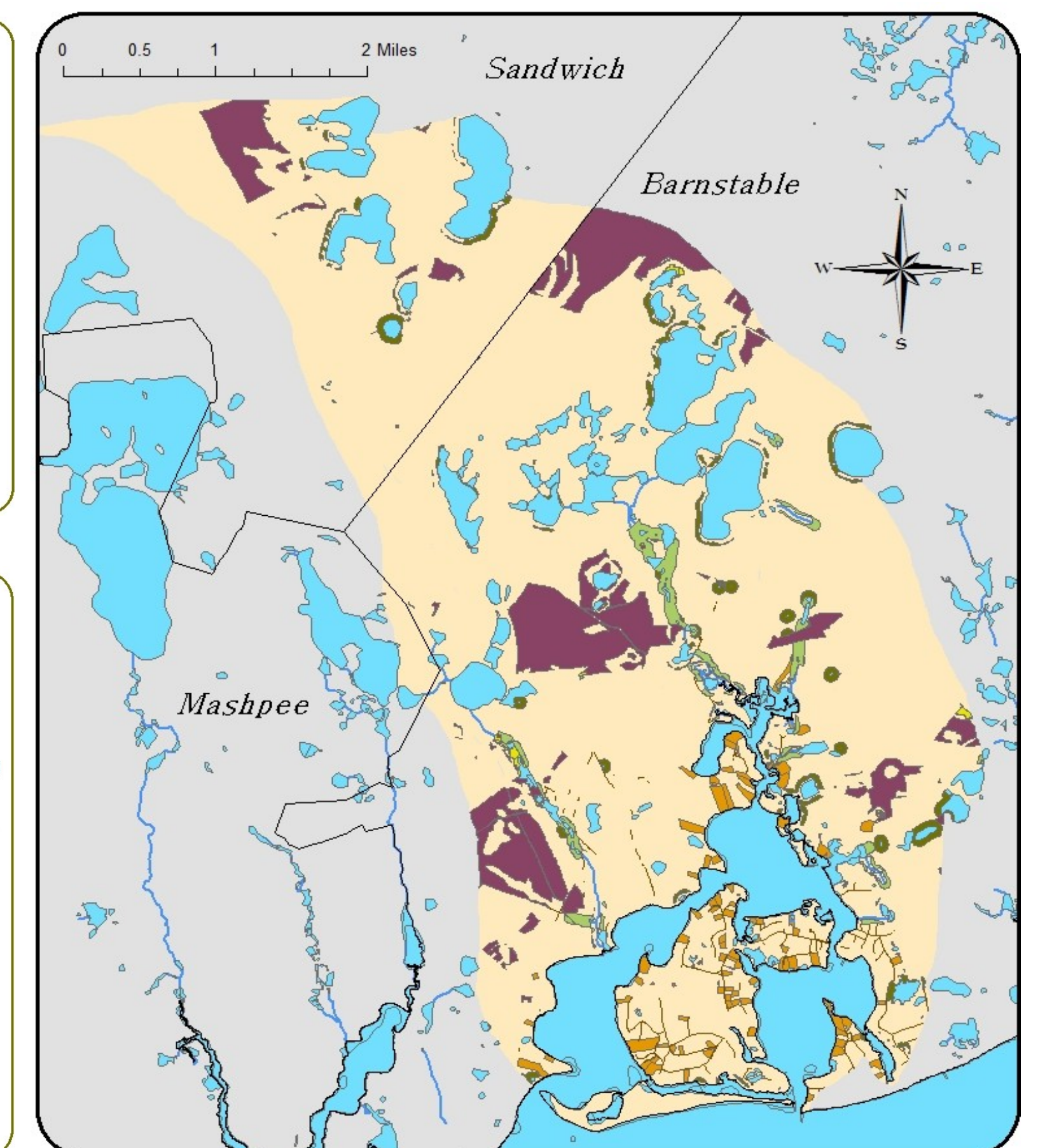
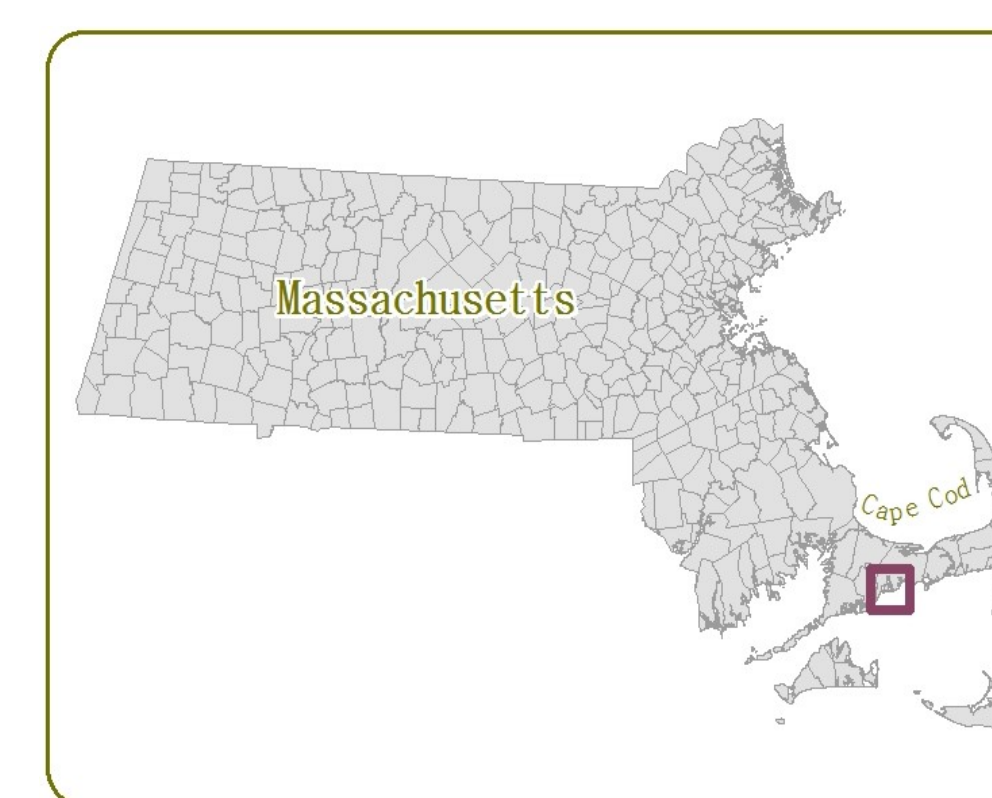
The project has researched the following components regarding each technology:

- How the Technology Works
- Performance Data
- Potential Performance Challenges
- Existing Applications - Case Studies and Results
- Costs
- Co-benefits
- Implementation Challenges (e.g. cultural acceptance, climate change considerations)
- Regulatory Considerations
- General Site Considerations and Monitoring

Implementation

Technology-specific site considerations and nitrogen reduction needs are taken in to account in siting potential locations of technologies within the 57 watersheds on Cape Cod. The CCC will use the technology reports in addition to GIS mapping to identify areas for technology pilot projects. Ultimately, an adaptive management plan with phased implementation of technologies will be considered.

Potential Locations of Technologies in the Three Bays Watershed



Graphic Sources:
 Constructed Wetlands (www.venturariver.org);
 Phytoremediation (www.intechopen.com); PRBs (AECOM);
 Fertigation Capture Wells (Horsley Witten Group);
 EcoToilets (www.sswm.info); Oysters (Inter-Research Science Center)

Map Data: Barnstable Parcel Data obtained from Town of Barnstable. SSURGO Soil Data obtained from USDS/NRCS. Depth to groundwater data obtained from the Cape Cod Commission. Watershed delineation georeferenced from Massachusetts Estuaries Project Report (2006). All other data obtained from MassGIS.
Coordinate System: NAD_1983_StatePlane_Massachusetts_Island_FIPS_2002
Cartographer: Monica Mejia