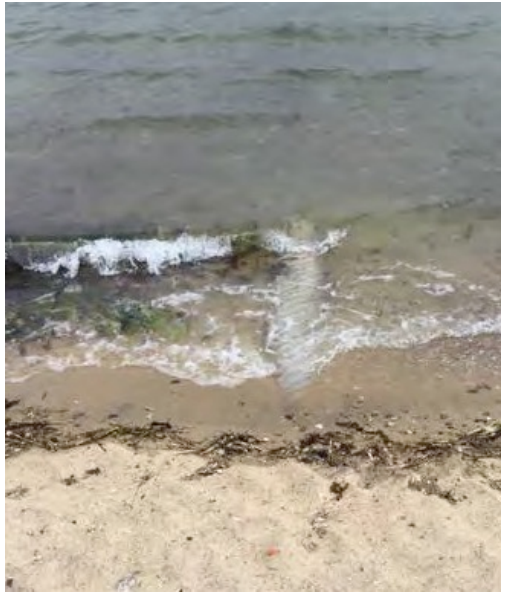
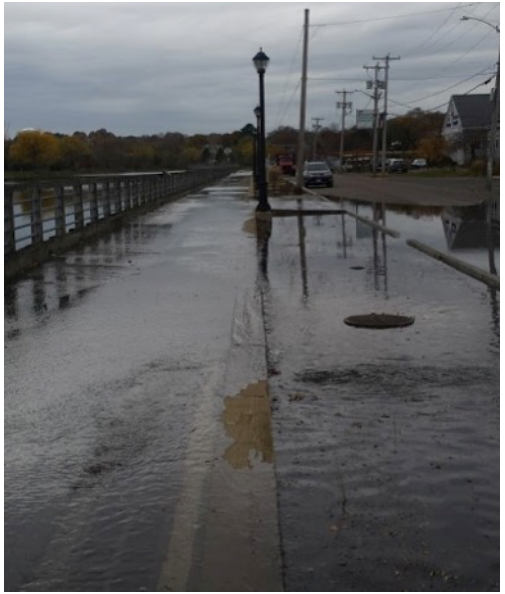
Climate Change Impacts on Stormwater Best Management Practices (BMPs) and Recommended Design Considerations





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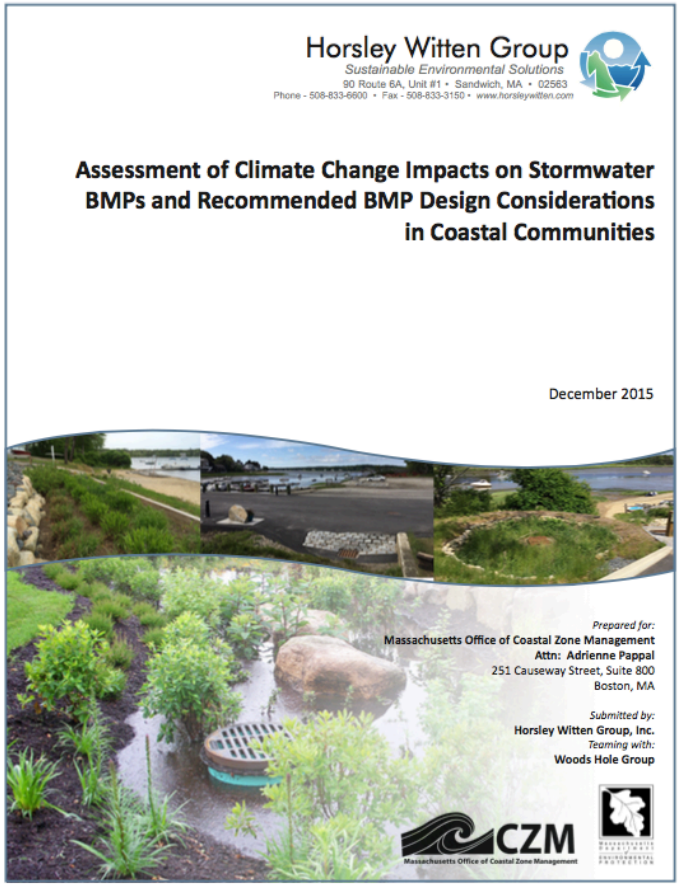
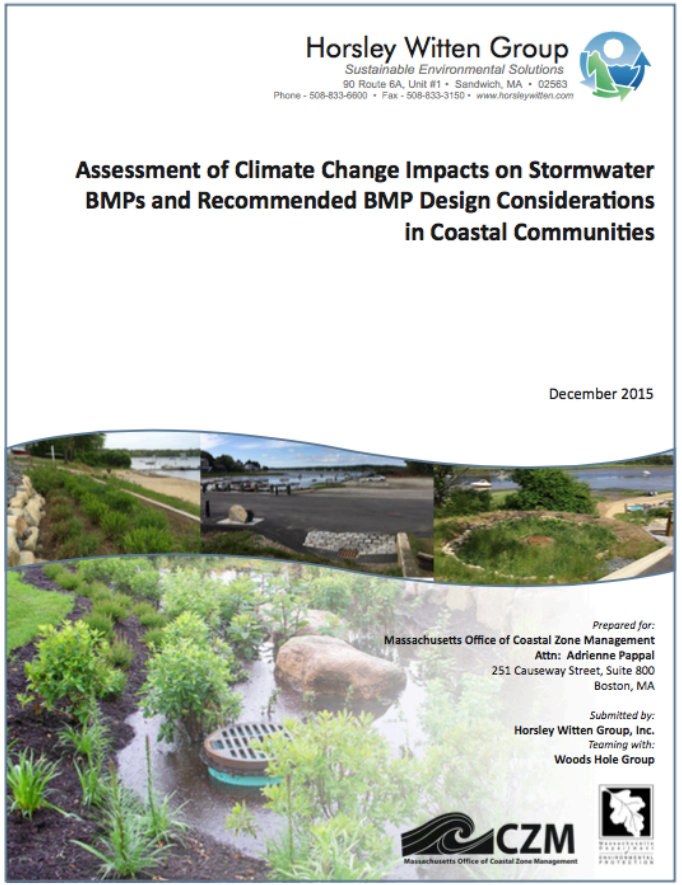
Creating Resilient Infrastructure & Watershed Specialty Conference
July 12, 2017
Lowell, MA



Assessment of Climate Change Impacts on Stormwater BMPs and Recommended BMP Design Considerations in Coastal Communities

Report available at: http://www.mass.gov/eea/agencies/czm/program-areas/coastal-water-quality/cpr/climate-change-stormwater-bmps.html

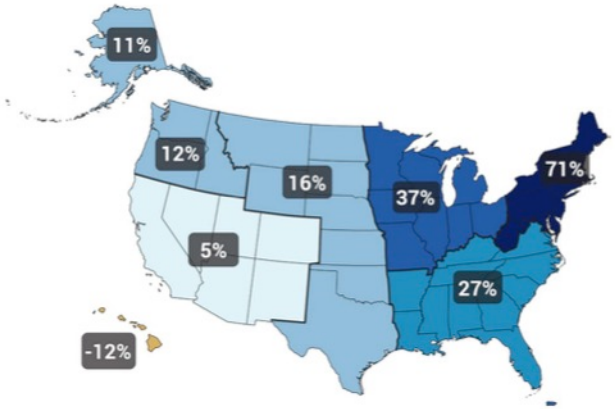


Talk Outline

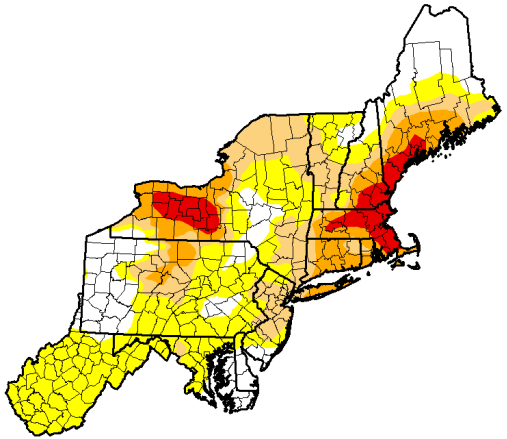
- Climate change impacts
- Field assessments
- BMP vulnerabilities
- Design recommendations and examples
- Pilot grant example

Climate Change Impacts

Precipitation and Drought

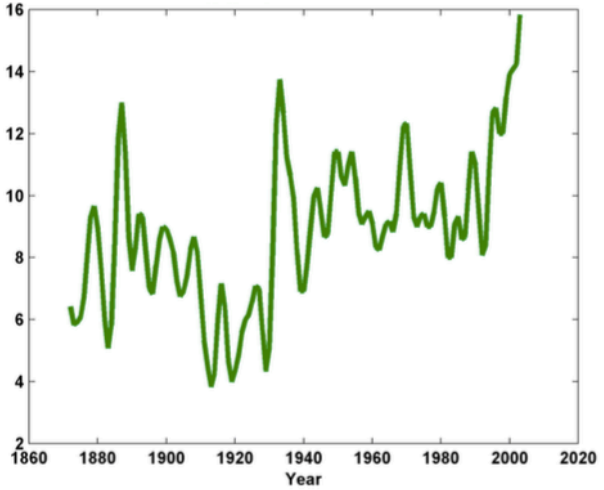


1958-2012
Heavy downpours % increase
Karl *et al*. 2009



September 2016
NE drought conditions
US Drought Monitor

Hurricanes

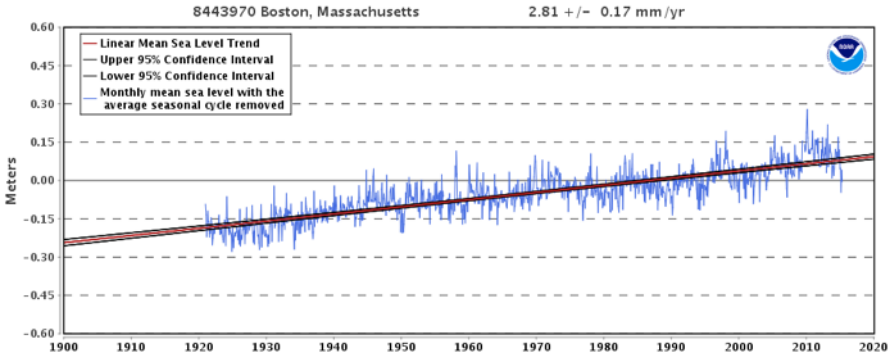


Annual number of hurricanes

Emanuel 2005

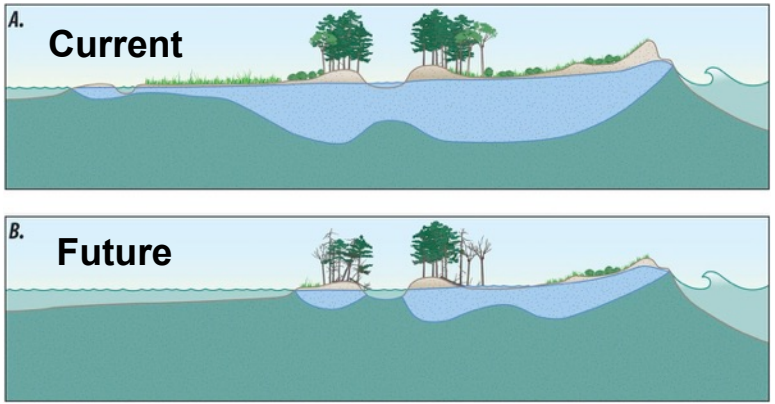
Climate Change Impacts

Sea Level Rise

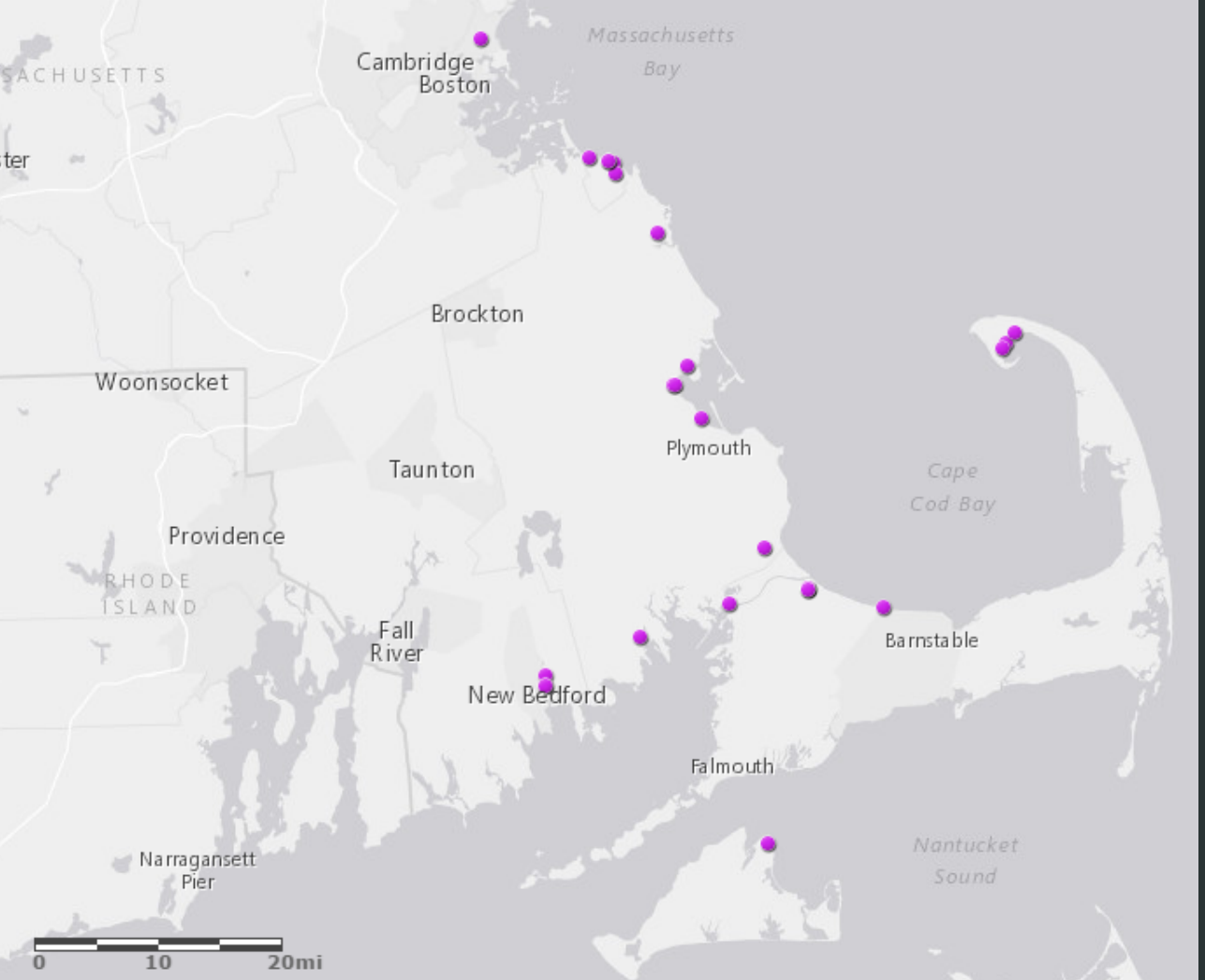


Boston Mean Sea Level (meters) 1900-2013

Groundwater Elevation



Masterson *et al.* 2014



Locations of Stormwater BMPs Assessed

Field Assessments

- 26 BMPs evaluated in spring 2015

- Both green and grey infrastructure

Flood risk projections (Appendix B)

Field Assessments

- BMP type
- BMP condition
- BMP plant health
- Climate change risks
- Signs of storm damage/ flooding
- Shoreline condition
- Outfall condition

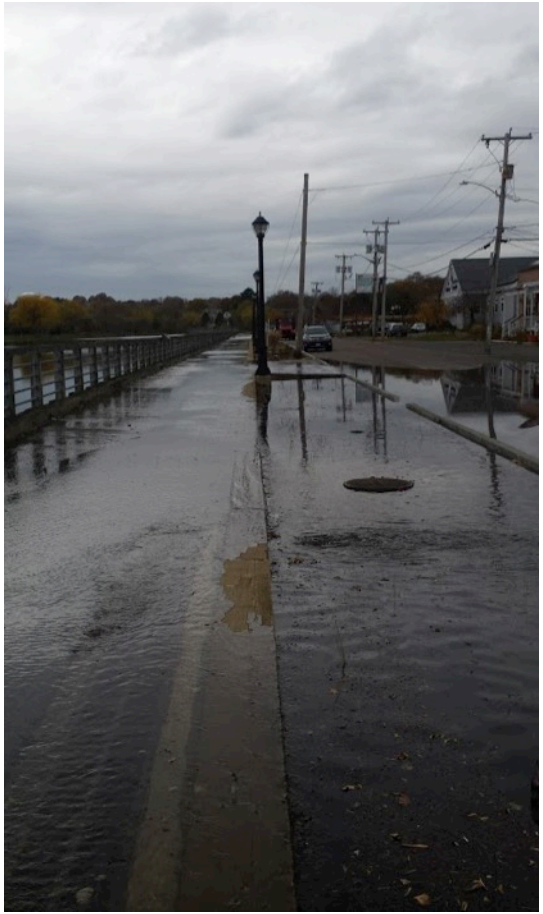
BMP Vulnerabilities to Climate Change

Increased flooding and drought

Rising sea level and submerged outfalls

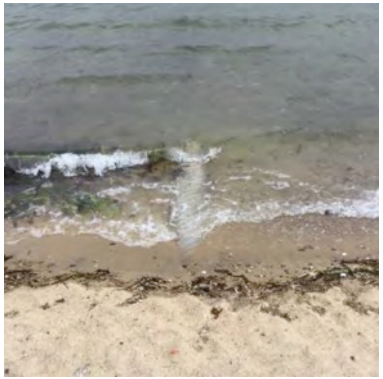
Rising groundwater and shrinking separation distances

Chronic wind, sand and salt exposure



Clogged inlet

Invasives species

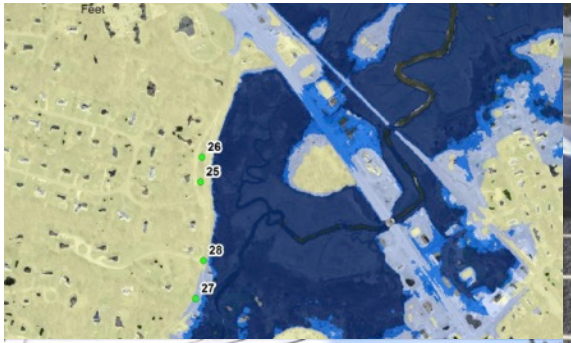


Submerged outfall

Flooded rain garden

Design Recommendations

- Using a 50-year planning horizon
- Proper siting of practices
- Selecting appropriate practices and materials
- Ensuring redundancy and flexibility in design
- Choosing “green” over “grey”
- The importance of maintenance

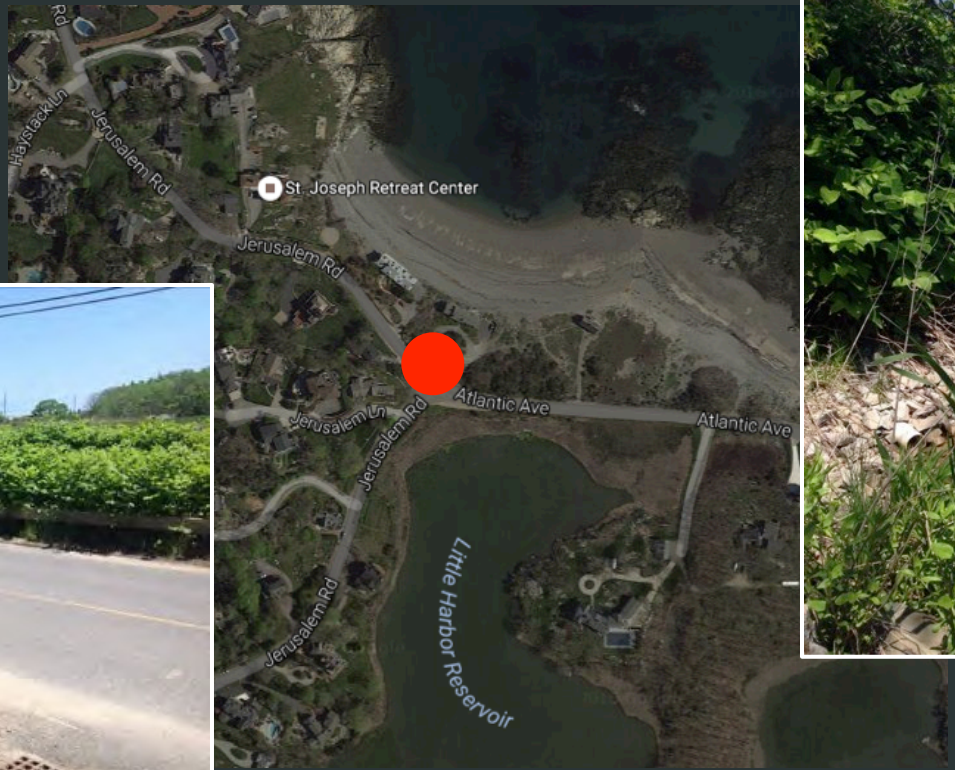


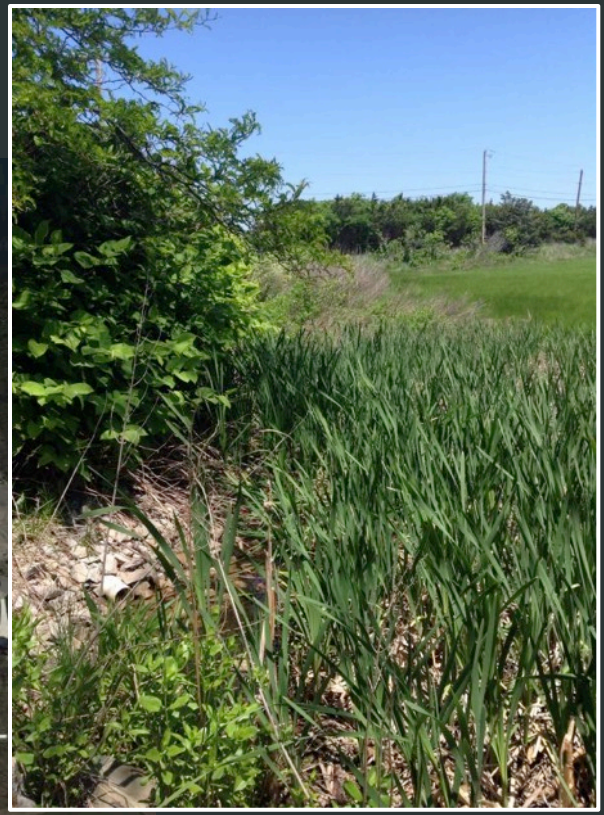
Design Recommendations: Example 1

BMPs:

Stormceptor Unit

Infiltration Basin

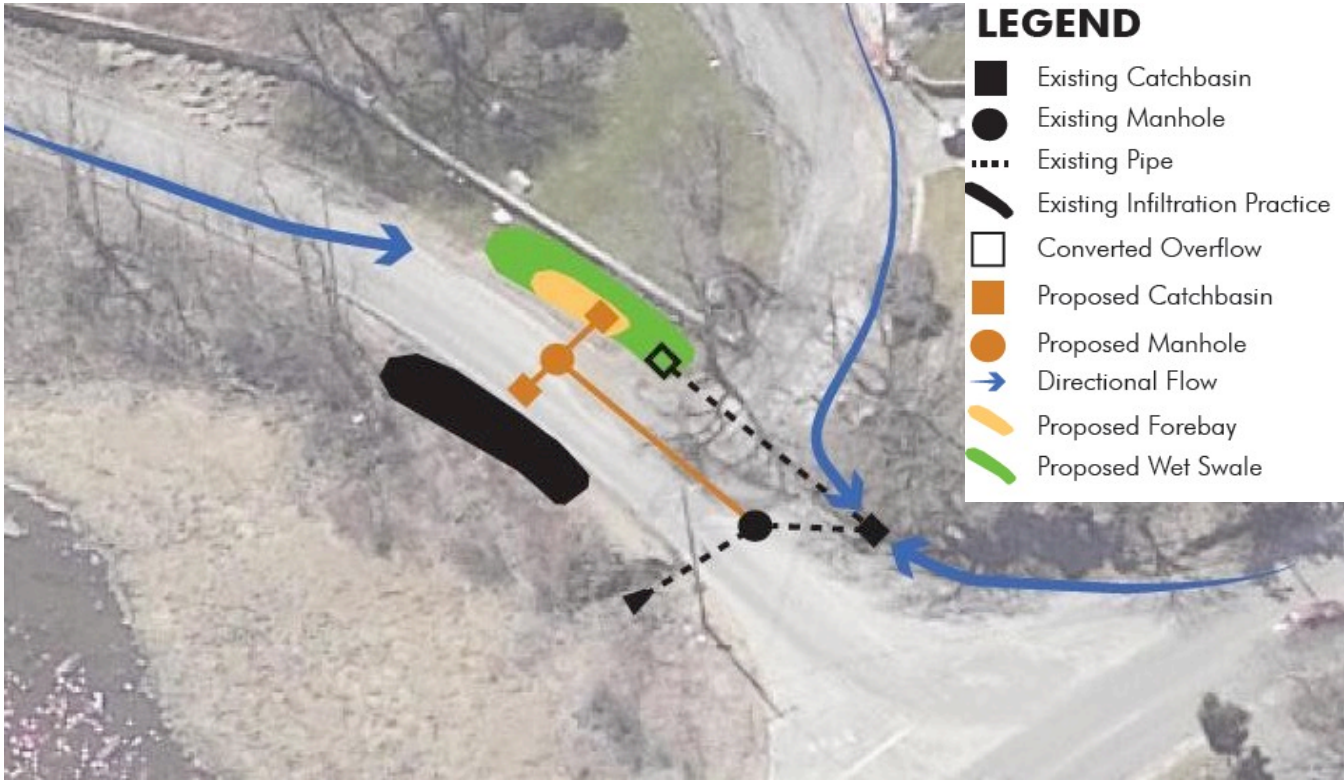




Design Recommendations: Example 1

Vulnerabilities

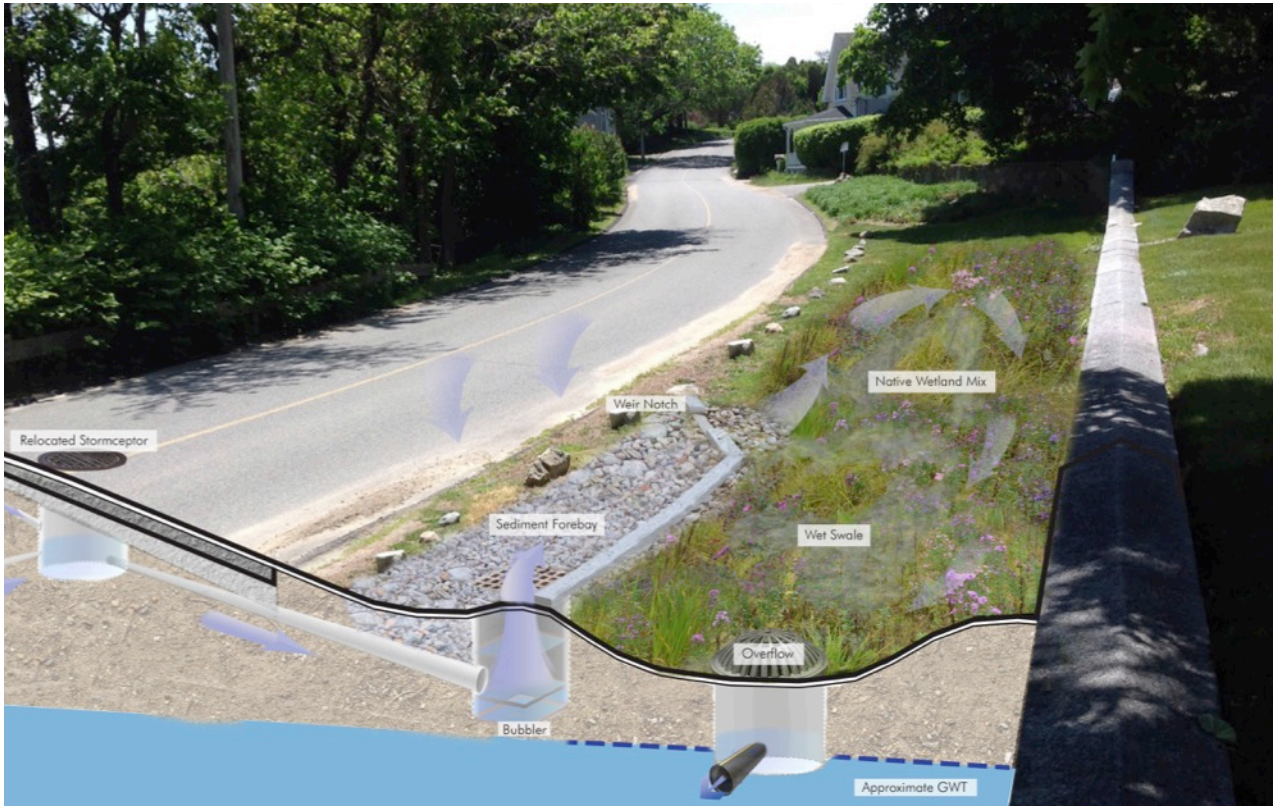
- Relocate BMP
- SLR
- Storm surge
- Rising groundwater
- Wind, sand, salt exposure



Design Recommendations: Example 1

Recommendations

- Relocate BMP
- Enlarged sediment forebay
- Aboveground green BMP



Design Recommendations

Design Recommendations: Example 2

BMPs:
Deep sump catch basins
Rain Gardens

Design Recommendations: Example 2

Vulnerabilities

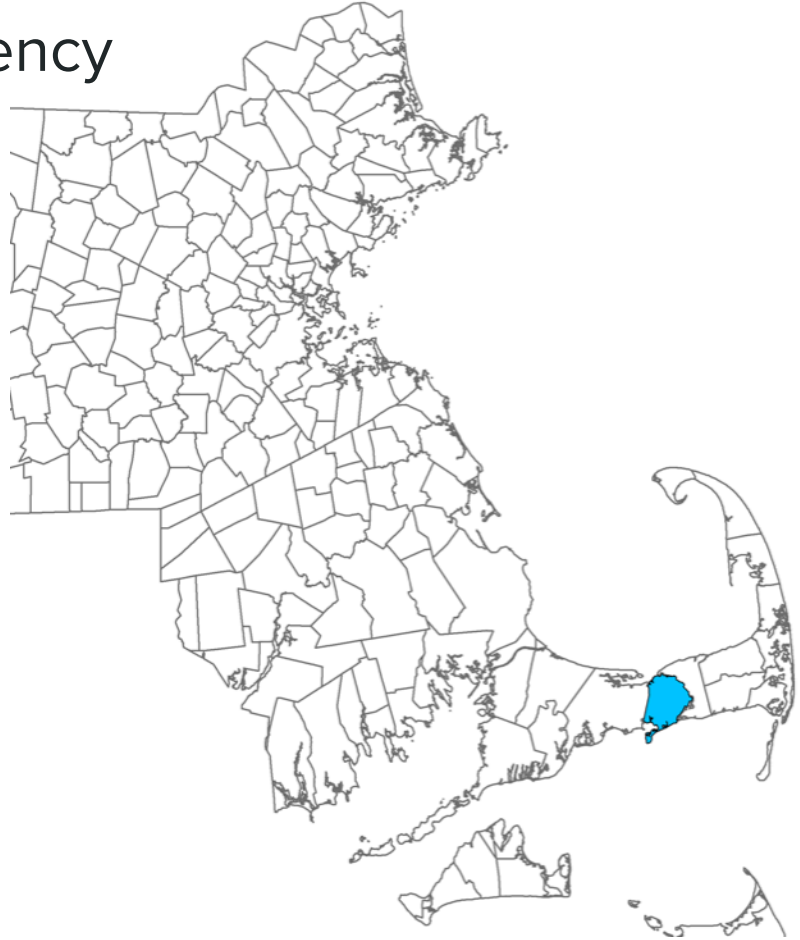
- Wind, salt and sand exposure
- Sand debris clogging

MA CZM 2017 BMP Retrofit Design Pilot Grants

Community	Site Vulnerabilities	Design Recommendations	Water Quality Benefit
Manchester	Flooding from increased precipitation	Porous asphalt parking lot to reduce stormwater volume flow	Reduce sediments and other pollutants entering Smelt spawning habitat
Melrose	Flooding from increased precipitation	Upsized bioretention areas to handle larger volume	Reduce pollutants entering an impaired waterbody
Winthrop	Flooding from increased storms and SLR in an urban area	Upsized piping and treatment chambers, bioretention areas and permeable pavers for infiltration	Reduce pollutants, esp. pathogens discharging to a swimming beach
Yarmouth	**Flooding from increased storms, SLR, and rising groundwater**	**Conversion of infiltration to filtering BMPs, upsized sw storage, shallower infiltration structures**	**Reduce pollutants, esp. pathogens and nutrients to impaired waterbodies**

Yarmouth Project: Assessment & Prioritization of BMPs in Support of Climate Change Resiliency

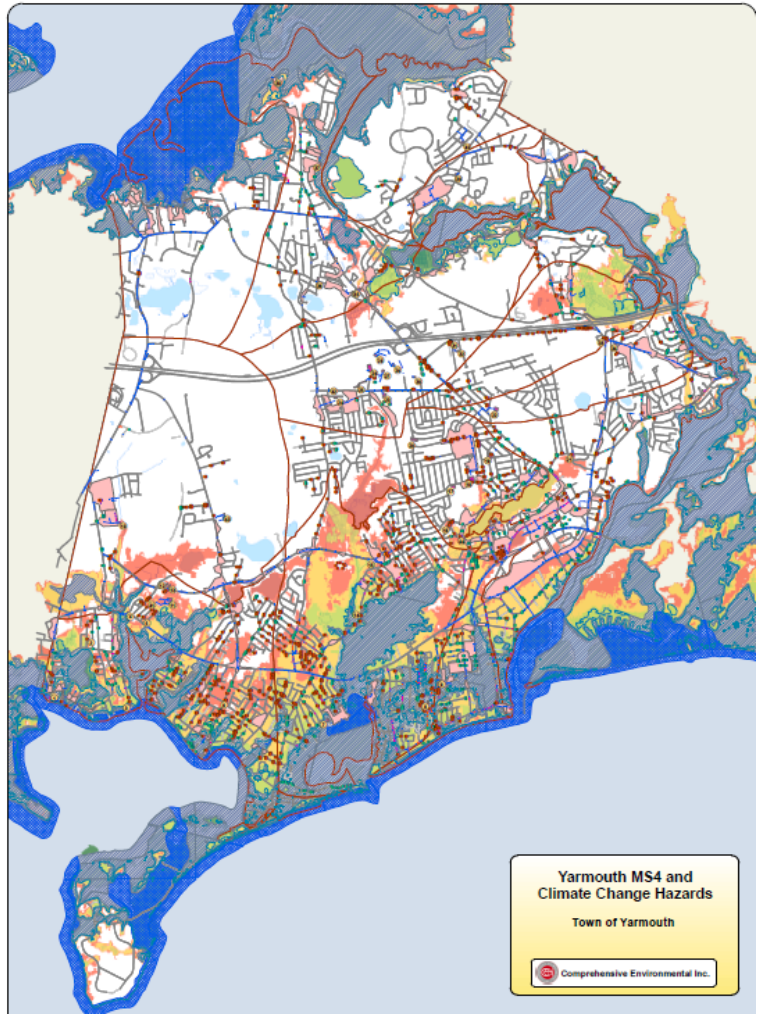
- Evaluate existing BMPs vulnerable to climate change
- Two-part study: desktop GIS and field inspections



Yarmouth Project

Vulnerabilities

- Coastal and inland flooding
- Storm surge from SLR
- Rising groundwater tables
- Wind, salt and sand



Legend

Stormwater Structures
- Leaching Basin
- Leaching Galley
- Special Treatment Structure

Stormwater Drainage
- Pipe
- Leaching Chamber
- Leaching Galley
- Leaching Trench

- Drainage Impounds
- Outfall Catchment Delineations
- Flooding Extent after 6 ft. Sea Level Rise
- AE (100-year flood zone)
- VE (Velocity hazard zone)
- Watersheds
- Stream, Brook
- Lake, Pond, River

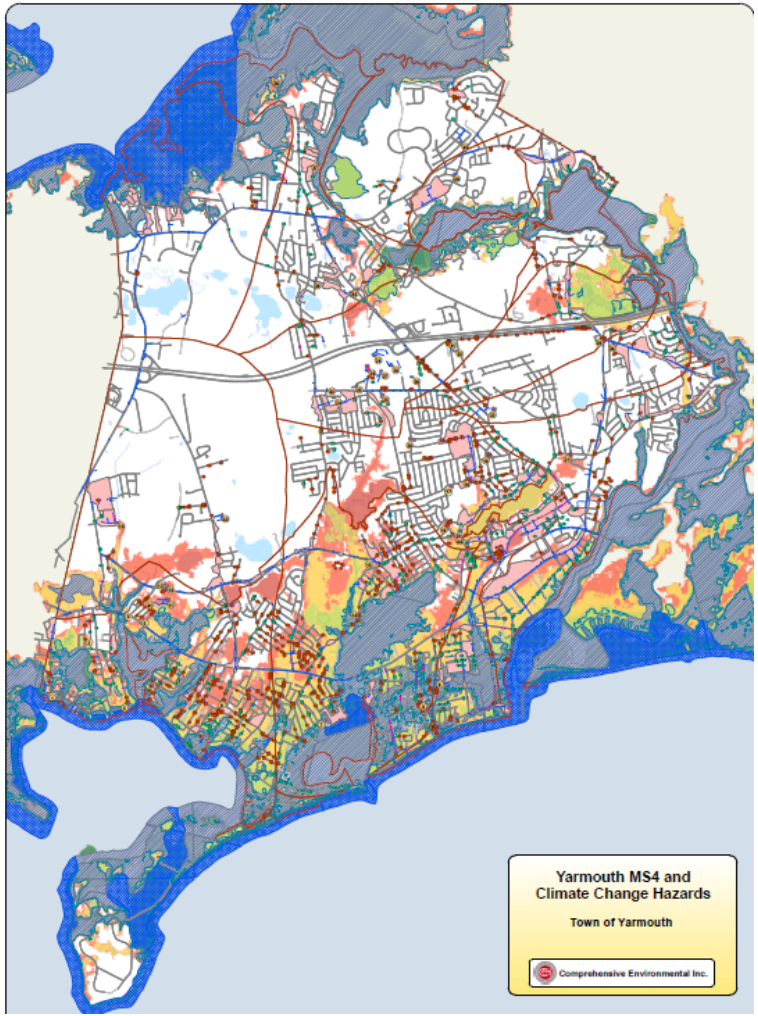
Hurricane Inundation Zones
by Hurricane Category
- 1
- 2
- 3
- 4

Data Source: Town of Yarmouth, MassGIS, FEMA, NOAA

Yarmouth Project

Desktop GIS Evaluation (21 BMPs)

Evaluation Criteria	Points
Inundation during Hurricane Event	4 points max for Category 1 Hurricane
Located in an AE and/or VE FEMA Flood Zone	2 points each
Sea Level Rise Inundation	3 points max for 2 ft SLR



Yarmouth Project

Field Evaluation & Prioritization (9 BMPs)

Type	Conceptual BMP Description	Candidate Location
End-of-Pipe	Retrofit infiltration impoundment to an aboveground green infrastructure BMP	Impoundment #1
Roadside	Retrofit infiltration impoundment to filtering BMP	Impoundment #9
Leaching Basin	Retrofit leaching catch basin to allow shallower infiltration in high groundwater	Leaching catch-basins town-wide

Yarmouth Project: End-of-Pipe Conceptual Design

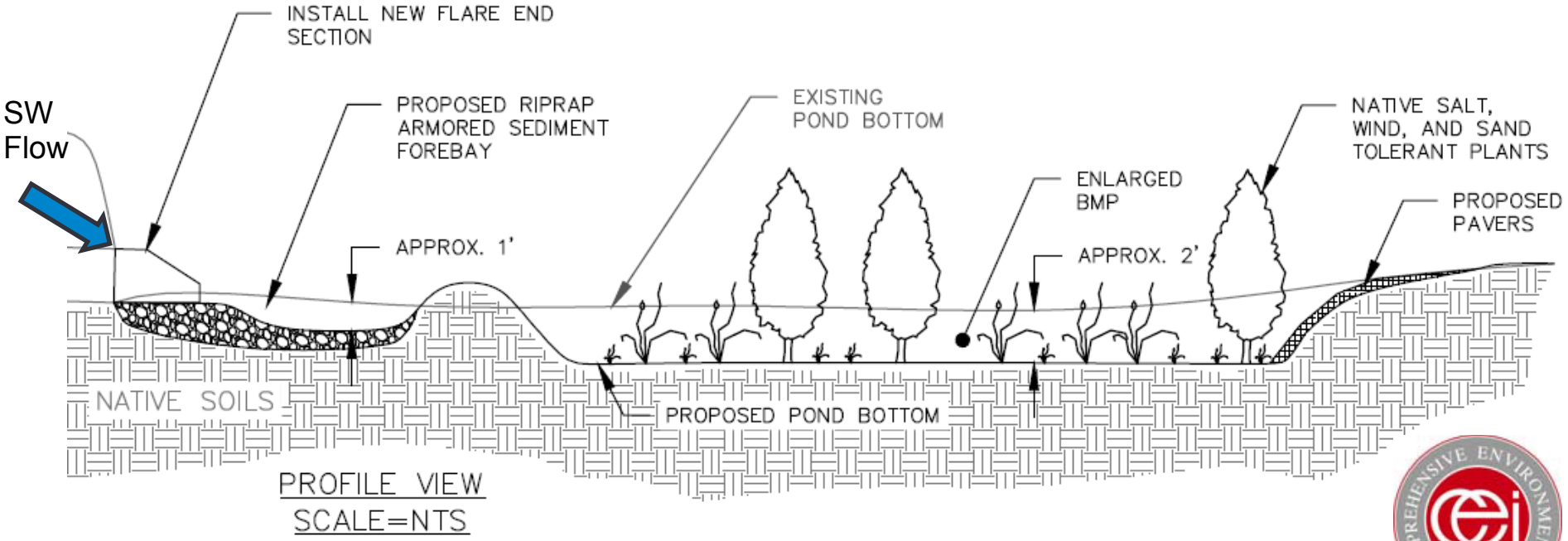
Infiltration Basin (~1500 ft^2)

- Residential area and public beach

Climate Change Impacts

- Sand fill from neighboring beach
- VE flood zone
- Category 1 Hurricane and 2 ft SLR

Yarmouth Project: End-of-Pipe Conceptual Design



Yarmouth Project: Leaching Catch Basin Design

Climate Change Impacts

- Increased flooding
- Decreasing depth to groundwater

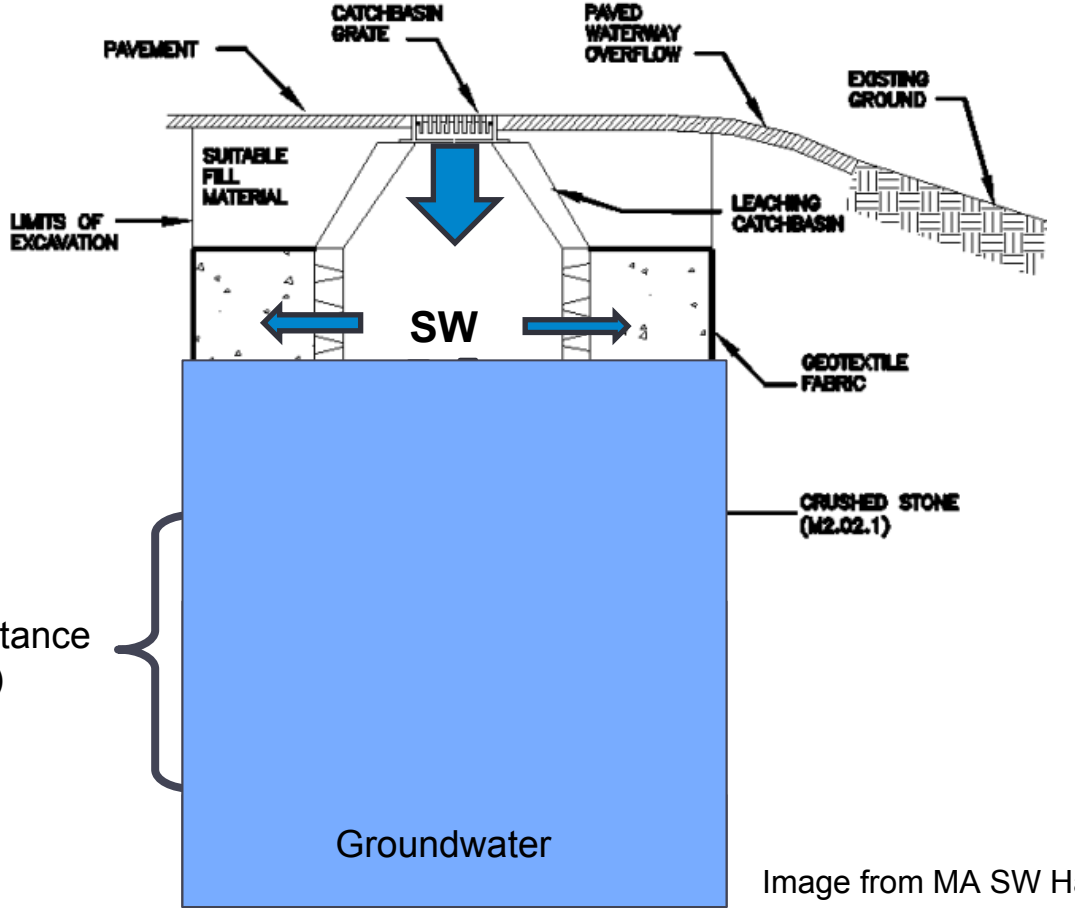
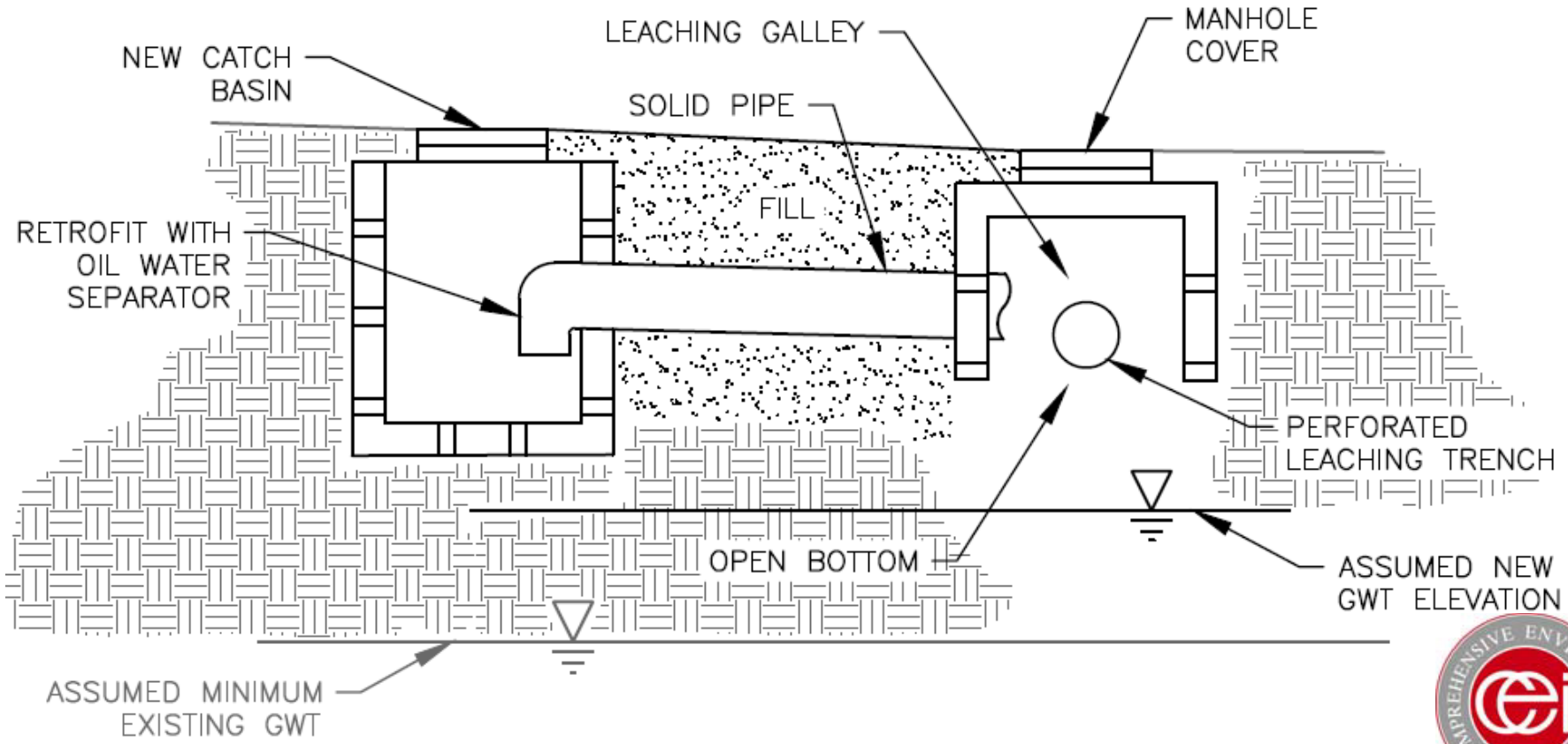
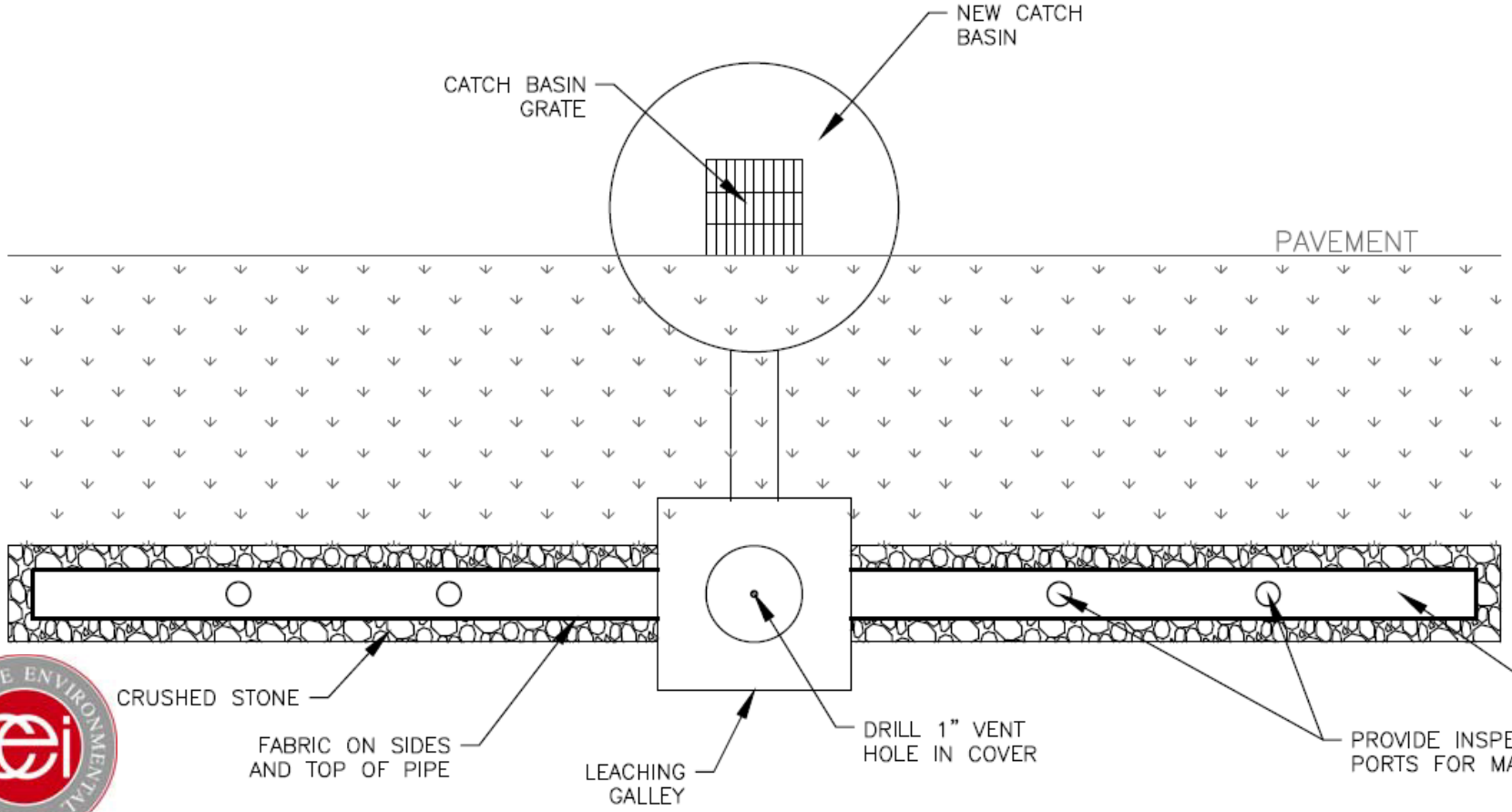


Image from MA SW Handbook

Yarmouth Project: Leaching Catch Basin Design



Yarmouth Project: Leaching Catch Basin Design

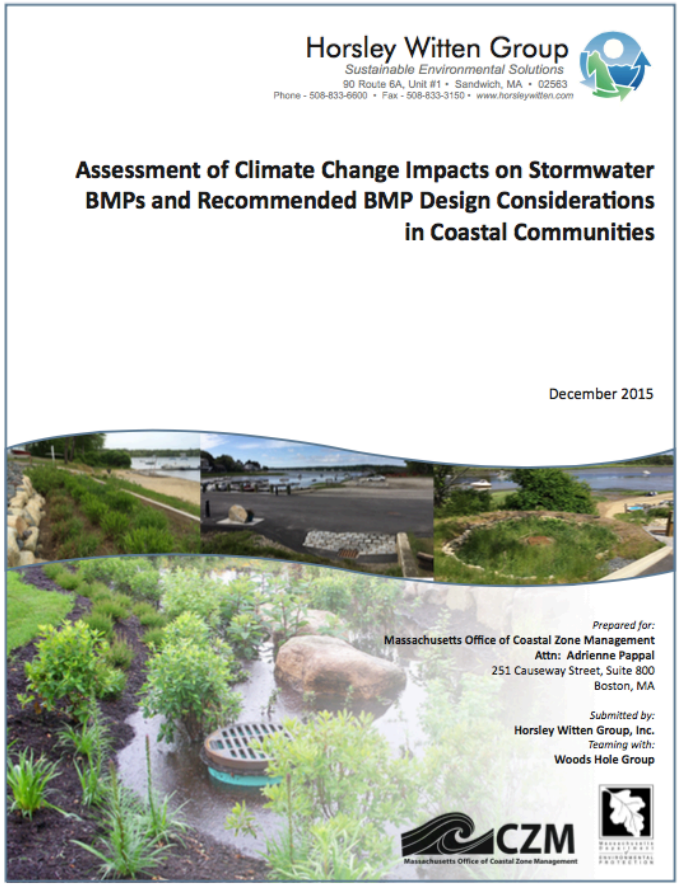


Conclusions

Common sense, practical guidelines

The future is now

MA CZM Coastal Pollutant Remediation Grant



Questions?

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Horsley Witten Group
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Report available at: http://www.mass.gov/eea/agencies/czm/program-areas/coastal-water-quality/cpr/climate-change-stormwater-bmps.html

End Slide Show

Tools for Implementation

BMP Selection

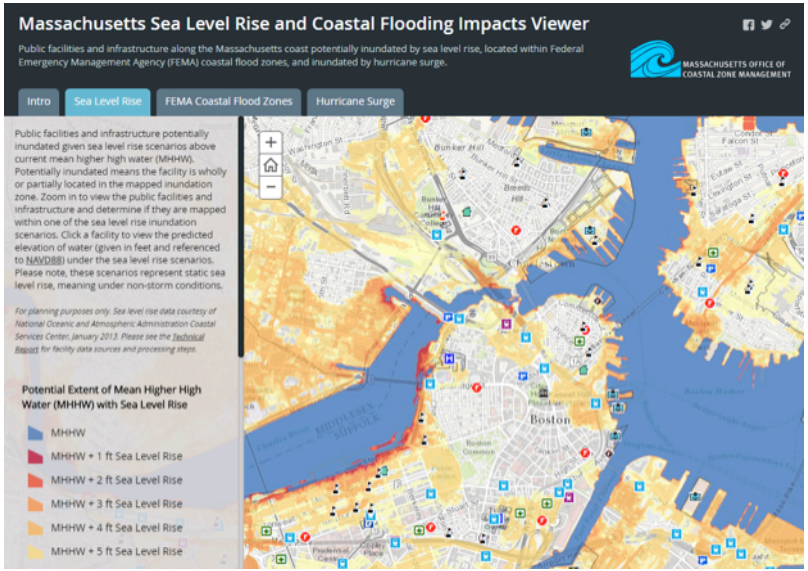
- BSWC Stormwater Best Management Practices: Guidance Documents (urban focus)
- http://www.bwsc.org/ABOUT_BWSC/systems/stormwater_mgt/Stormwater%20BMP%20Guidance_2013.pdf
- EPA and MassBays Green Infrastructure Handbook: http://www.mass.gov/eea/docs/mbp/publications/massbays-green-infrastructure-handbook.pdf

Landscaping Tips

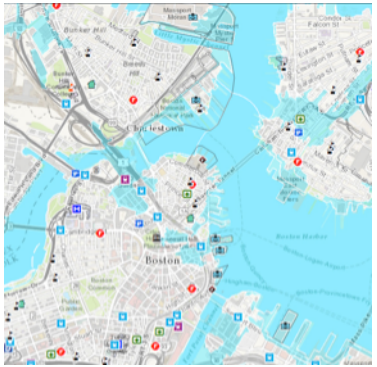
- http://www.mass.gov/eea/agencies/czm/program-areas/stormsmart-coasts/coastal-landscaping/tips.html
- http://ag.umass.edu/landscape/fact-sheets

BMP Coastal Siting

- CZM Sea Level Rise Viewer: http://www.mass.gov/eea/agencies/czm/program-areas/stormsmart-coasts/flooding-impacts-viewer/
- CZM's MORIS: http://www.mass.gov/eea/agencies/czm/program-areas/mapping-and-data-management/moris/
- NOAA's Digital Coast: https://coast.noaa.gov/digitalcoast/topics/coastal-storms.html



CZM Sea Level Rise Viewer



FEMA Flood Zones

Hurricane Surge

References

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