Comprehensive Environmental Incorporated

Yarmouth MASSACHUSETTS

Design and Construction of Resilient Stormwater BMPs

to

Address Climate Change and Improve Water Quality

A Case Study – Yarmouth MA

New England Water Environment Association (NEWEA) Conference –
"Enhancing Stormwater Resilience in the Built Environment"

May 7, 2018

Presentation Overview

- **Climate Change**
  - Impacts
  - What it means for stormwater
- **Yarmouth's Approach**
  - Climate change resiliency
  - Water quality pollutant remediation
- **Project Examples**
  - Roadside design and construction
  - End-of-pipe design
- **Upcoming Projects**
  - Localized groundwater flooding
- **Lessons Learned**

Climate Change Impacts

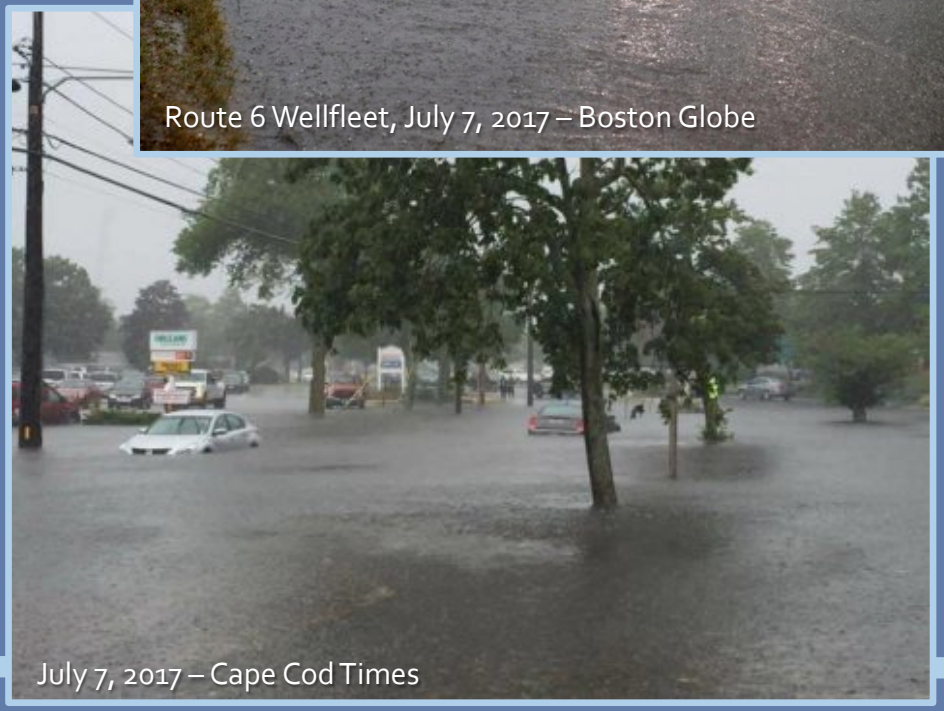
- **Higher Temperatures**
- **Bigger Storms, More Often**
  - More intense rainfall events
  - Stronger winds
  - More stream bank erosion
- **Rising Sea Levels and GW**
  - Bigger storm surge
  - More flooding
  - More property inundation
  - Salt water intrusion
- **Vegetation Sensitivity**
- **More Stormwater!**

Stormwater Climate Change Challenges

- **More Rainfall**
  - Higher peak flows and more volume
- **Sea Level Rise**
  - Less places to put stormwater
- **Higher Groundwater**
  - Less room for infiltration

Translation: More Stormwater

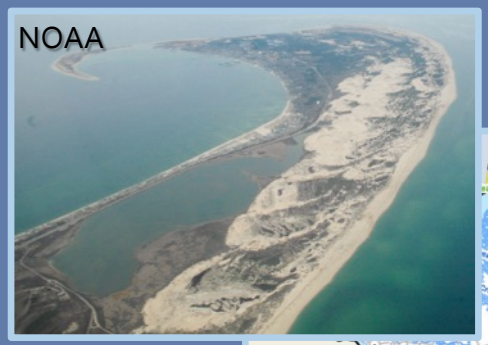
Route 6 Wellfleet, July 7, 2017 – Boston Globe

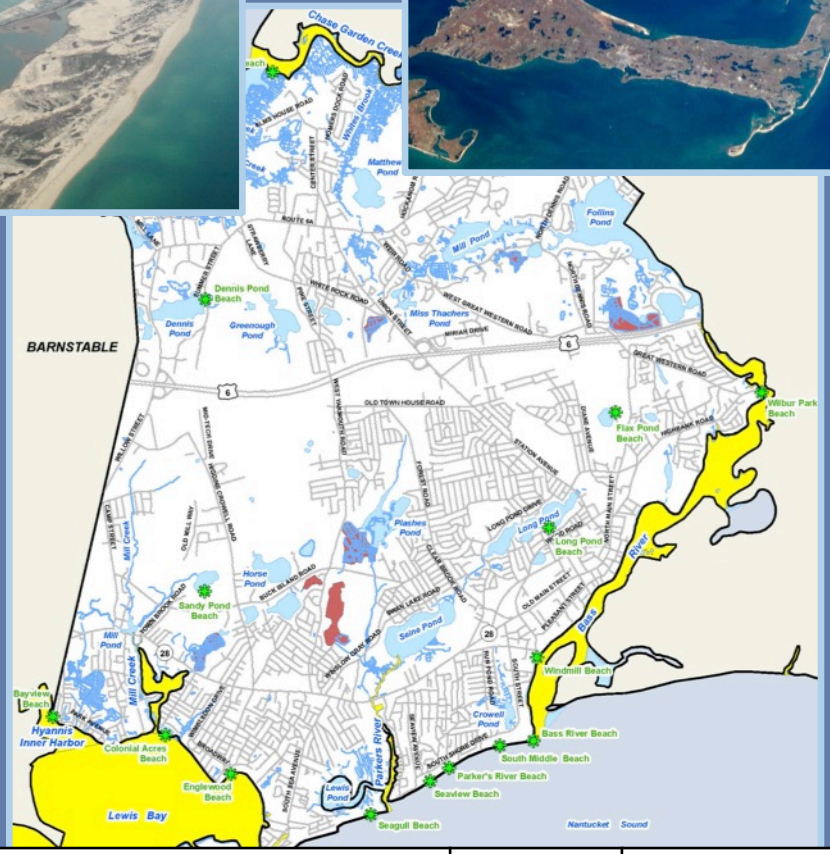

July 7, 2017 – Cape Cod Times


Falmouth, July 7, 2017 – Cape Cod Times

Cape Cod

- **Very Susceptible to Climate Change**
- **Very Sandy Soils**
  - Isolated systems; leaching structures
  - Good infiltration & less runoff
  - Poor N removal, flows subsurface
  - Septic system contributions
- **Nitrogen Impacts**
  - Algae blooms (eutrophication)
  - Low dissolved oxygen, fish kills
- **Fecal Coliform (Bacteria)**
  - Sickness / illness, beach closures
- **Tourism! Can't Close Beaches**

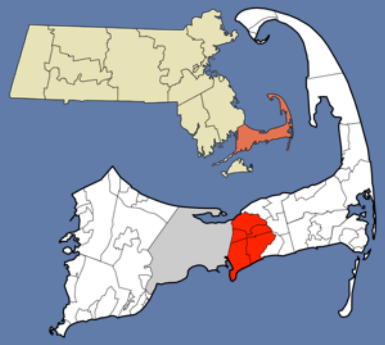




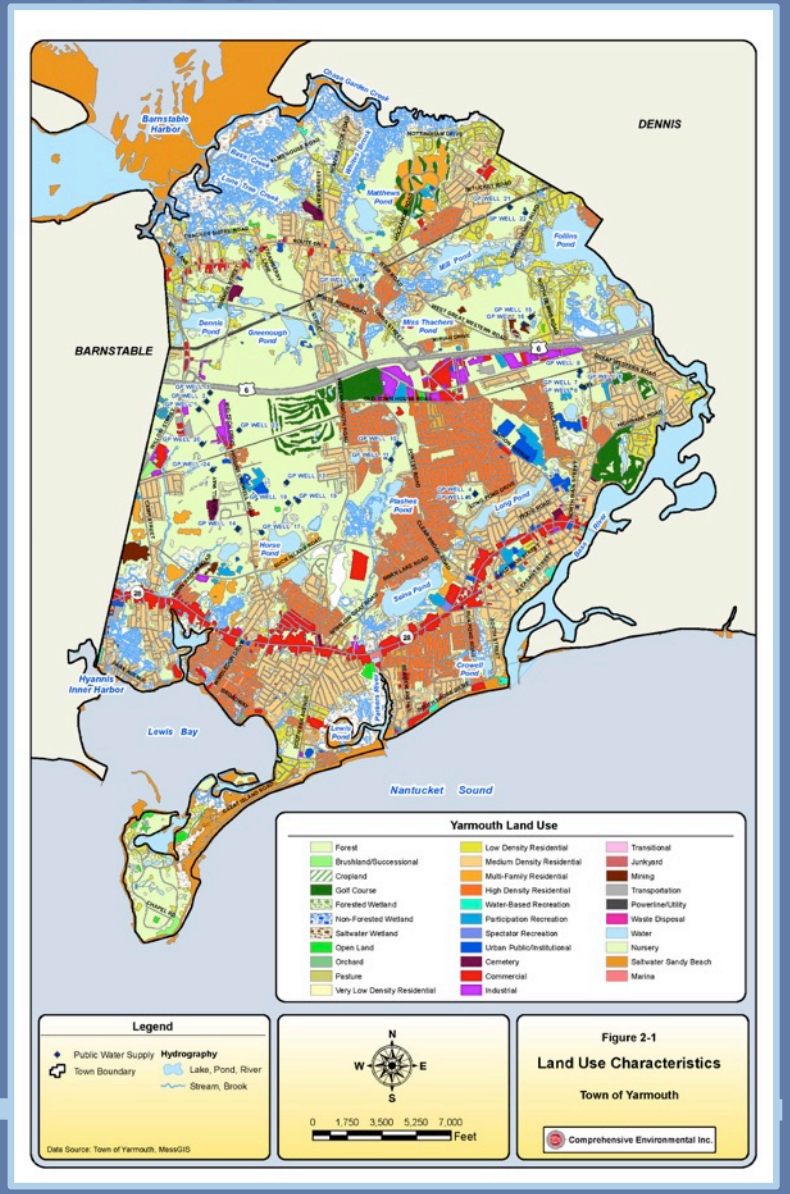
Yarmouth's TMDLs	Fecal	Nitrogen
Parkers River	X	X (draft)
Bass River	X	X (draft)
Hyannis Inner Harbor	X	X
Lewis Bay	X	X
Mill Creek	X	X
Chase Garden Creek	X	

Background, Yarmouth Mass.

- **Population:** 23,793 people
  - Triples in summer months
- **Land: (sq. mi): 25.3, 4.5 impervious**
  - Forest: 35%
  - Residential: 33%
  - Water: 20%
  - Comm/indust: 7%
  - Other: 5%



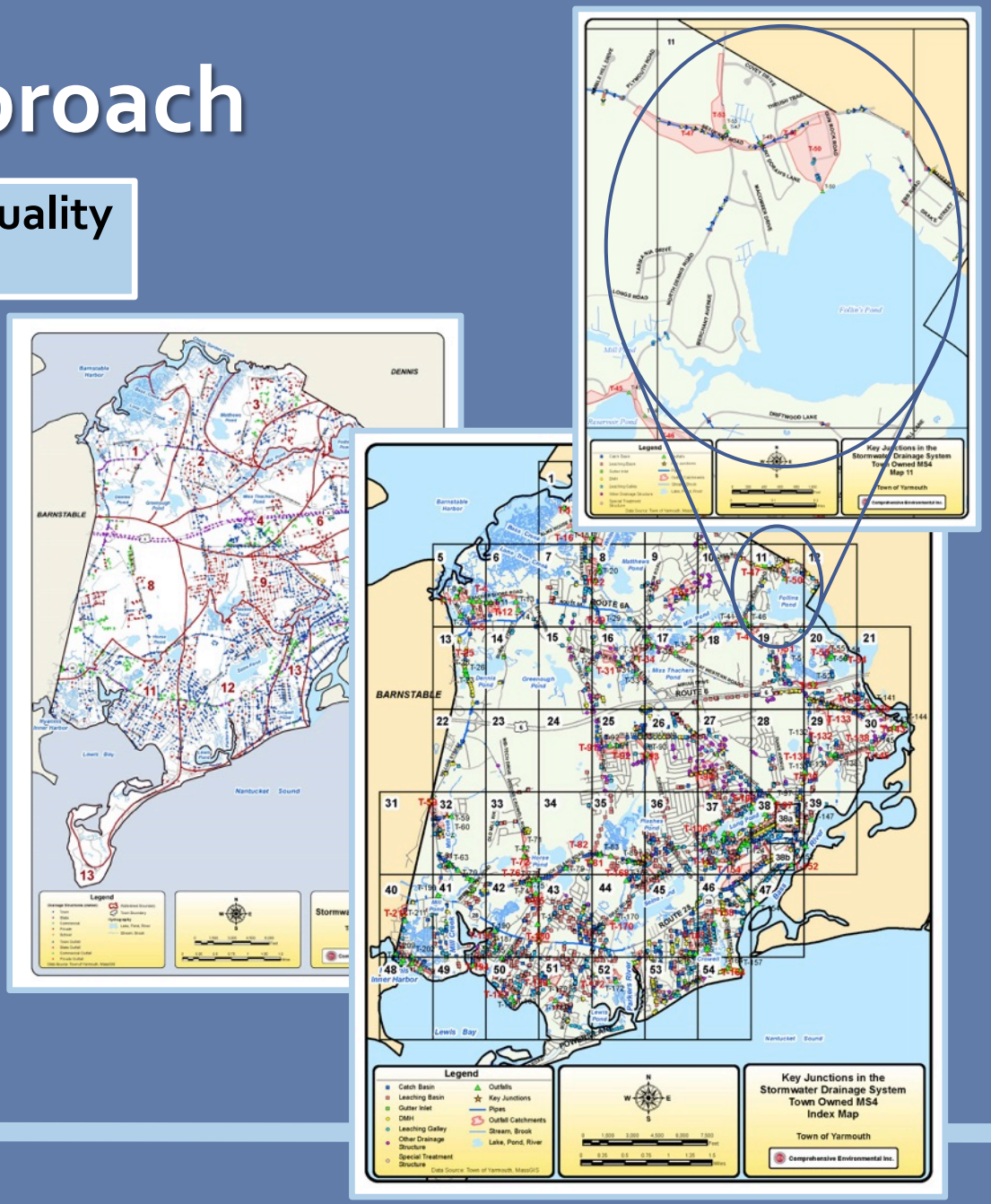
- **Infrastructure**
  - 162 known stormwater outfalls
  - 100% onsite septic
  - 1,000+ leaching structures!



Yarmouth's Approach

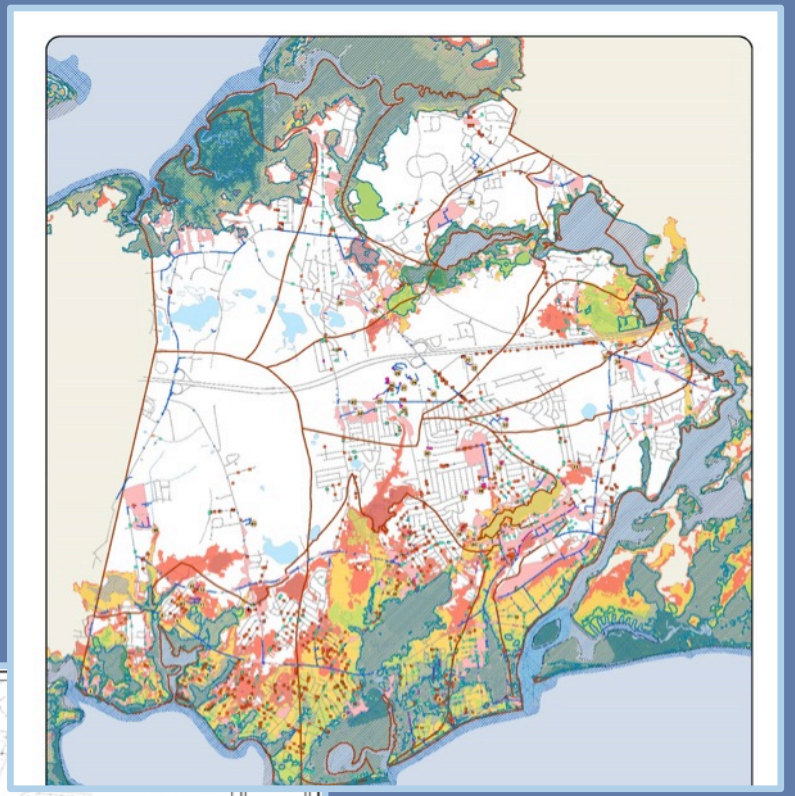
<u>Overall Goal</u>: Improve Water Quality & Address Climate Change

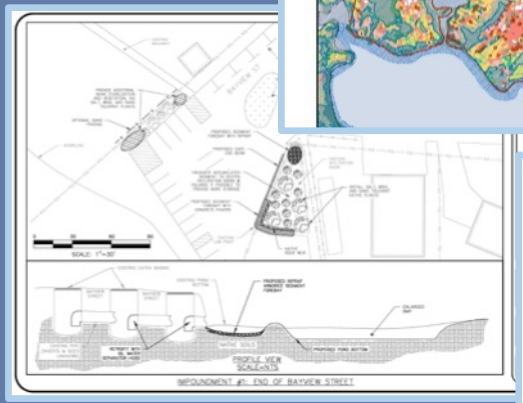
- **Where to Begin?**
  - Prioritize!
- **2 Grant Programs, Mass. Office of Coastal Zone Management (CZM)**
  1. Climate Change Resiliency
  2. Coastal Pollutant Remediation
- **Multi-Year Approach**

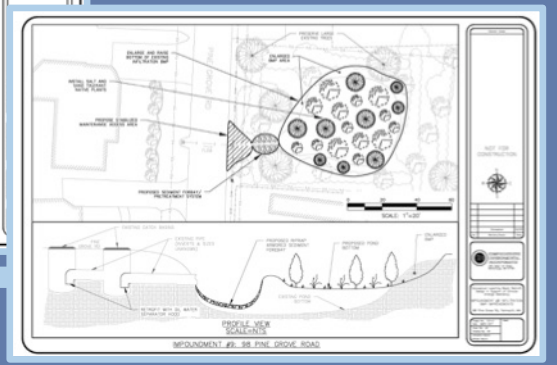


Climate Change Resiliency Grant

- **Existing BMP Retrofit Opportunities**
- **<u>Phase 1</u>, Desktop GIS Prioritization**
  1. Hurricane SLOSH zones
  2. AE 100-year flood zone
  3. VE velocity zone
  4. Sea level rise inundation
- **<u>Phase 2</u>, Field Assess and Feasibility**
- **<u>Phase 3</u>, Conceptual BMPs**
  1. End-of-pipe
  2. Roadside
  3. Leaching basin retrofit



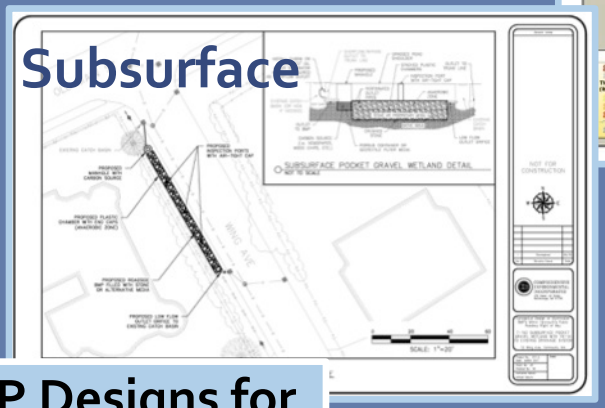




<u>Goals</u>: Different BMP Designs for High Priority Sites

Coastal Pollutant Remediation Grant

- 115 Outfall Catchments
- Phase 1, Desktop GIS Prioritization
  1. Nitrogen and bacteria concentrations
  2. Discharge location – impaired waters
  3. Catchment size
- Phase 2, Field Assess and Feasibility
- Phase 3, Conceptual BMPs
  1. End-of-pipe
  2. Subsurface
  3. Roadside



Goals: Different BMP Designs for Implementation at Multiple Sites

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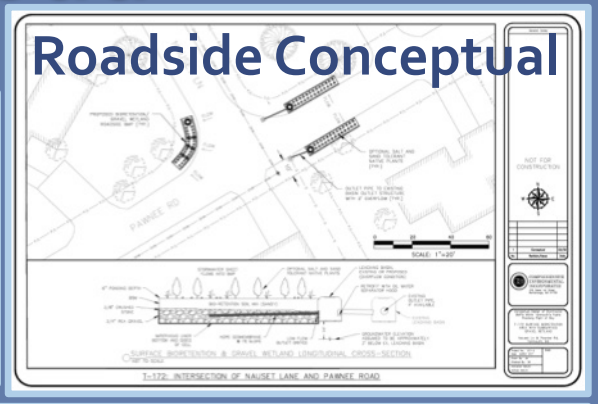
Recent Projects

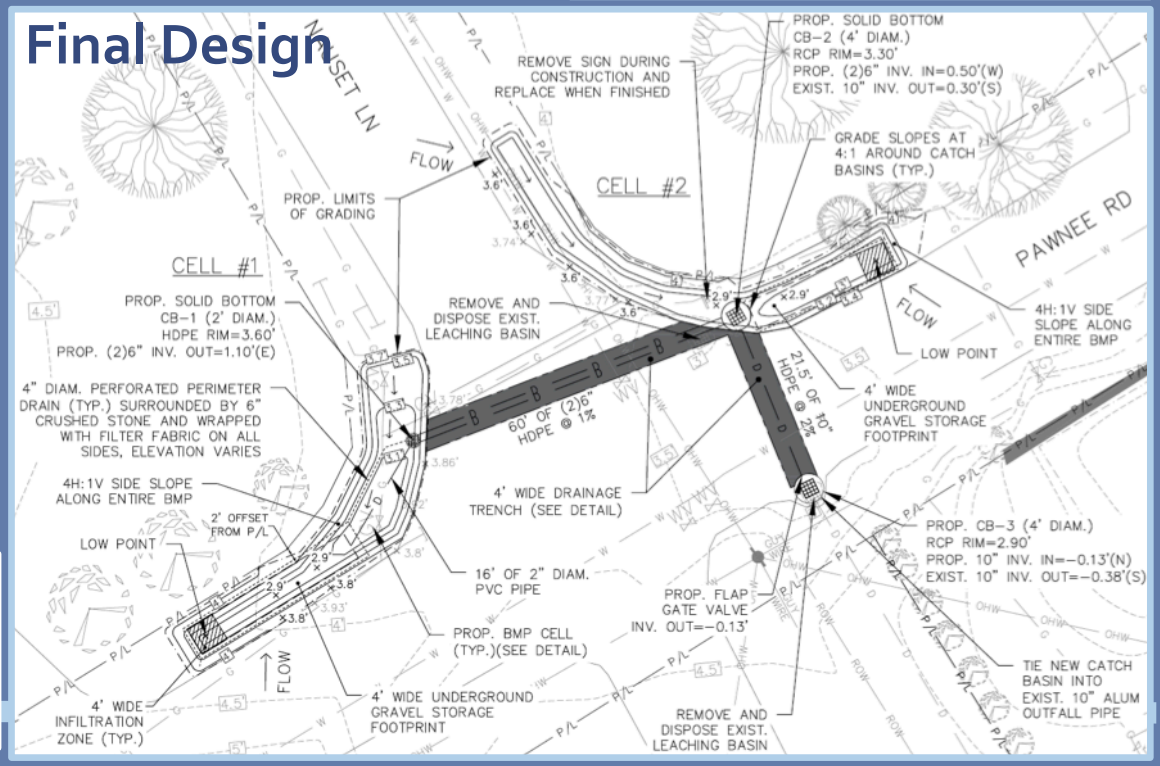
New England Water Environment Association (NEWEA) Conference –
"Enhancing Stormwater Resilience in the Built Environment"

May 7, 2018

Roadside BMP – Pawnee Road

- **Challenges**
  - Limited ROW
  - Very flat area
  - Shallow groundwater <1’ deep
- **Design Solutions:**
  - Subsurface gravel wetland – functionality
  - Surface bioretention – aesthetics
  - Minimize maintenance





<u>Goals</u>: Treat Stormwater, Address Climate Change, Inexpensive, Easy to Build

Roadside BMP – Pawnee Road

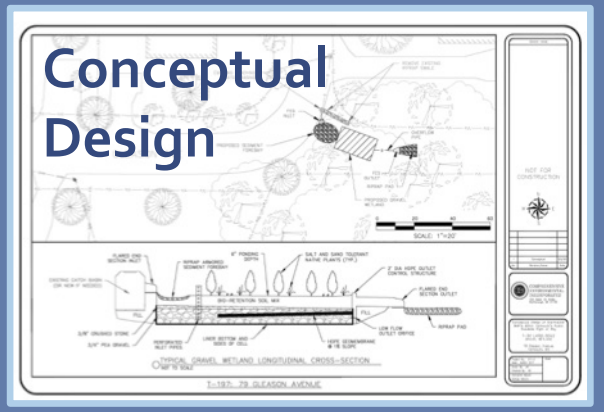
- Lined trench – no groundwater intrusion
- Filters, not infiltrating – better N removal

- Treatment largely below ground
- Can be constructed as part of roadway work

- Blends to existing grade
- Maintained by residents, not town
- Less resource burden

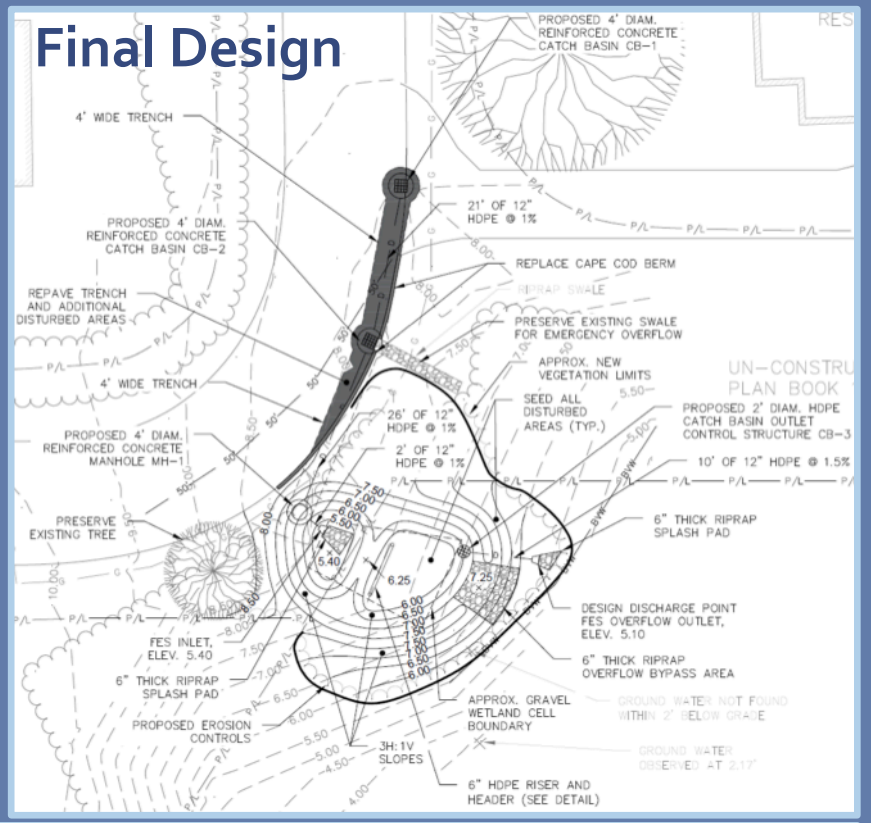
End-of-Pipe BMP – Gleason Avenue

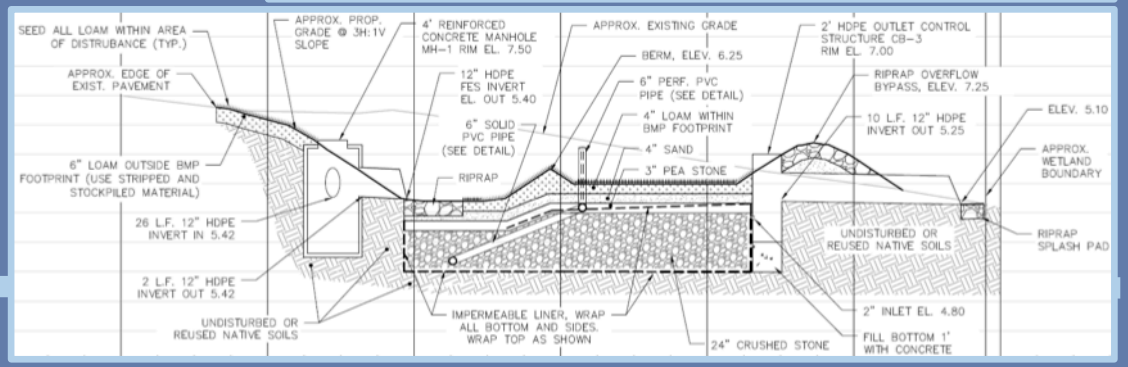
- **Challenges**
  - Abuts wetland area – permitting
  - Moderately high groundwater
  - Limited property availability – "paper" road
  - Large contributing catchment, ~4.4 acres



End-of-Pipe BMP – Gleason Avenue

- **Design Solutions**
  - Sediment forebay (pretreatment)
  - Subsurface gravel wetland – allows for rising groundwater
  - Surface bioretention area – provides for aesthetics
  - Use of design, bypass, and emergency overflows – controls larger storms
  - Optional salt-tolerant plants
- **Construction – Fall 2018**





Goals: Minimize Environmental Impacts, Treat Stormwater, Address Climate Change

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Upcoming Projects

Localized Groundwater Flooding

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Mulford Street

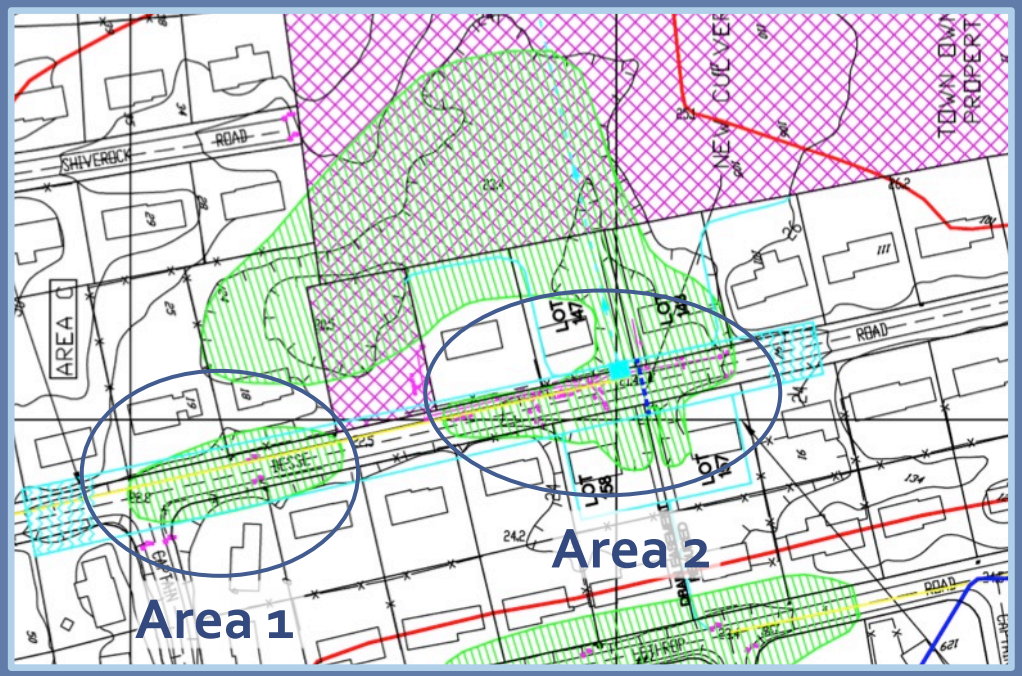
- **Challenges**
  - Abuts an isolated wetland area
  - Receives substantial offsite drainage
  - Street floods 2+ feet deep!

Mulford Street

- **Appear to be Options Available**
- **Needs Careful Design**
  - Create berm from isolated wetland area – houses may still flood
  - Lift road – good, but need to match driveway grades
  - Direct surface water to nearby low spot
  - Loss of flood storage
- **Don't push flood problems to somewhere else**

Captain Besse Road

- **Challenges**
  - Very flat area
  - Close to houses – sump pumps
  - Floods spots in the road
  - High groundwater means can't infiltrate



Captain Besse Road

- **Ideas?**
  - Pump groundwater – high aquifer transmissivity means endless water
  - Lift road – road may be okay, but houses?
  - Direct surface water away – to where?
  - Buy house(s) and create basin – $$$
  - Do nothing approach – may be viable here

- **This One's Tough!**
  - Maybe next year's conference

Observations and Lessons Learned

- **Climate Change and Water Quality are Related**
- **Prioritization Makes Best Use of Resources**
- **Creative Design = More Options**
  - Handling groundwater is critical
  - Evaluate permitting early, make sure you can construct
  - Think beyond infiltration and detention
  - Treating small storms is okay
- **Doing Something is Better than Doing Nothing**
- **Be Proactive!**

Town of Yarmouth
Cape Cod.
Within Reach.

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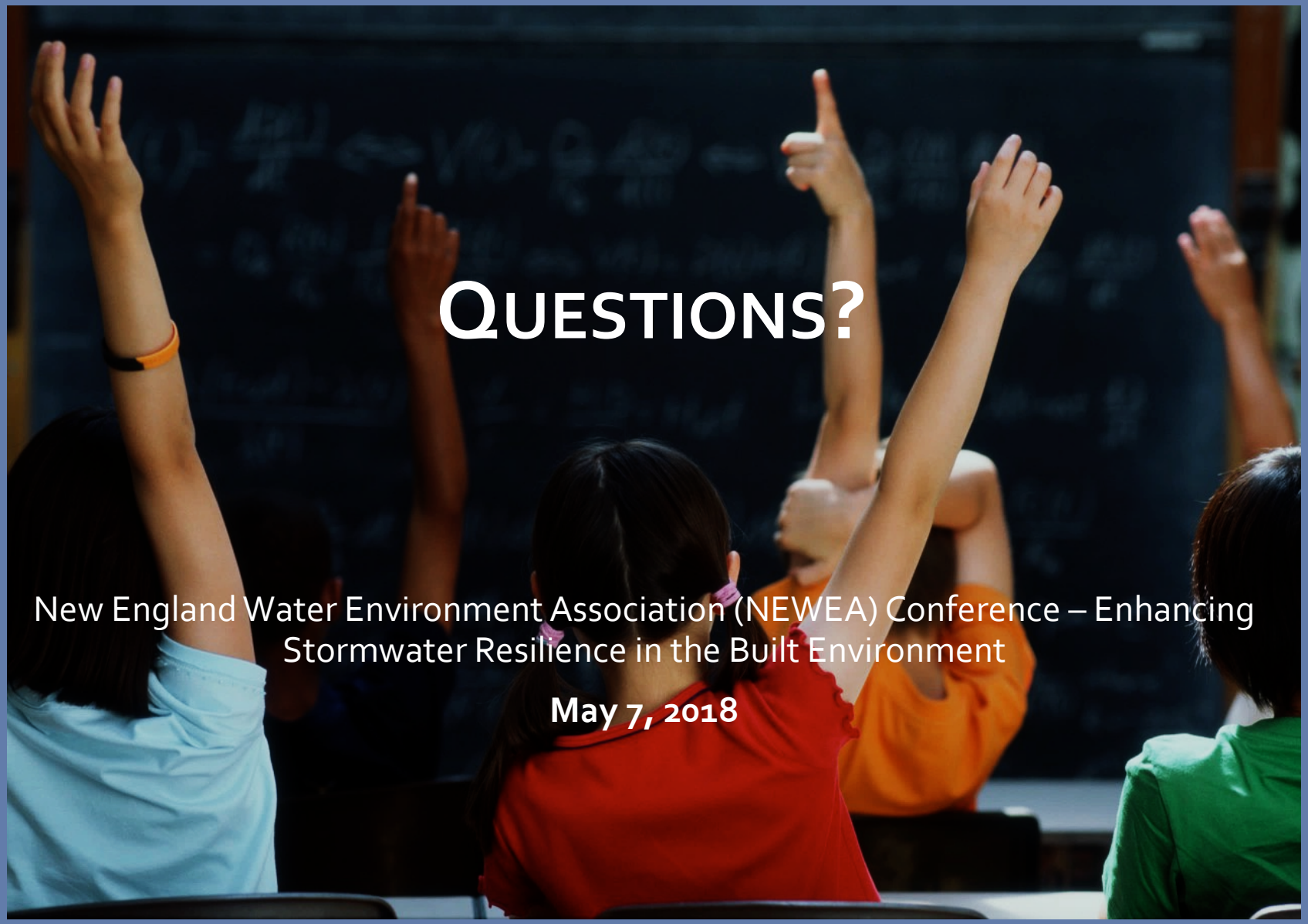


QUESTIONS?

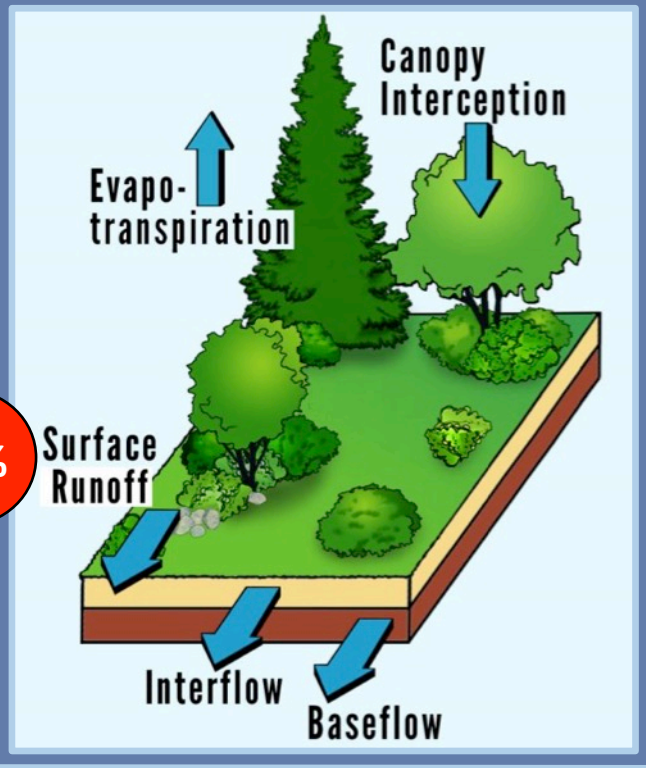
New England Water Environment Association (NEWEA) Conference – Enhancing Stormwater Resilience in the Built Environment

May 7, 2018

What is Stormwater?

- **In short, water that runs off during precipitation events**

Natural Conditions: forests and soils absorb most of it



Developed Conditions: impervious areas create much more runoff