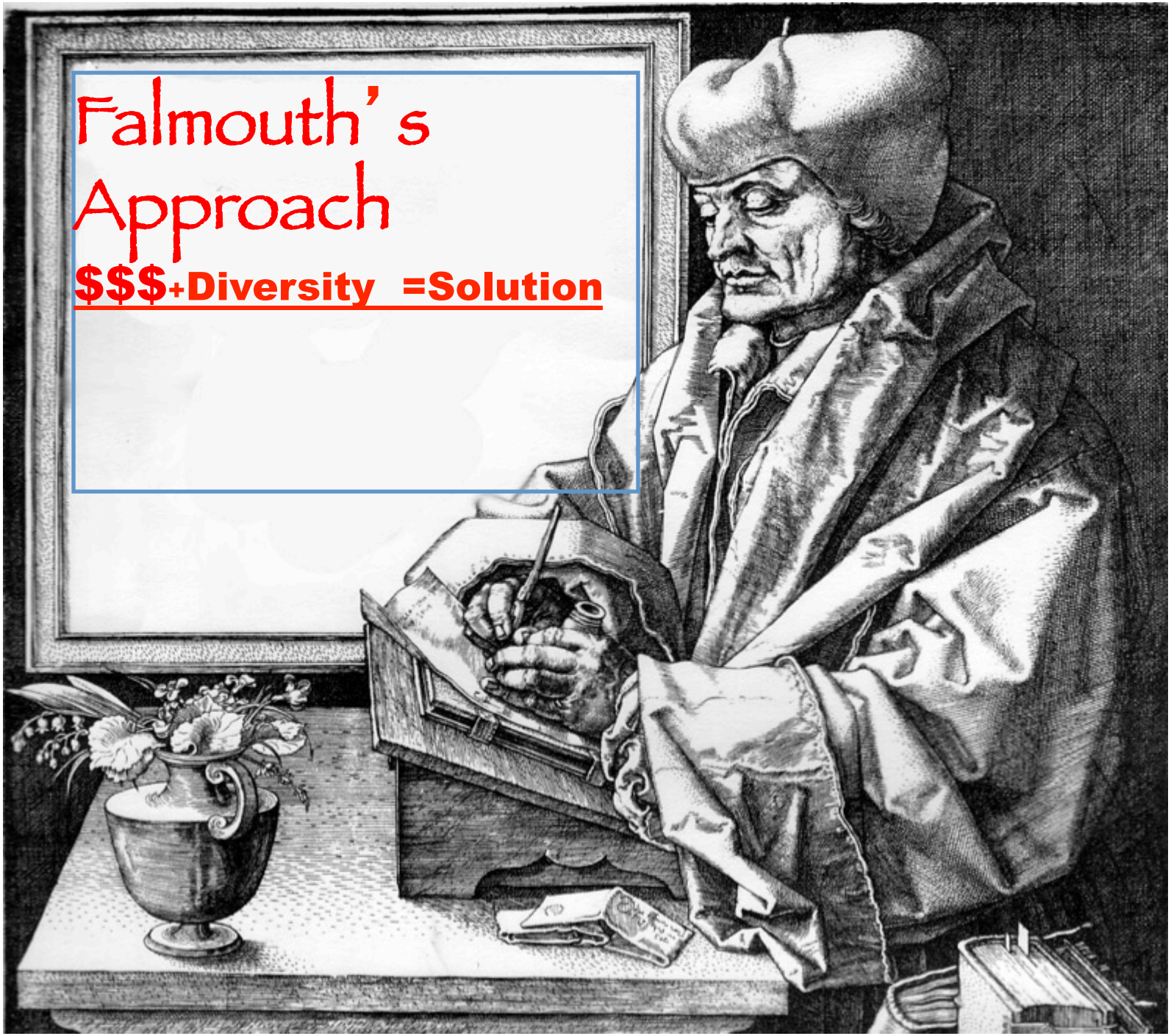
CAPE COASTAL CONFERENCE

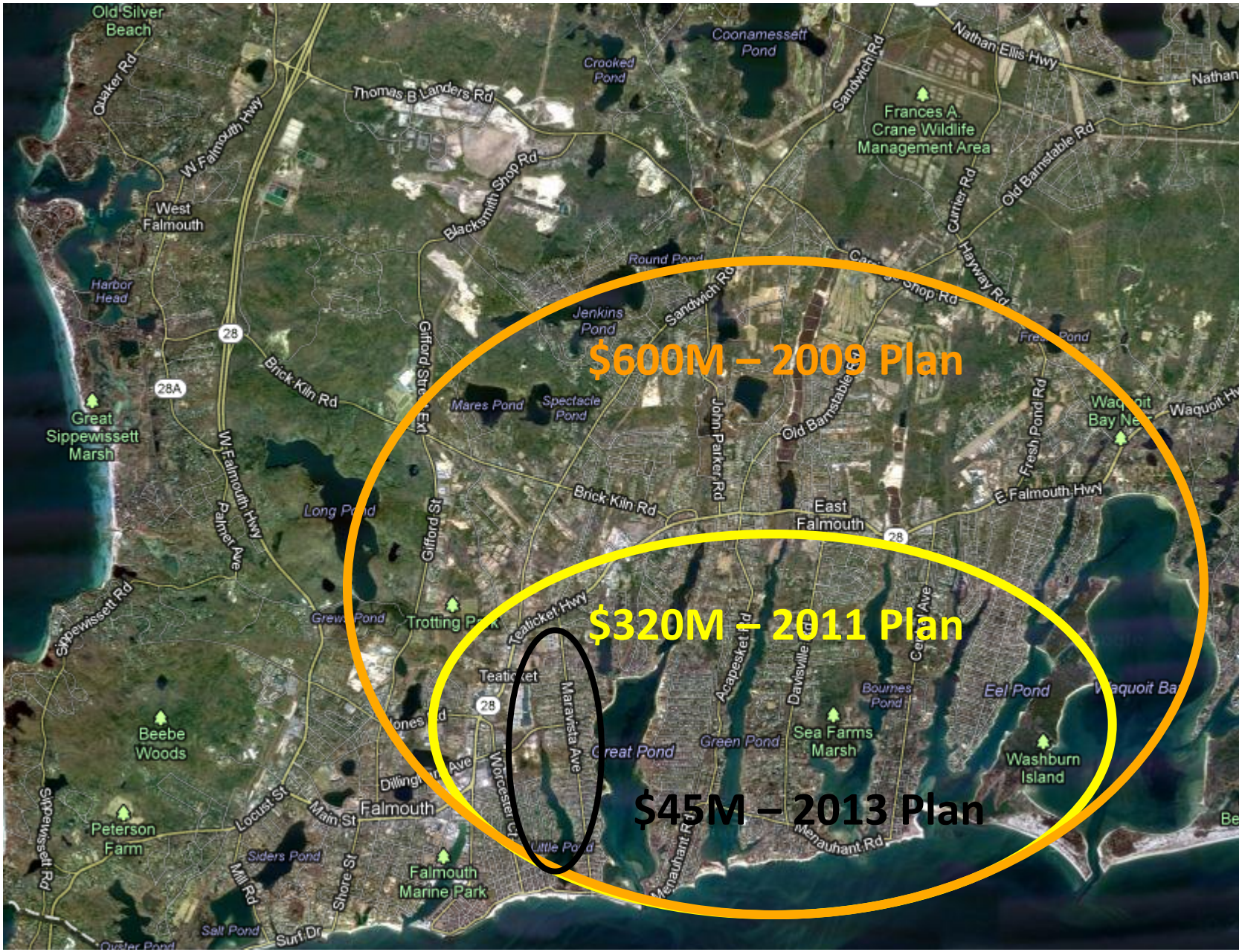
Linking Science with Local Solutions and Decision-Making

Inlet Widening & Permeable Reactive Barriers

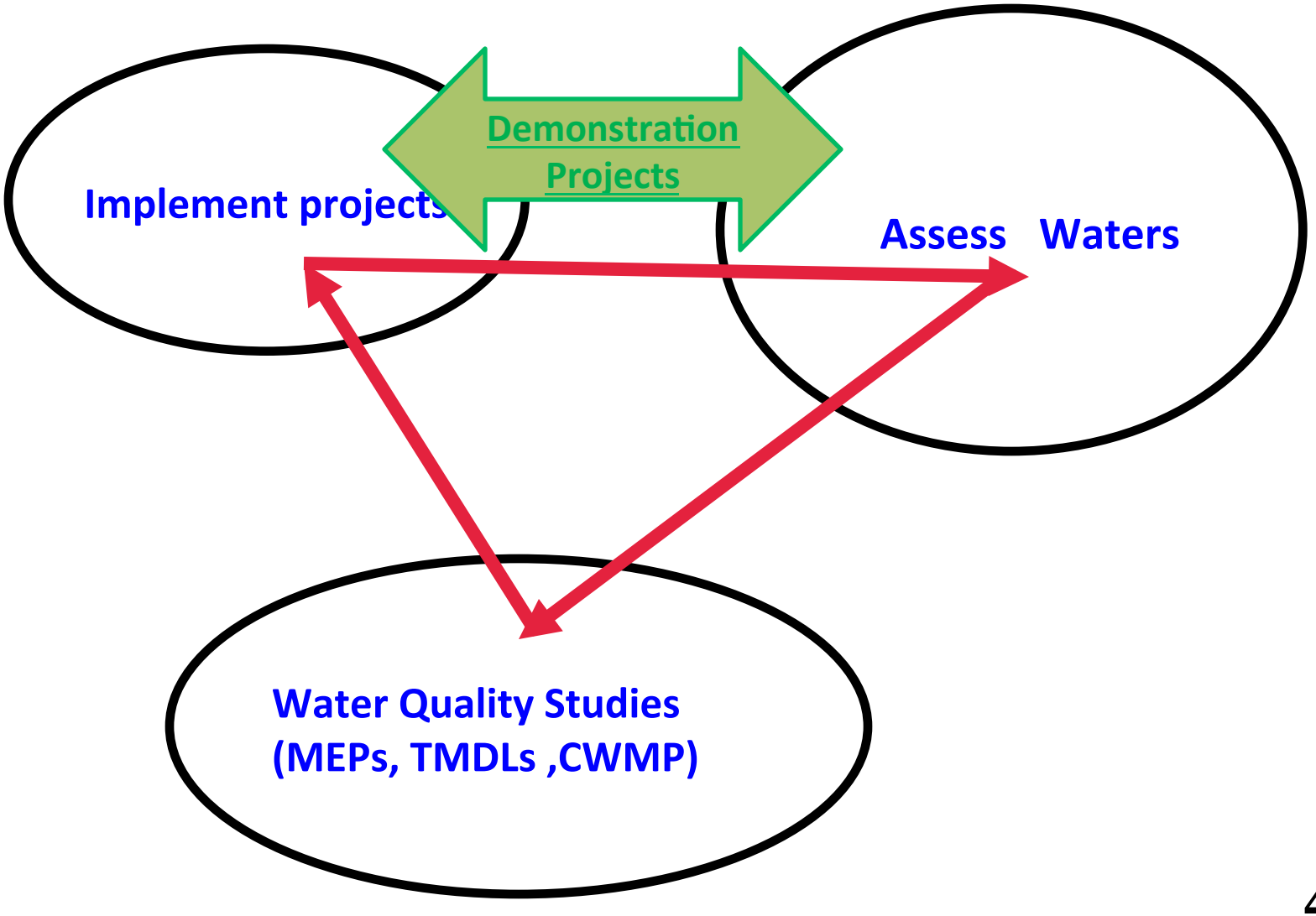
Gerald C Potamis P.E.

Falmouth Wastewater Superintendent


Falmouth's Approach
$$$+Diversity =Solution


$600M – 2009 Plan
$320M – 2011 Plan
$45M – 2013 Plan
Old Silver Beach
Quaker Rd
W Falmouth Hwy
Thomas B Landers Rd
Crooked Pond
Coonamessett Pond
Nathan Ellis Hwy
Sandwich Rd
Frances A. Crane Wildlife Management Area
Old Barnstable Rd
Curtier Rd
Hayway Rd
West Falmouth
Blacksmith Shop Rd
Round Pond
Harbor Head
28
28A
Brick Kiln Rd
Jenkins Pond
Gifford St
Mares Pond
Spectacle Pond
John Parker Rd
Fresh Pond Rd
Waquoit Bay
E Falmouth Hwy
Great Sippewissett Marsh
W Falmouth Hwy
Palmer Ave
Long Pond
East Falmouth
Sippewissett Rd
Trotting Park
Teaticket Hwy
Teaticket
Maravista Ave
Acapesket Rd
Davisville
Bournes Pond
Eel Pond
Waquoit Bay
Beebe Woods
Great Pond
Green Pond
Sea Farms Marsh
Washburn Island
Falmouth
Main St
Locust St
Peterson Farm
Siders Pond
Mill Rd
Shore St
Falmouth Marine Park
Little Pond
Menauhant Rd
Salt Pond
Surf Dr

Watershed Adaptive Management



Falmouth's Estuaries Restoration Plan

April 2011 Town Meeting unanimously passed Article 17, appropriating $2.7 million to proceed with sewer design and alternative demonstration projects

Voters approved this measure on a town-wide ballot, supporting it by a 2:1 margin in every precinct.

In August 2012, Board of Selectmen unanimously approved a Draft Comprehensive Wastewater Management Plan (DCWMP) with these elements and submitted it to the state.

Shellfish Cultivation

*Bournes Pond Inlet Widening

Denitrifying Septic Systems

Eco-toilets

Lower Little Pond Sewers

*Permeable Reactive Barriers

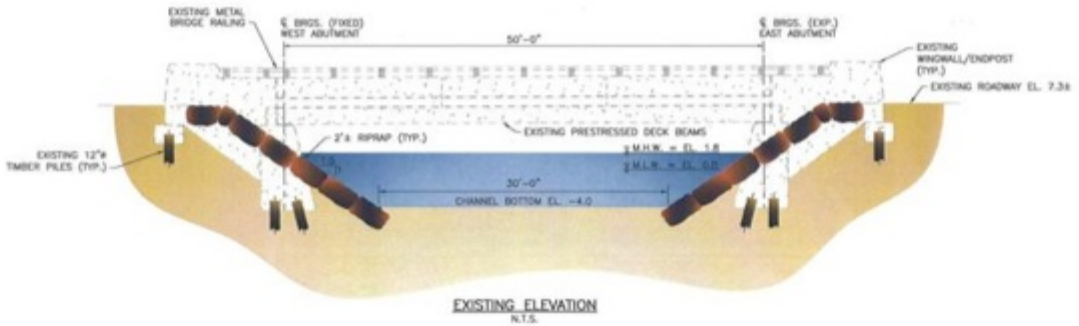
Road Runoff Remediation

Fertilizer Bylaw

Inlet Widening Project Scope

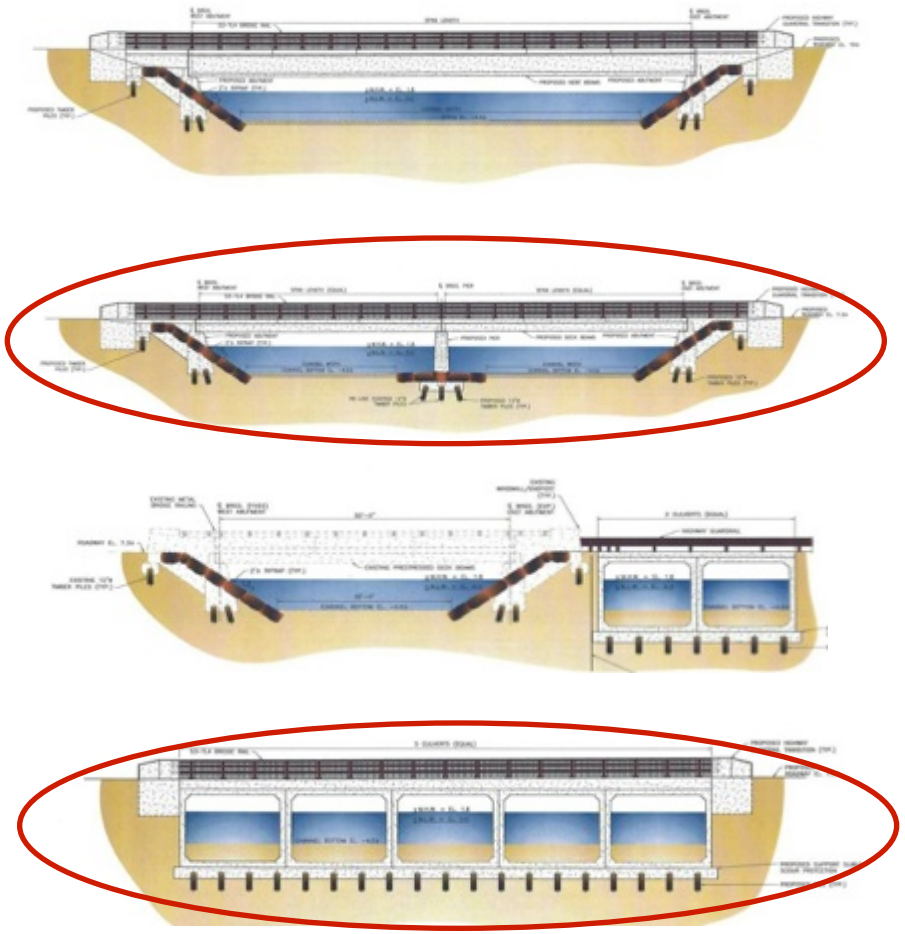
- Hydrodynamic modeling to optimize the inlet opening
- Evaluate alternative inlet openings and bridge types
- Develop preliminary design information and costs
- Develop permitting strategy
- Summarize findings

Existing Opening



Screening of Alternatives

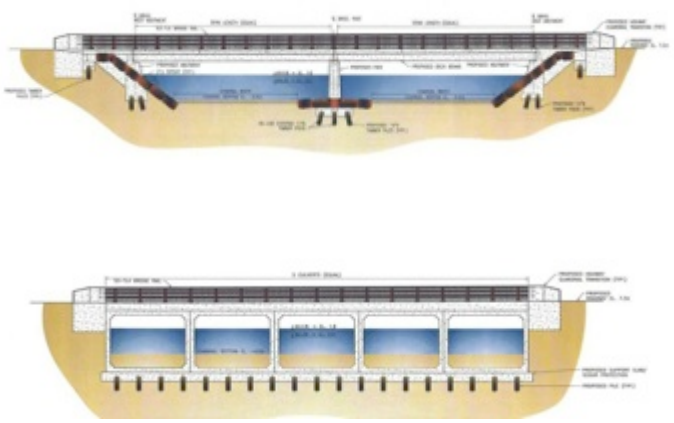
- Two Alternatives Selected for Cost development
  - Scenario 2: Double-span bridge
  - Scenario 4: Multiple culvert bridge



Cost Estimate

	Scenario 2: Double-Span Bridge	Scenario 4: Multiple Culvert Bridge
Capital Costs		
Bridge and Road Work	2,500,000	2,600,000
Jetty Modifications and armoring	800,000	720,000
Dredging and Beach Nourishment	75,000	80,000
Permitting Allowance	300,000	300,000
Design	400,000	400,000
Engineering during Construction	520,000	520,000
Contingency (25%)	920,000	930,000
Total	**5,520,000**	**5,550,000**

Notes:
1. All capital costs referenced to a date of January 1, 2013.
2. All costs are rounded to 2 significant digits except the total which is rounded to 3 significant digits.
3. Engineering during construction includes fiscal and legal allowance



Permitting Strategy

- Develop support from the Executive Office of Energy and Environmental Affairs (EOEEA) Nutrient Management Workgroup
- Convene a pre-submittal meeting
- Prepare and Submit **Expanded** Environmental Notification Form (ENF) as part of the Massachusetts Environmental Protection Act (MEPA) review
- Expect some Special Conditions in the MEPA approval certificate

Permitting Strategy (continued)

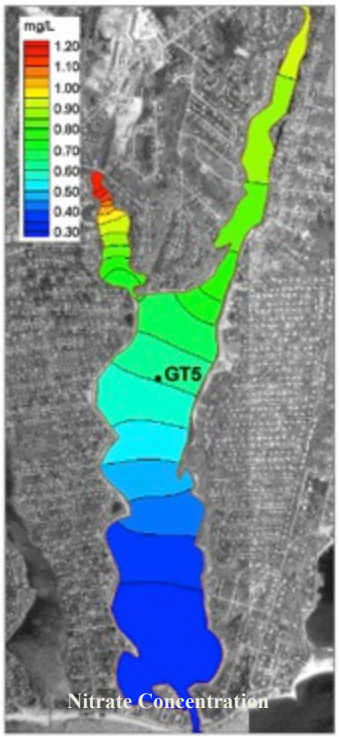
- Develop and coordinate permit application and approval process
  - Notice of Intent and Order of Conditions (Falmouth Conservation and MassDEP)
  - 401 Water quality Certification (MassDEP)
  - Chapter 91 License (MassDEP)
  - 404 Permit (U.S. Army Corps of Engineers)
  - Coastal Zone Consistency (Massachusetts CZM)
  - Natural Heritage and Endangered Species Program (NHESP) approval

Next Steps

- SRF Funding Applications
- Environmental Review
- Permitting
- Final Design
- FY14 Appropriation
- Construction
- Public Outreach

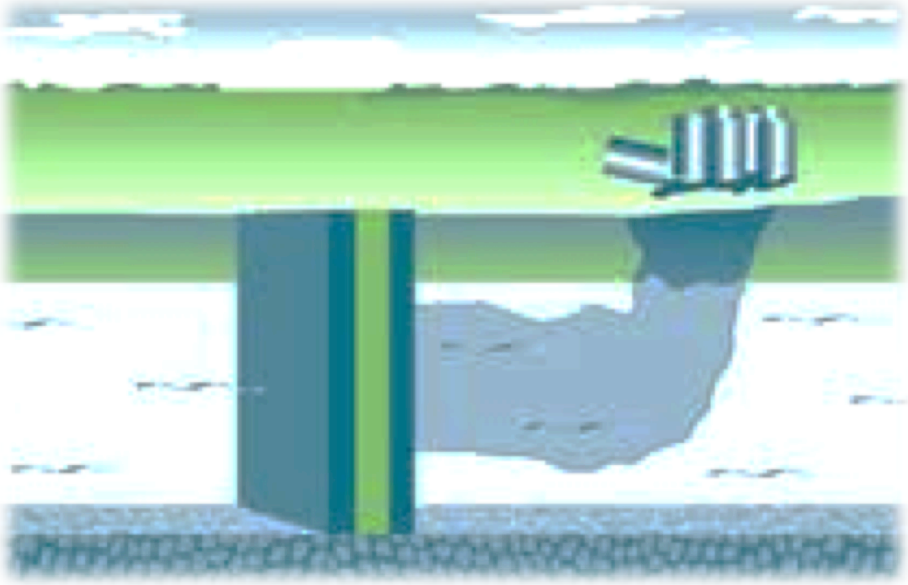
Falmouth Permeable Reactive Barrier (PRB) Study

- Water quality issues in the estuaries
- Plume from WWTP effluent in W. Falmouth
- Previous projects
  - Conducted on a smaller scale



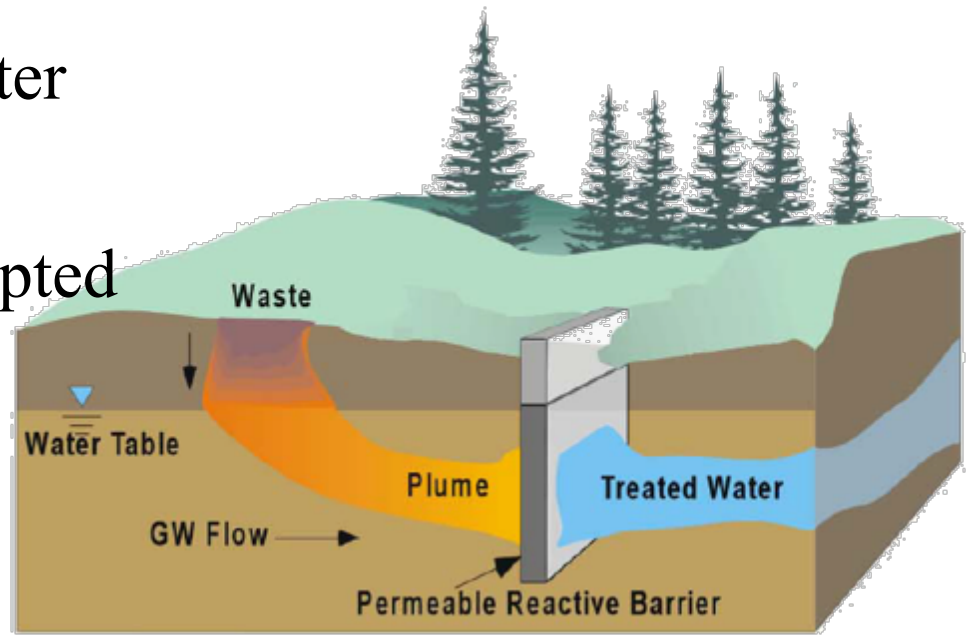
Outline

- Evolution of PRBs
- Falmouth Ma application
- Stages of the project



Permeable Reactive Barriers

- In-situ treatment zone
  - Intercept and treat contaminated groundwater
- Iron based PRBs
  - From innovative to accepted
  - Traditionally used for:
    - Chlorinated solvents
    - Metals
    - Radionuclides
- Biowalls
- Other media types

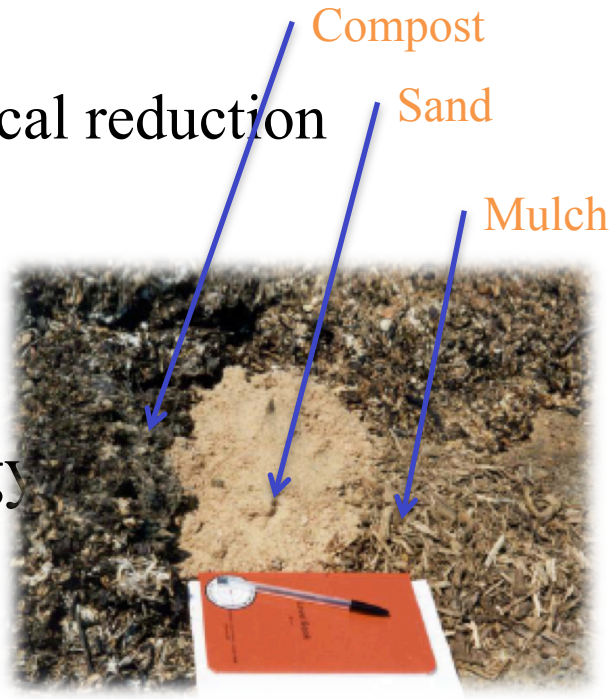


PRBs as a Sustainable Solution

- Perform under hydraulically passive means
- Groundwater is not removed or discharged
- Treatment material often consists of recycled media
  - Solid carbon sources
    - mulch
    - compost
    - sawdust
    - wheat straw
- Best Management Practices Program, USEPA Green Remediation
  - Energy requirements
  - Air emissions
  - Material consumption and waste generation

Existing PRB Knowledge: Nitrate Removal

- Focus on PRBs implemented for nitrate removal
  - 17 pilot scale and 10 full scale examples
  - 70—100% nitrate removal can be achieved
- Reactive media
  - Wood-based organic media for biological reduction
    - Rejuvenation may be necessary
  - Inorganic media
    - Iron
    - Sulfur/limestone
- USEPA accepted treatment technology
- Typically ~ ≤10’ in depth
  - Excavation equipment
  - >10-35’ use one-pass trenching
  - Can be deeper with other construction techniques



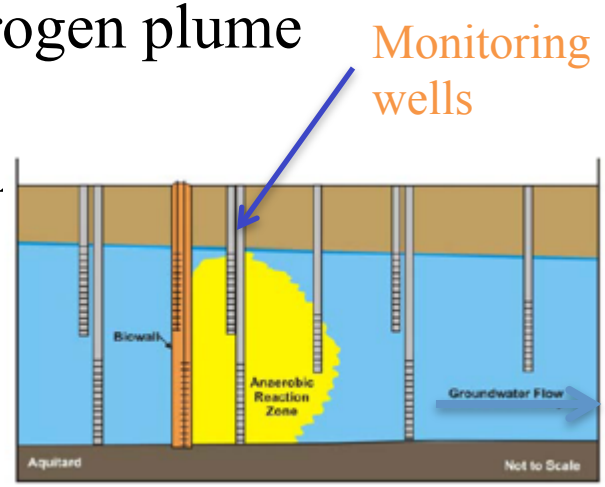
PRB Media

PRB Costs Drivers

- Factors
  - Type of PRB
  - Depth of installation
  - Nature of the geologic materials present
  - Surface/subsurface obstructions (e.g., buildings and utilities)
- Installation
  - Media
    - Effectiveness of the media at treating the contaminants
    - Effective lifespan
  - Construction
- Long-term maintenance and monitoring

Typical PRB Design Considerations

- Hydrogeological
  - Understanding GW flow to intercept nitrogen plume
- Nitrate concentration
  - Position PRB to target highest concentra
- Proximity to tidal area
  - Avoid salt water inundation
- Infrastructure and land use
  - Avoid buildings or utilities that cannot be moved
- Aquifer properties
  - Geochemistry
- PRB media thickness
- Monitoring locations



Potential Downgradient Impacts

- Lessons learned from similar projects
  - Geochemical changes
    - Water quality impacts
    - Aesthetics
- Proper grading during construction

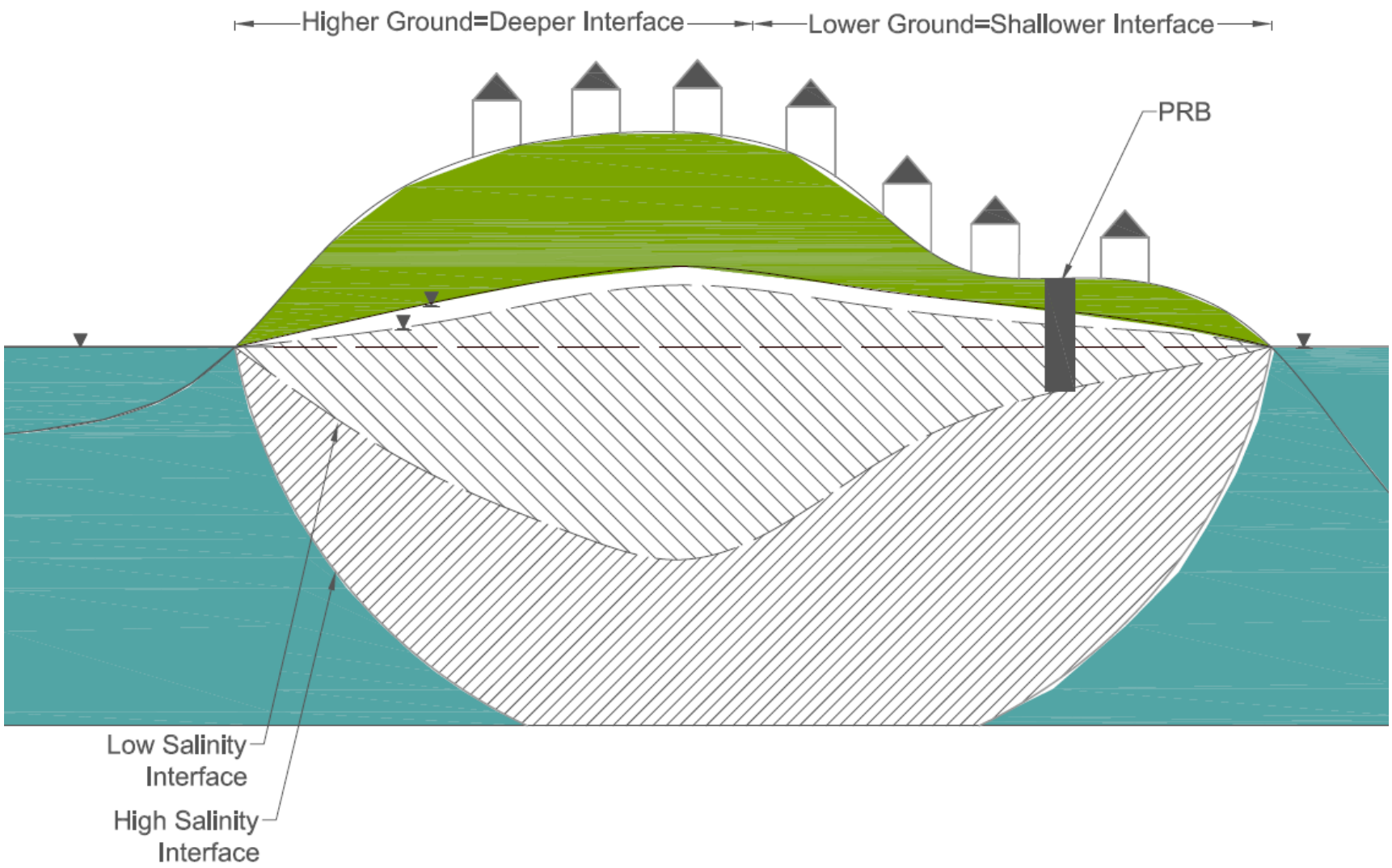
Potential Environmental Permitting Requirements

- Federal
- State
- County
- Local

Project Goals

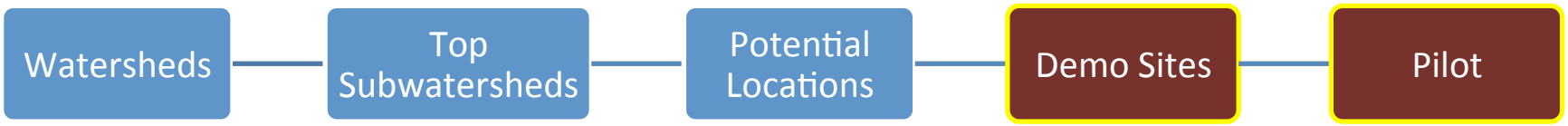
1. Confirm technology appropriate
2. Select the two best locations for pilot projects

Permeable Reactive Barriers in Falmouth, MA



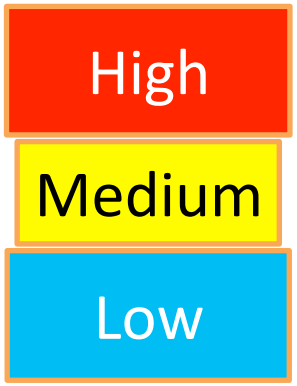
Site Selection Framework

- Two areas of town (W. Falmouth; South Coast)
- Watersheds to top subwatersheds
- Top subwatersheds to potential PRB locations
- Potential PRB locations to three demonstration sites
- Three demonstration sites to one pilot project

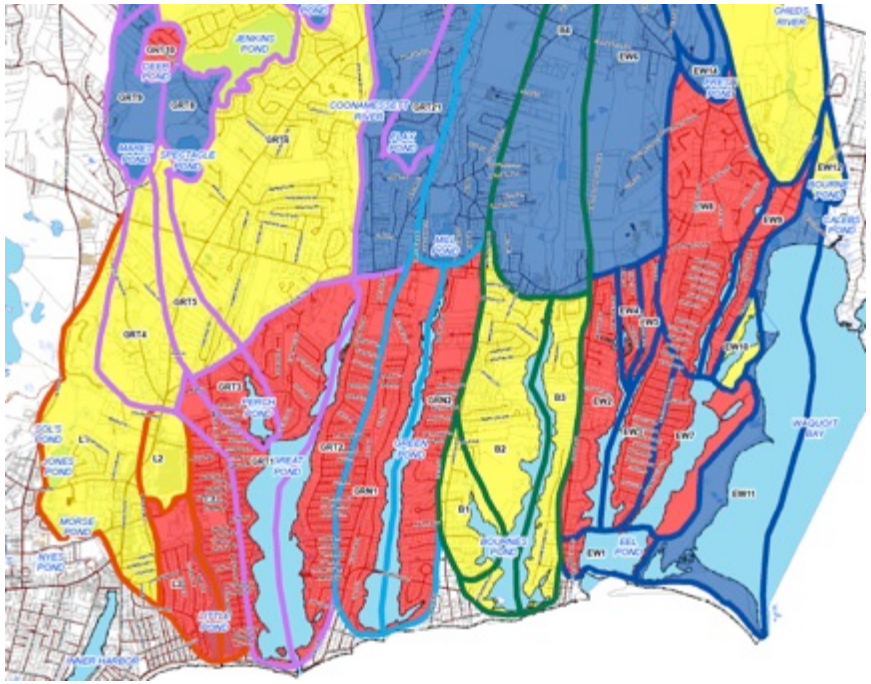


Screening Step 1

- Step 1 criteria (watersheds to top subwatersheds)
  - Existing land use density
    - Parcels per square mile
  - Depth to groundwater
  - *Depth to groundwater (W. Falmouth)*
  - Vertical extent of nitrate contaminated GW



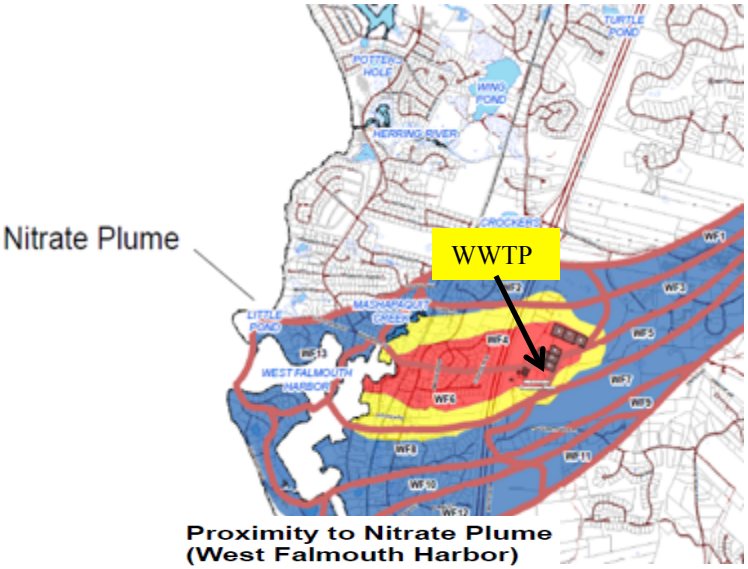
Groundwater Nitrogen Concentrations
Simulated via Housing Density



Parcels per Square Mile of Subwatershed Area (Ponds/Estuaries)

- >1000
- 500 - 1000
- < 500

Nitrogen Concentrations in Groundwater

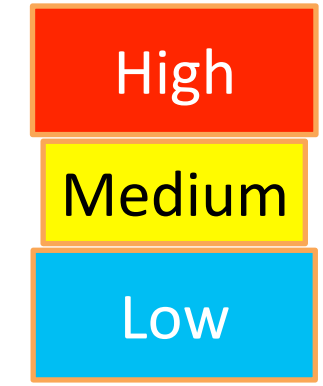


Proximity to Nitrate Plume (West Falmouth Harbor)

- Core
- Fringe
- Outside

Screening Step 2

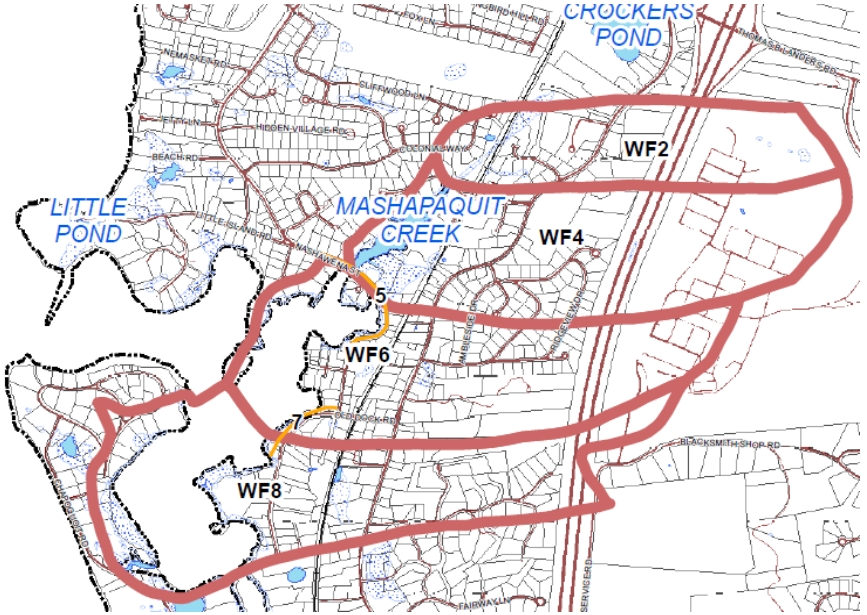
- Step 2 criteria (Top subwatersheds to potential PRB locations)
  - Property ownership
  - Availability of data and monitoring locations
  - Water use
  - Proximity to nitrogen attenuating Mashapaquit Creek (W. Falmouth)
  - Potential Funding/Collaboration opportunities
- Screened down from 15 sites to 8



Potential PRB Pilot Sites

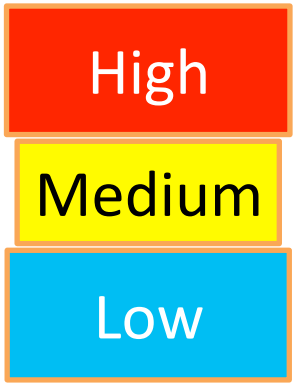
South Coastal Facing Watersheds

West Falmouth



Screening Step 3

- Step 3 criteria (Prioritization of selected locations)
  - Site Accessibility
  - Applicability to other sites
  - Potential for utility conflicts
  - Ease of monitoring
  - Expansion potential
  - Potential Total Maximum Daily Load (TMDL) Credit
  - Permitting Requirements
- Criteria currently being analyzed



Next Steps

- Prioritization of the selected sites
- 4 potential demonstration sites
  - 3 south coast
  - 1 W. Falmouth
- Preliminary design
- To seek funding Fall 2013/Spring 2014
- Final design

Conclusion

- PRBs have potential for application in Falmouth, MA
- Need for long-term full scale installation data
- Prove to regulatory agencies that PRBs are feasible option

Take Away Message

✓Falmouth will identify a plan to include costs using proven technologies and applicable laws to meet water quality standards !

✓The Town will determine project phasing and scheduling based upon affordability, logistical constraints and adaptive management !

Reality happens to be , like a landscape possessed of an infinite number of perspectives all equally veracious and authentic. The sole false perspective is that which claims to be the only one there is .

Jose Ortegay Gasset

Questions

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