

# Cost Effective Green Infrastructure in the Blackstone River Watershed

Project Workshop  
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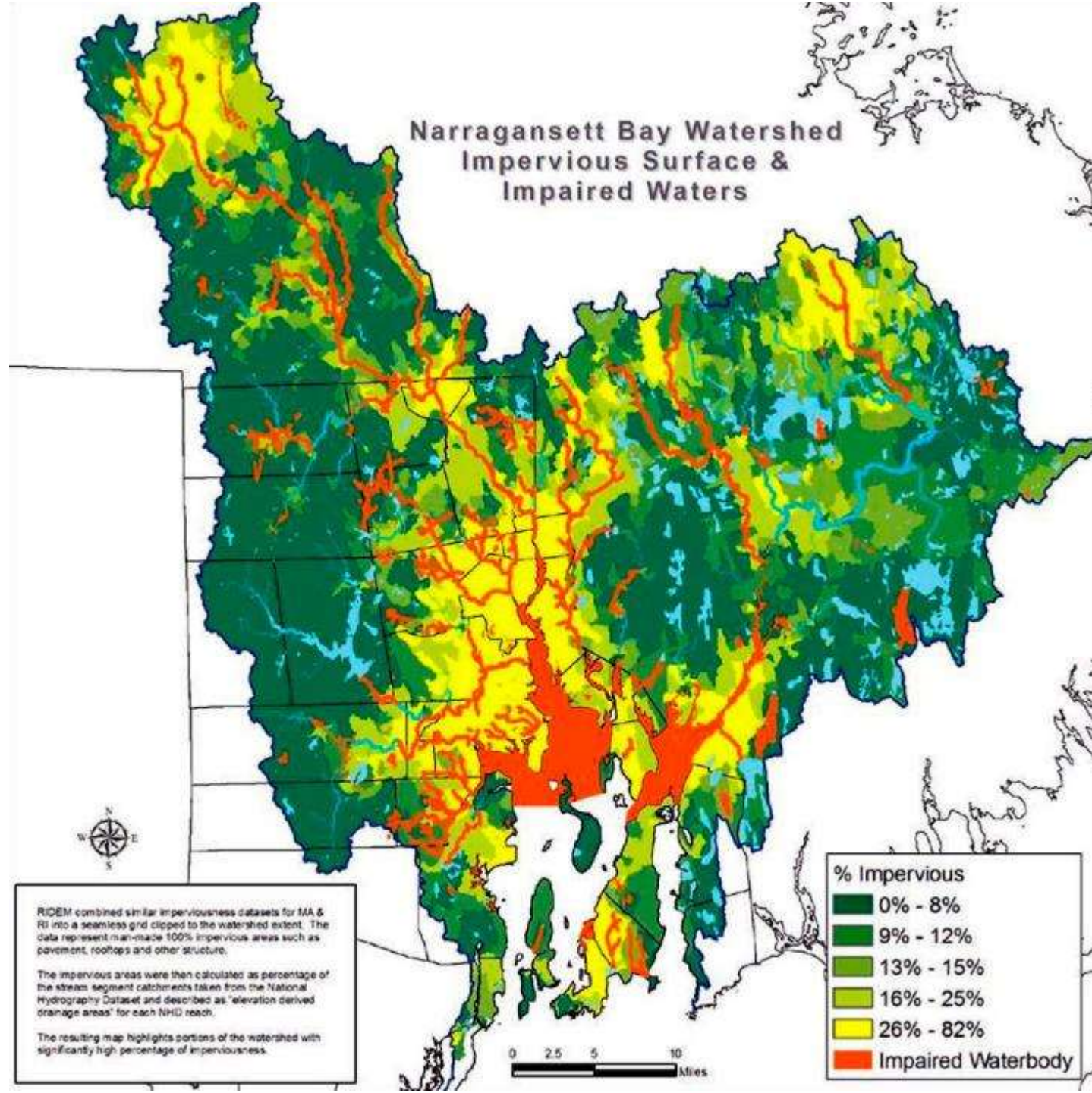


# Project Team

- Central Mass. Regional Planning Commission (CMRPC)
- Mass Audubon
  - Shaping the Future of Your Community Program
- The Blackstone River Coalition
- Scott Horsley, Horsley & Witten Group, Inc.



# Narragansett Bay Watershed Impervious Surface & Impaired Waters





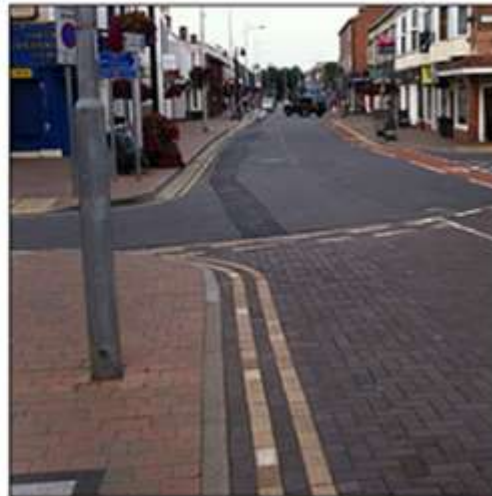
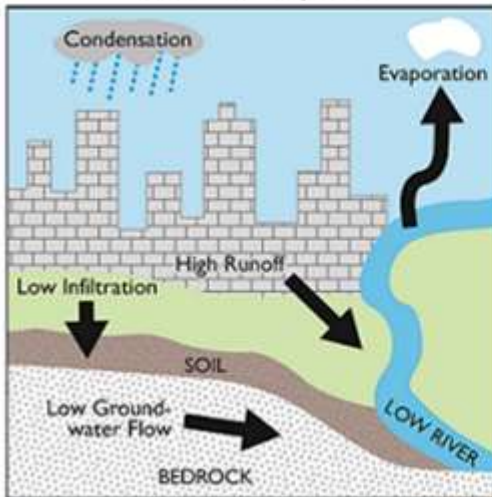
# The Problem

Slide credit: MAPC

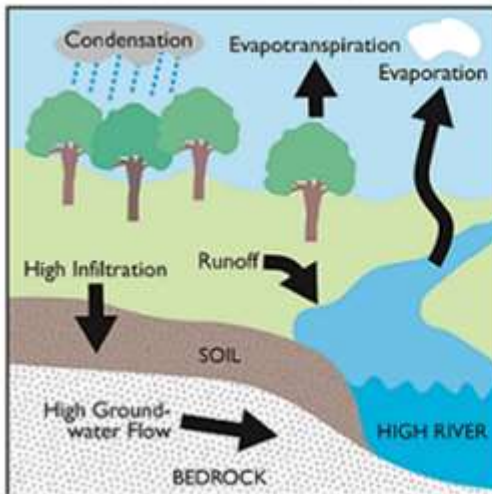
## Water Cycle

## Streetscape

Urban



Natural

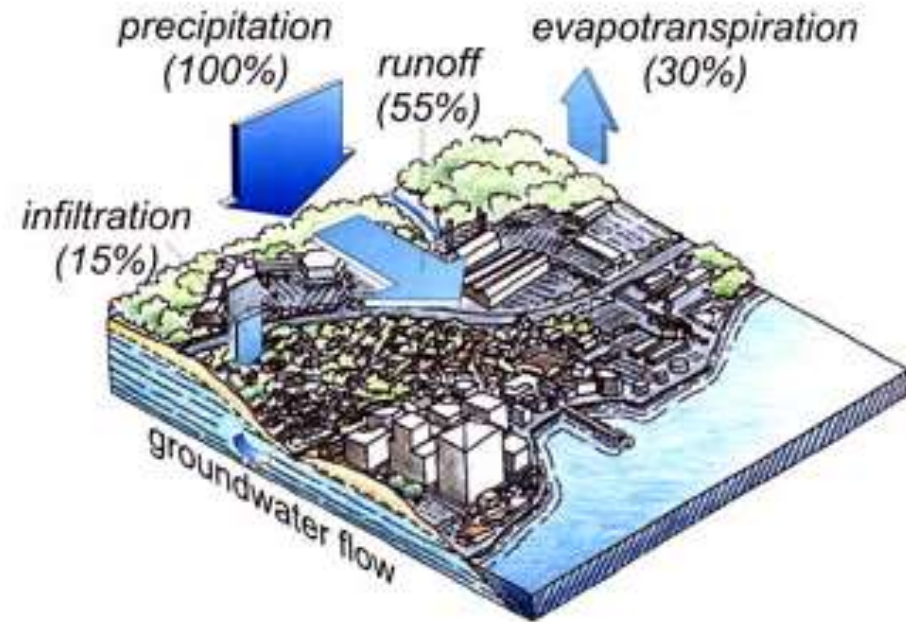


↑ Impervious surfaces

=

↑ Environmental & Community Impact

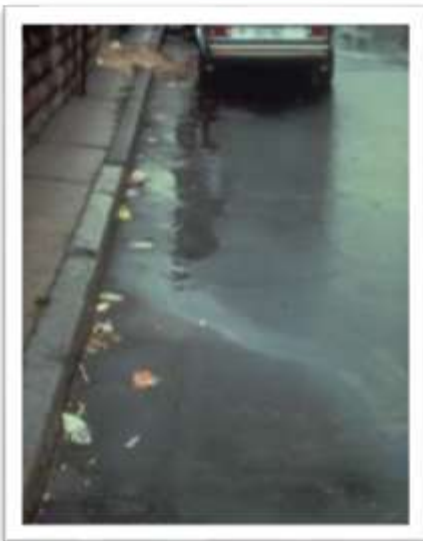
# Local Hydrologic Cycle



# Stormwater Issues



- Pollution: nutrients, bacteria, chemicals
- Erosion and sedimentation
- Loss of stream habitat
- Flooding: culvert and road failure
- Loss of recharge to aquifers
- Streams drying up



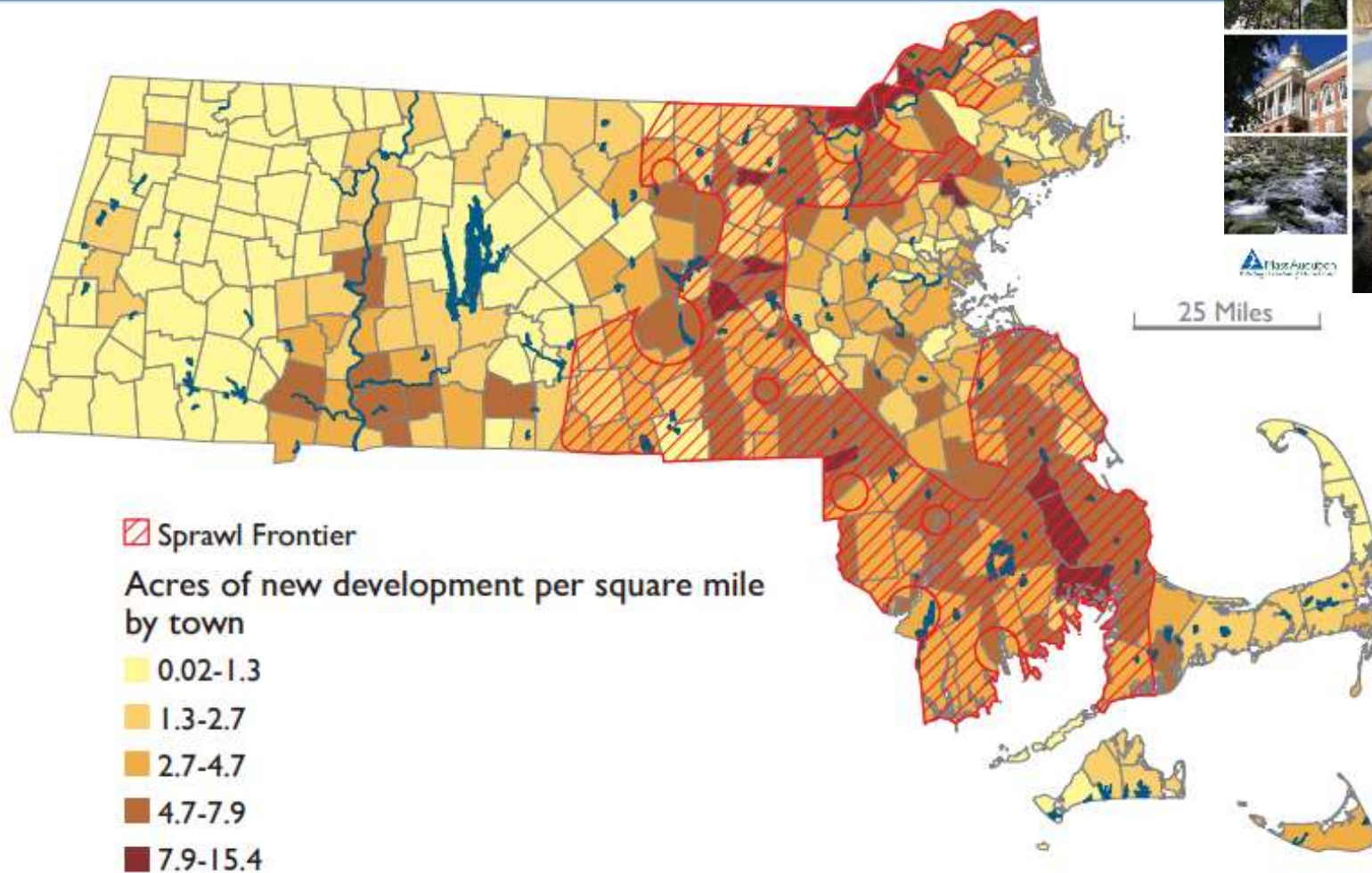


# Climate Change



Photo credit: MAPC

# New Development Trends 2005-2013



See more at: [www.MassAudubon.org/LosingGround](http://www.MassAudubon.org/LosingGround)



# What is Low Impact Development?

- “LID is an approach to land development (or re-development) that **works with nature to manage stormwater** as close to its source as possible. LID employs principles such as preserving and recreating natural landscape features, minimizing effective imperviousness to create functional and appealing site drainage that **treat stormwater as a resource** rather than a waste product.”



Source: Whole Buildings Design Guide, wbdg.com

# Green Infrastructure and Low Impact Development

- Tree planting & rain gardens
- Development and redevelopment projects
- Infrastructure improvements
- Land use planning and regulation



# Benefits of Reducing Sprawl & Protecting Natural Green Infrastructure

- Lower infrastructure & clearing costs
- Water supply protection
- Flood damage prevention
- Forest and farmland protection
- Open space and trails
- High quality of life
- Increased property values

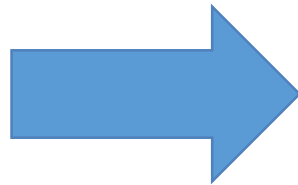




# Challenges to Traditional Regulations

- Traditional requirements in...

- zoning
- roadway
- lot dimension



- High road & stormwater maintenance

- Plowing
- Salting
- Outfalls
- Stormwater basins
- Increased impervious surface
- Decreased vegetated cover



Source: NCSU-BAE

# Benefits of Green Infrastructure and LID

- Environmental
- Climate change resiliency
- Meeting regulatory requirements
- Aesthetics and market value
- Cost savings



# Low Impact Development: LID



Scott Horsley

Horsley Witten Group, Inc.

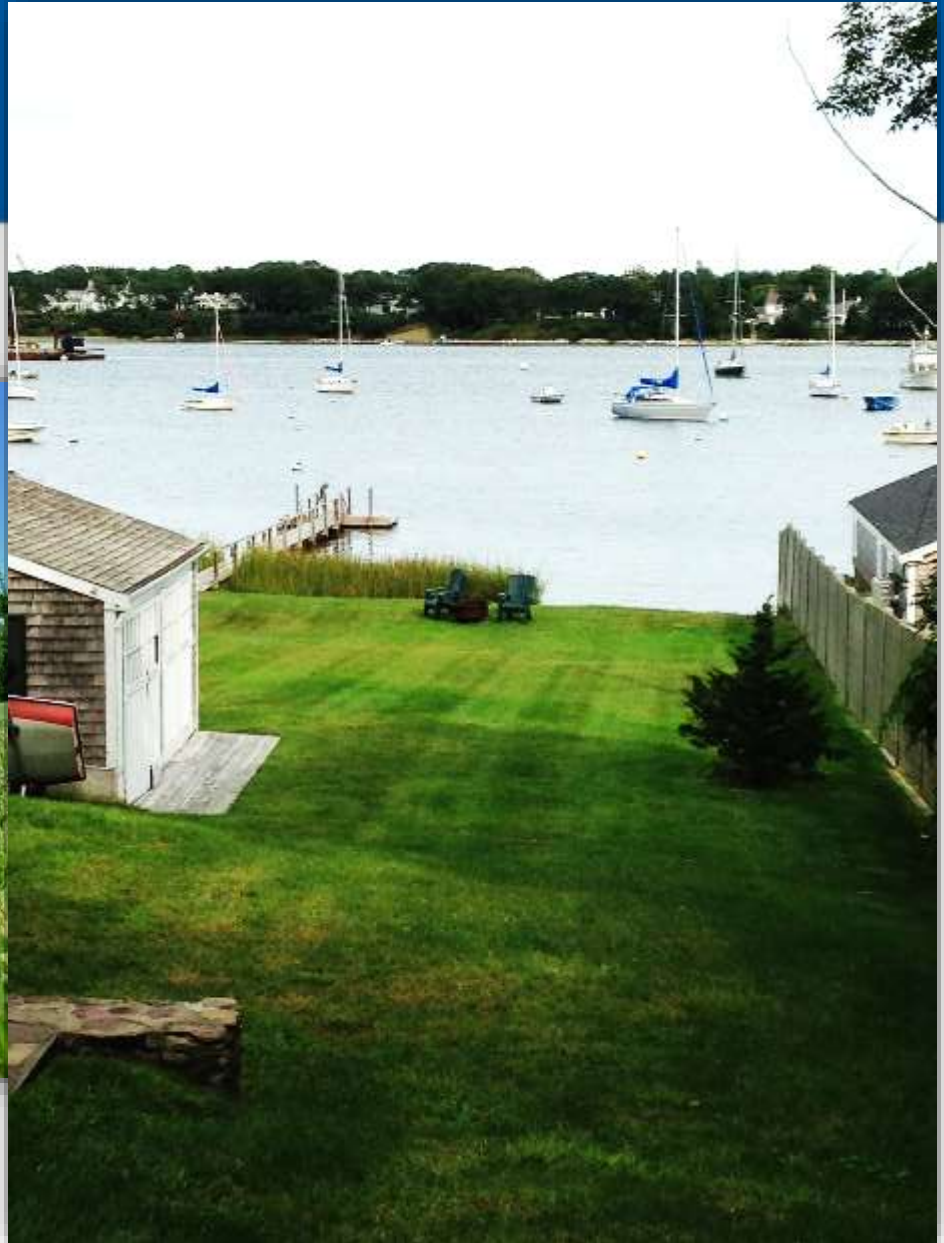


# Sources of Phosphorus in Stormwater

## Upper Charles River Watershed

Source	Annual Phosphorus Input (kg yr <sup>-1</sup> )	Annual Phosphorus Loading (kg yr <sup>-1</sup> )	Percent of Total Load
<b>Turf and Fertilizer Runoff</b>	<b>174.13</b>	<b>24.33</b>	<b>18%</b>
<b>Dog Waste</b>	<b>232.22</b>	<b>23.22</b>	<b>18%</b>
<b>Leaf Litter (Street Trees)</b>	<b>27.92</b>	<b>20.94</b>	<b>16%</b>
<b>Atmospheric Deposition</b>	<b>126.19</b>	<b>19.00</b>	<b>14%</b>
<b>Other</b>	<b>unknown</b>	<b>13.08</b>	<b>10%</b>
<b>Forest Runoff</b>	<b>unknown</b>	<b>12.41</b>	<b>9%</b>
<b>Winter Road Treatments</b>	<b>6.64</b>	<b>6.64</b>	<b>5%</b>
<b>Car Washing</b>	<b>8.03</b>	<b>6.43</b>	<b>5%</b>
<b>Motor Vehicle Traffic</b>	<b>4.01</b>	<b>4.01</b>	<b>3%</b>
<b>Grass Clippings</b>	<b>569.06</b>	<b>1.48</b>	<b>1%</b>
<b>Total</b>	<b>1,148.20</b>	<b>131.54</b>	<b>100%</b>

# Traditional Grass Lawn





# Alternative Outdoor Space





# Rain Garden



# Reducing Impervious Surfaces





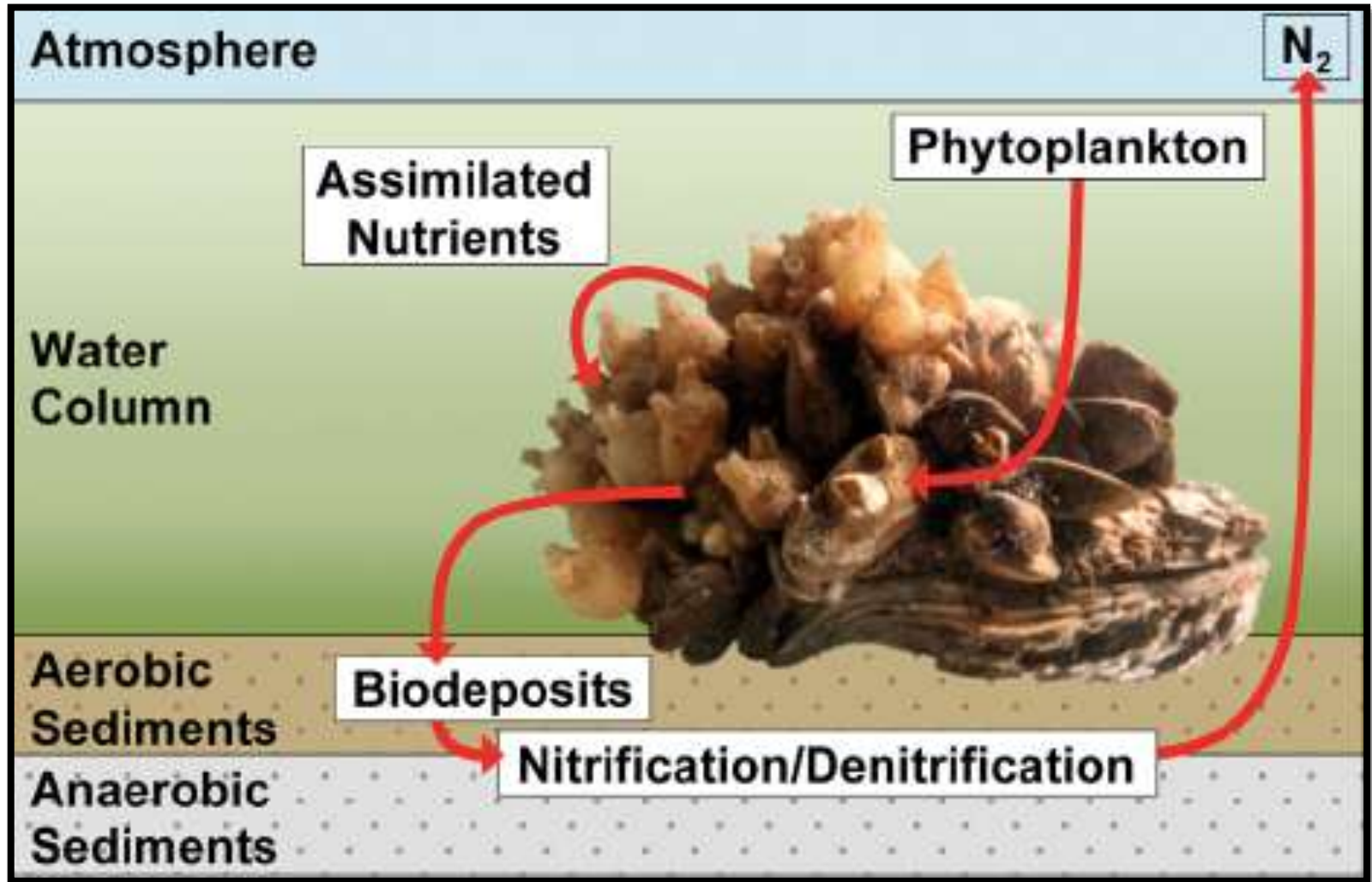
# Permeable Pavement



Source: Tata &  
Howard



# Nutrients in Aquatic Systems

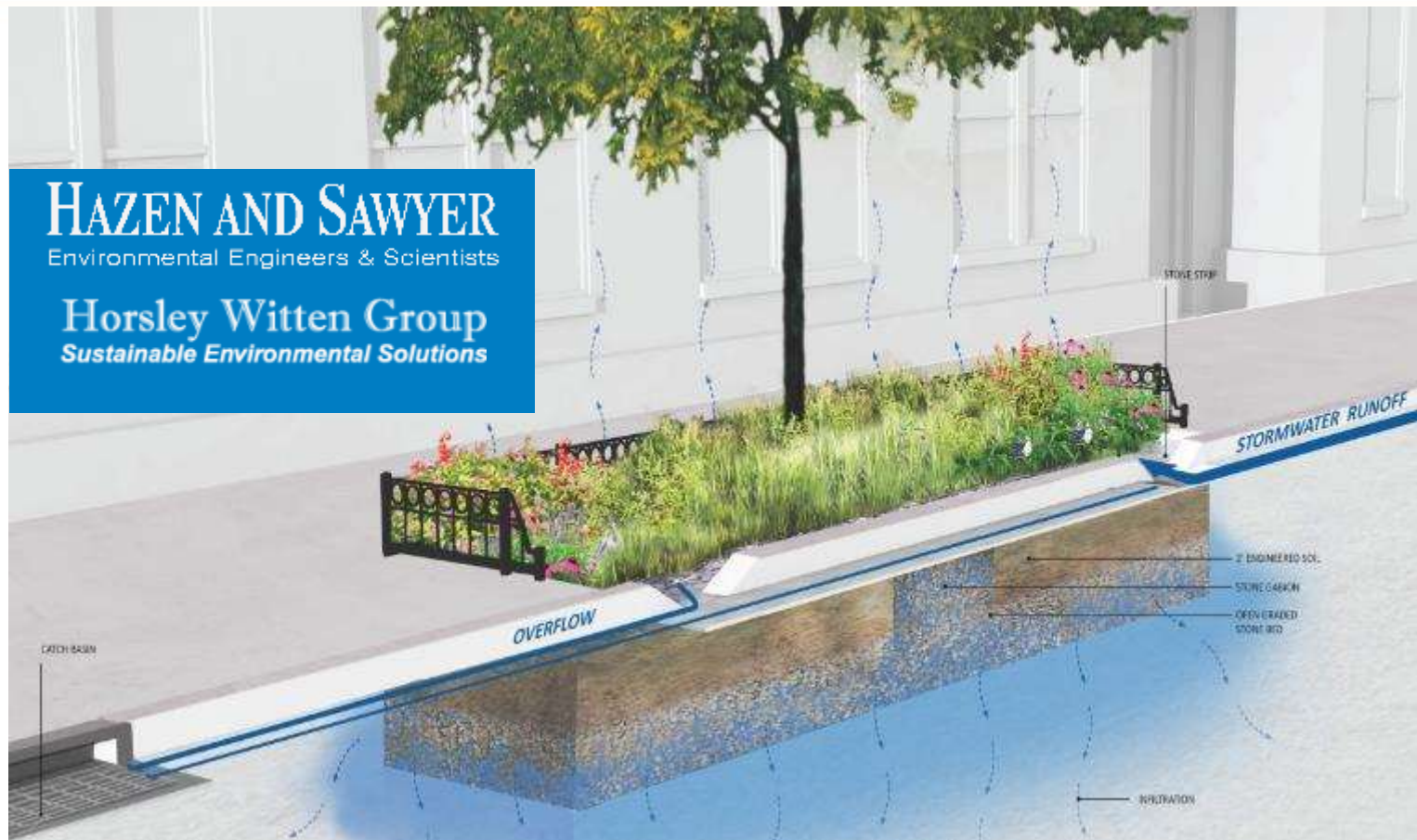


# Urine Diverting Toilets

- 90% of Nitrogen in wastewater is in the urine
- We pay for N removal (water)
- We pay for N addition (land)
- Waste to resource

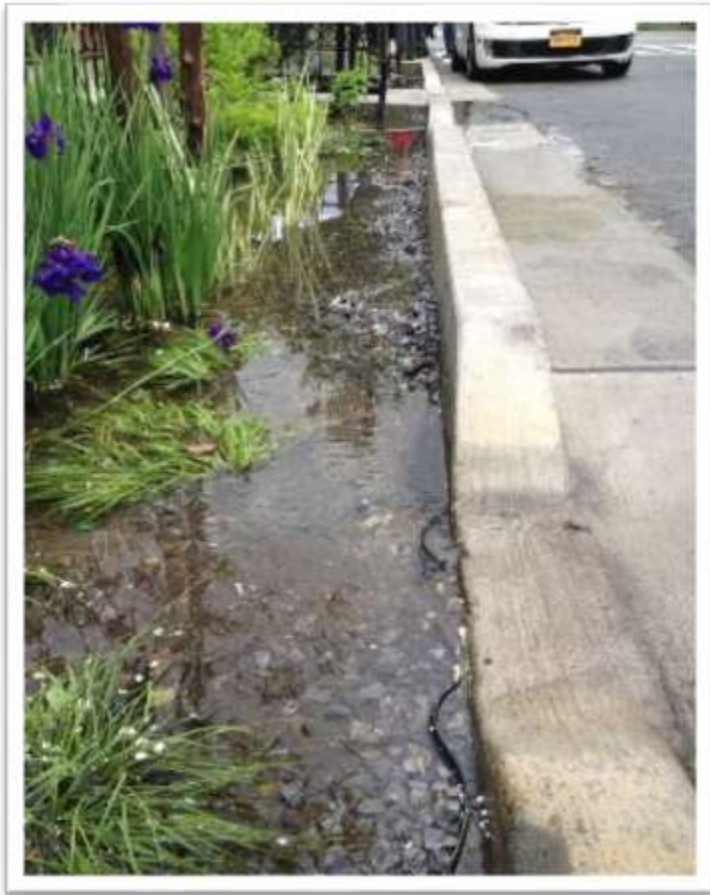


# NYC GI Design Criteria





# Bio-swales in Right of Way



# Green Roofs



# Pet Waste Management



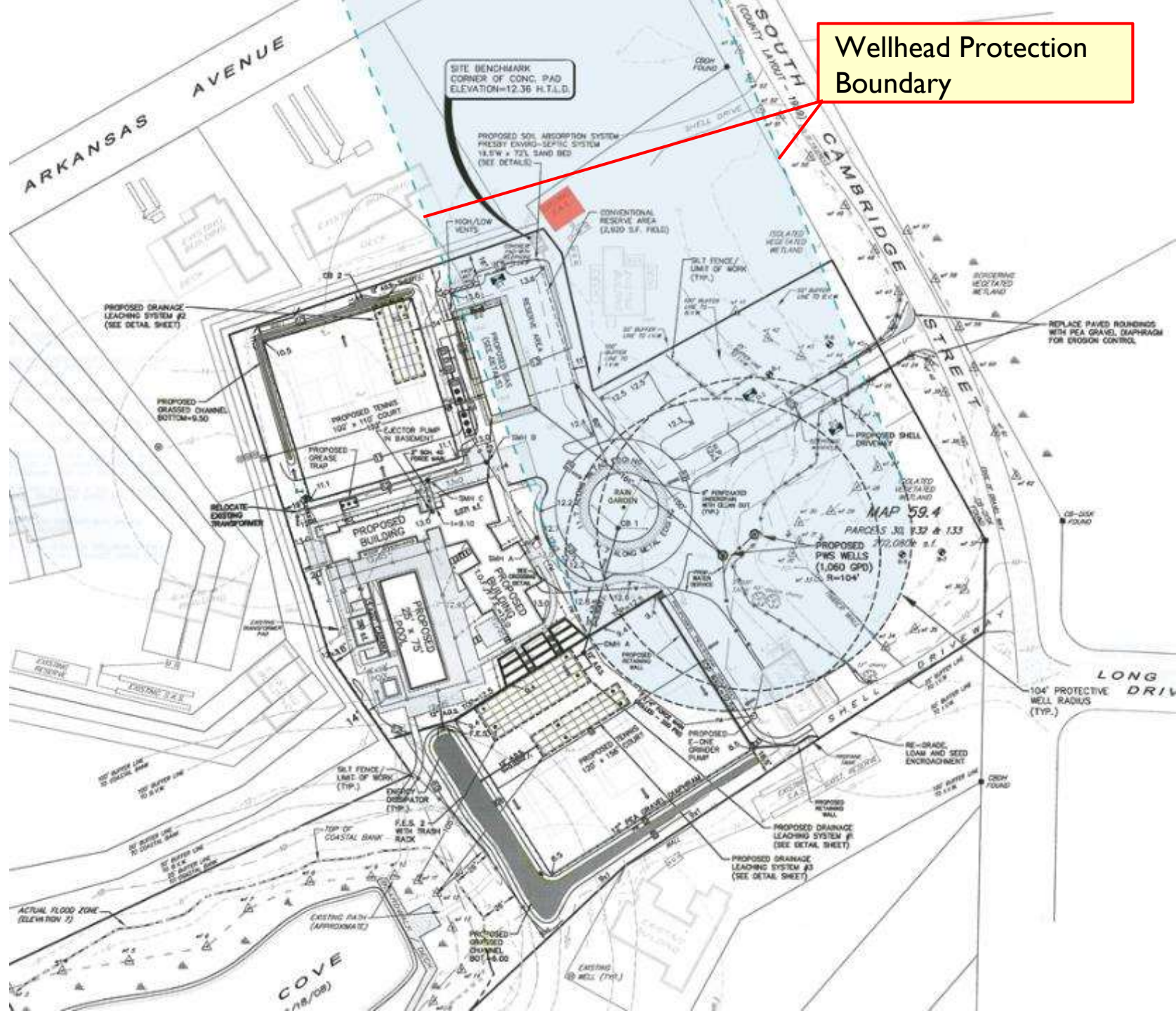


# Nantucket, MA: Madaket Tennis Club

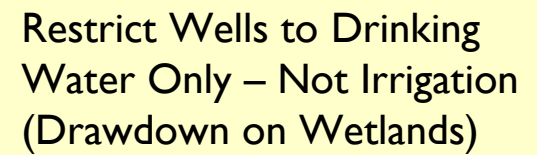




## Wellhead Protection Boundary

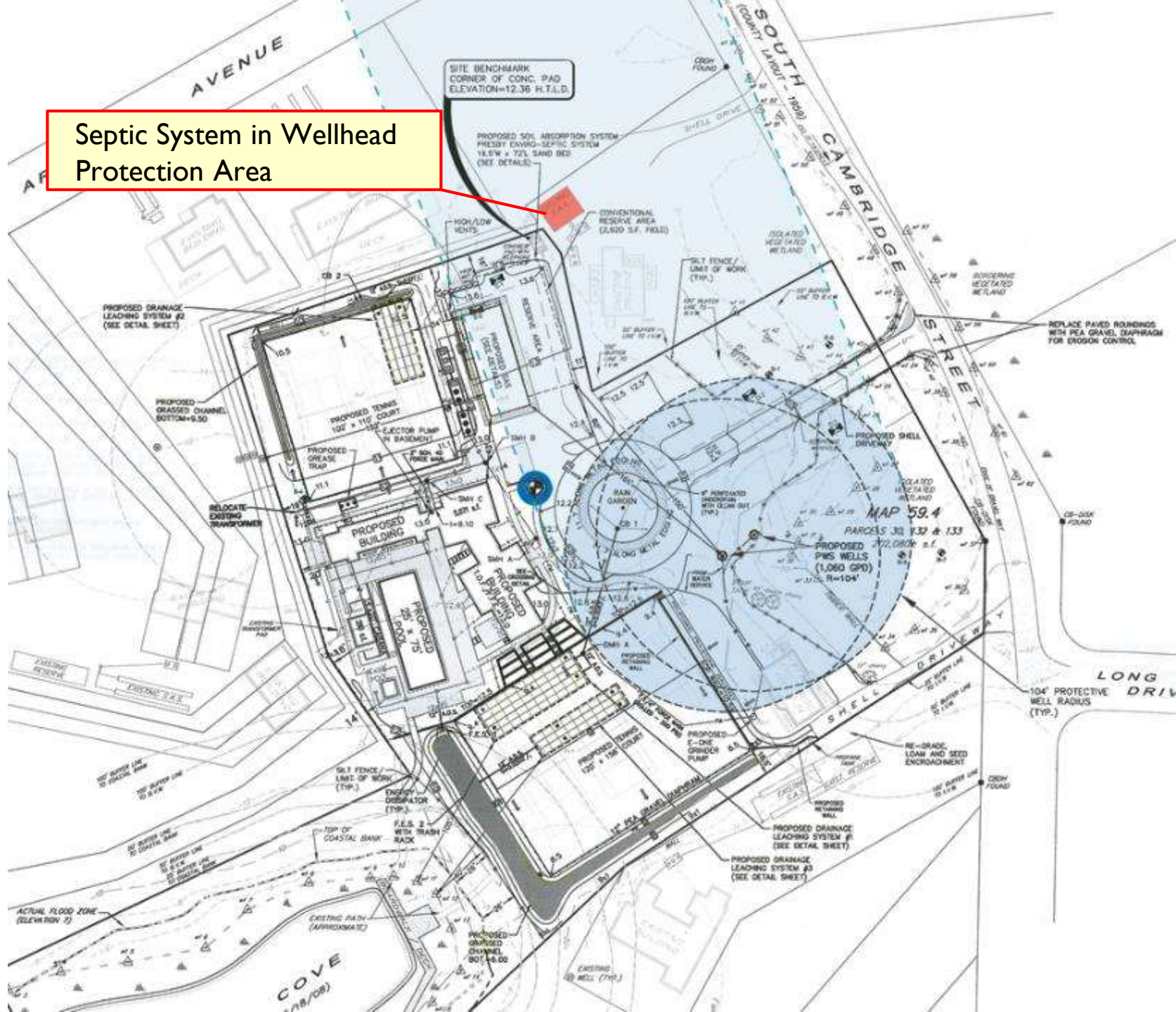








## Septic System in Wellhead Protection Area





Recovery /Fertigation  
Well





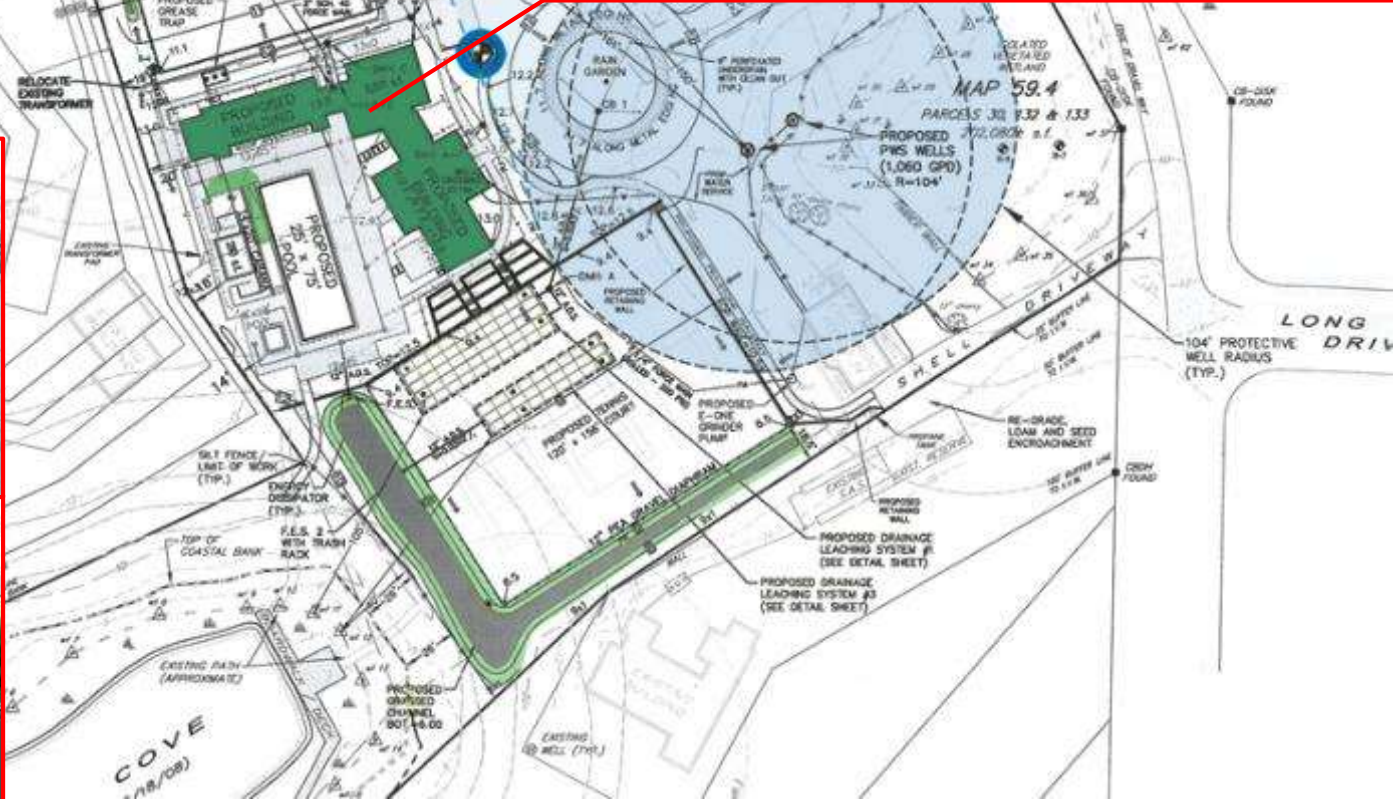








## Green Roof

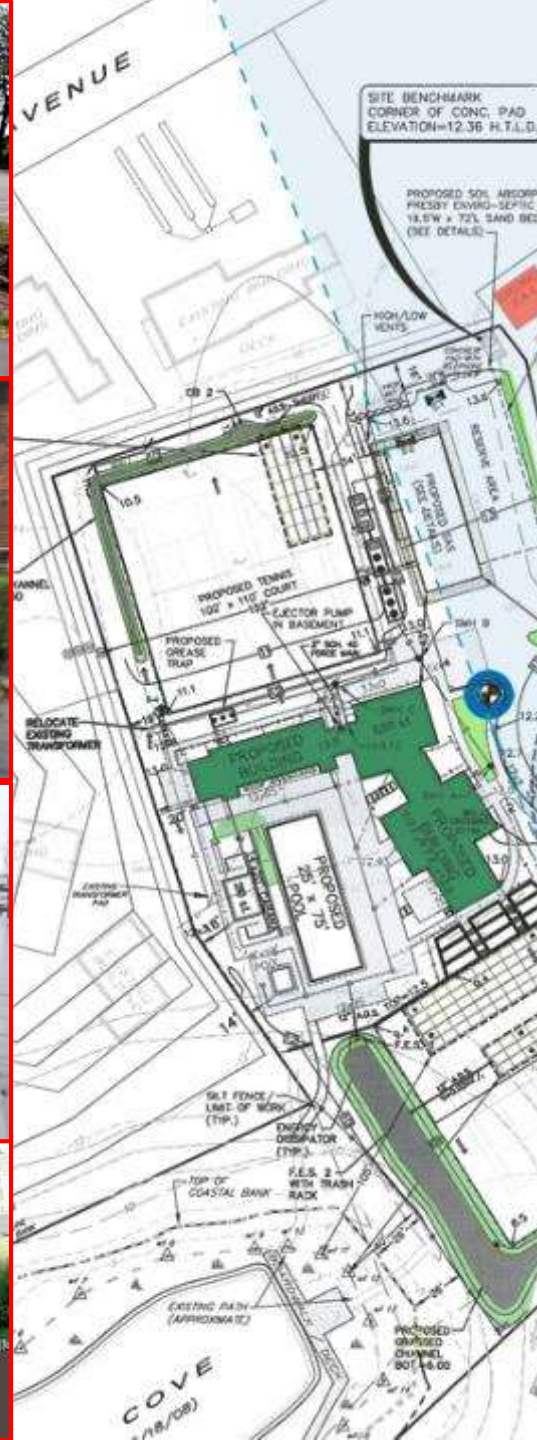




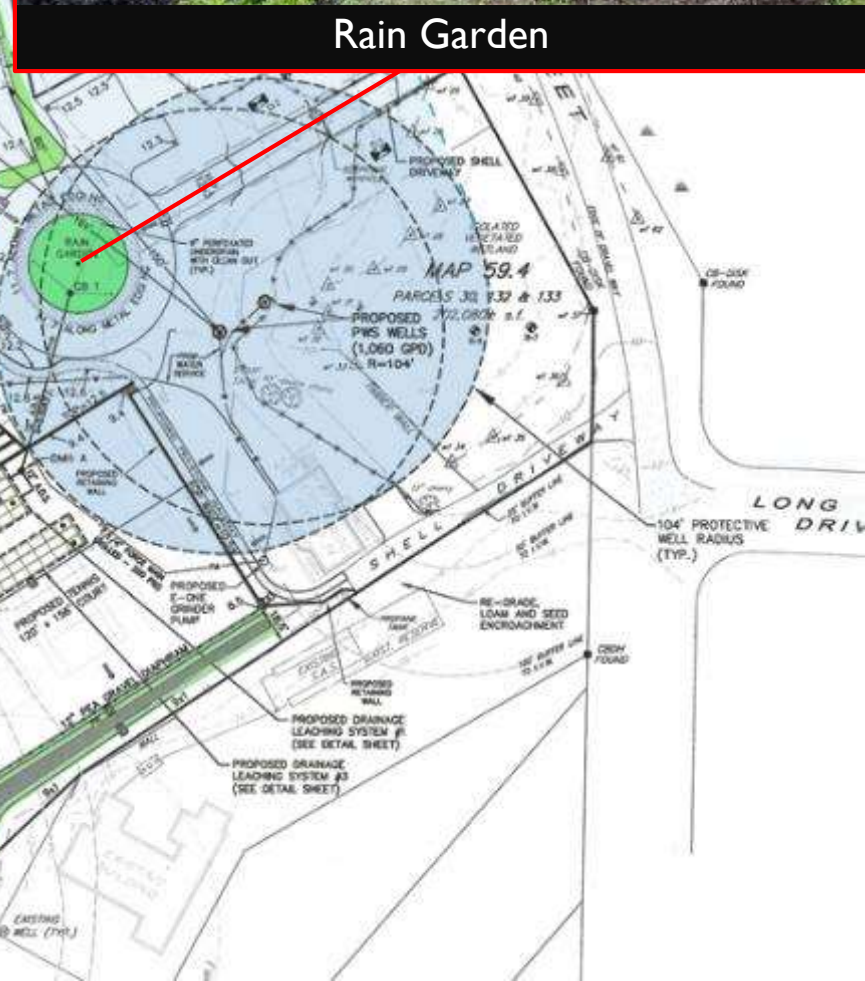


## Bioretention for Parking Lot

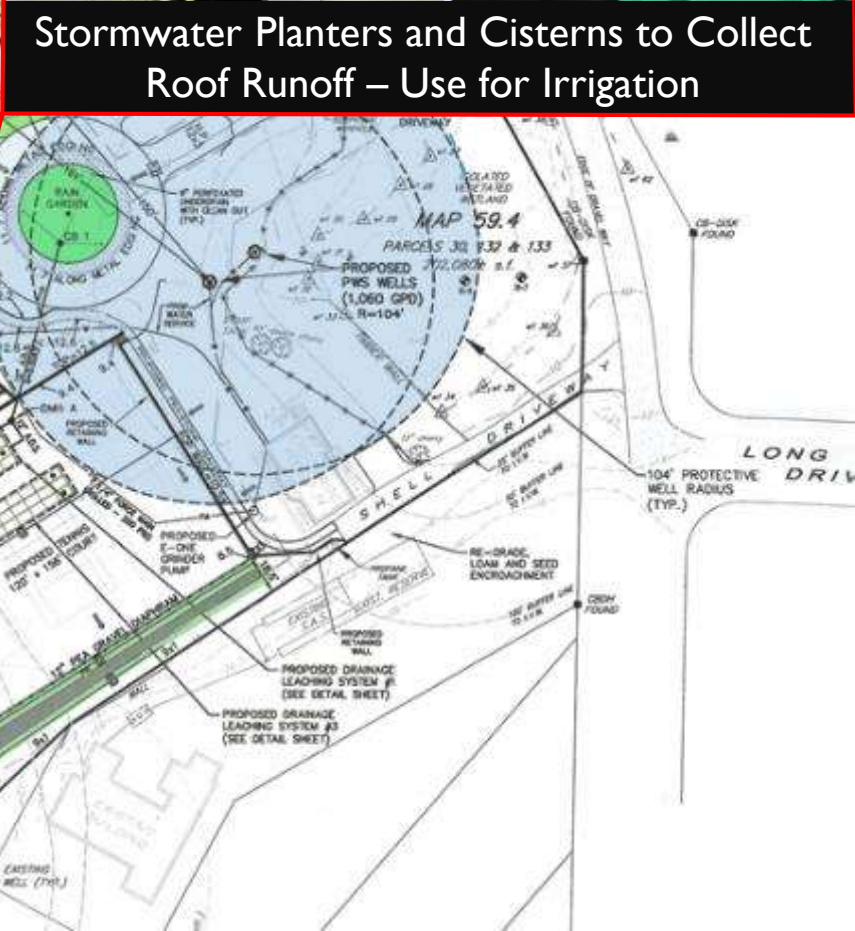
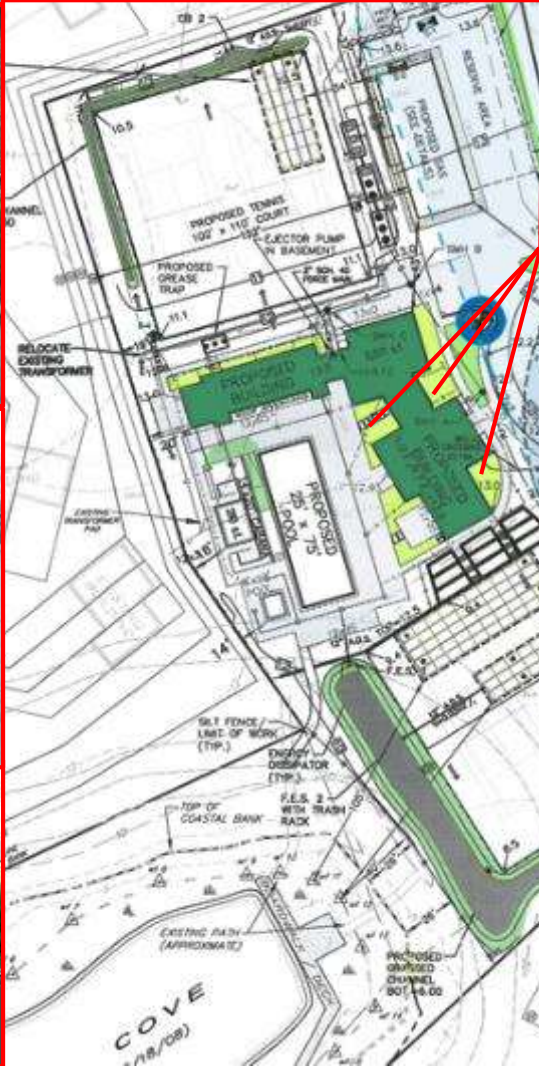




## Rain Garden





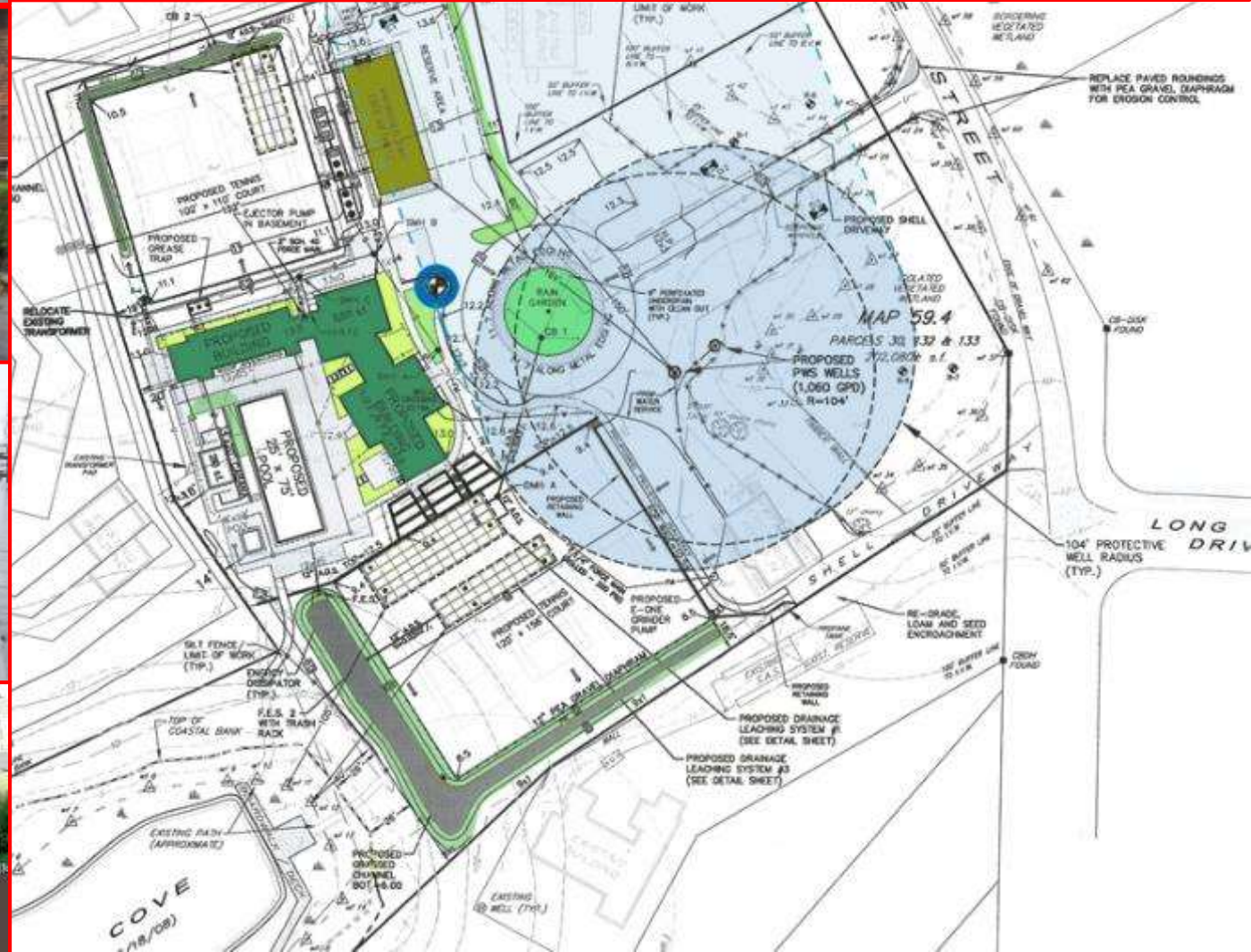


Stormwater Planters and Cisterns to Collect Roof Runoff – Use for Irrigation



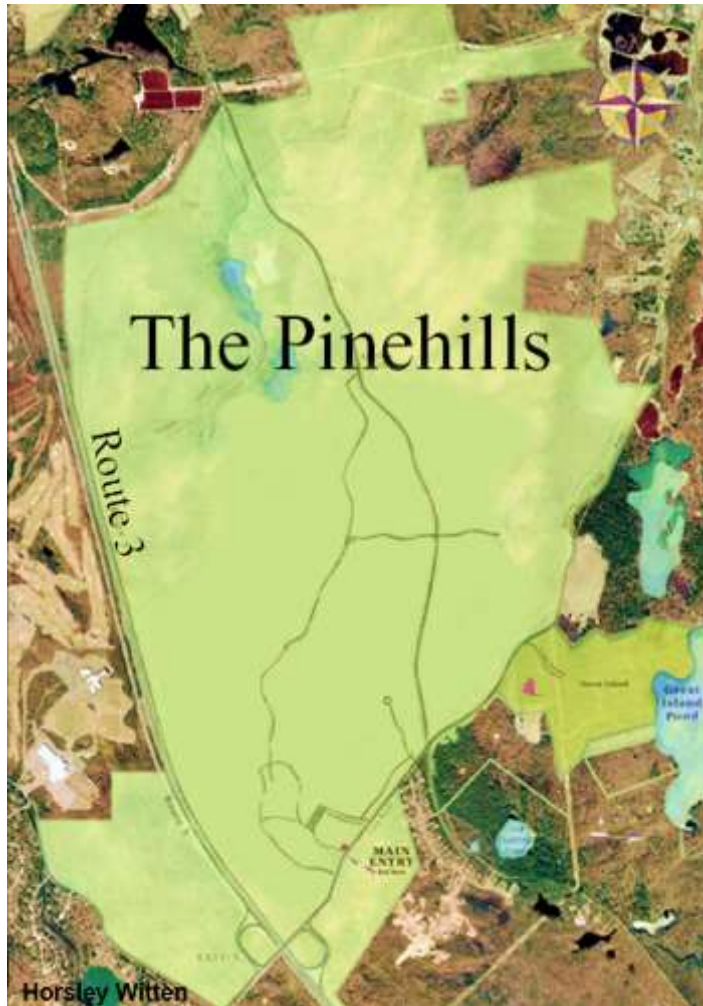








# The Pinehills



- Home to 1,800 families
- Consists of 3,174 acres
- 2,200+ acres (70%) of land preserved as natural and recreational open space





**Preserved Historic Sandwich Road**



# Density & Views



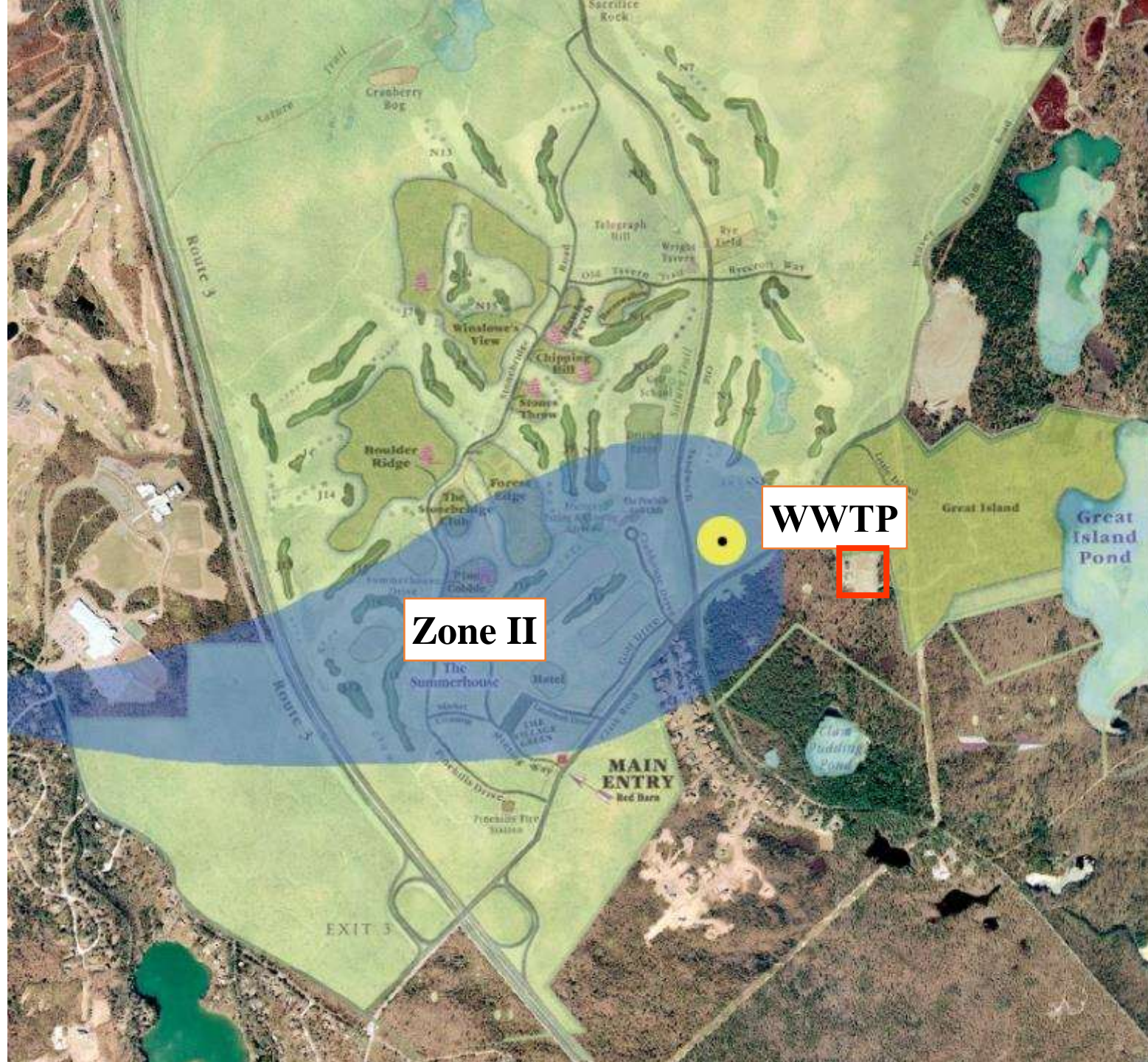




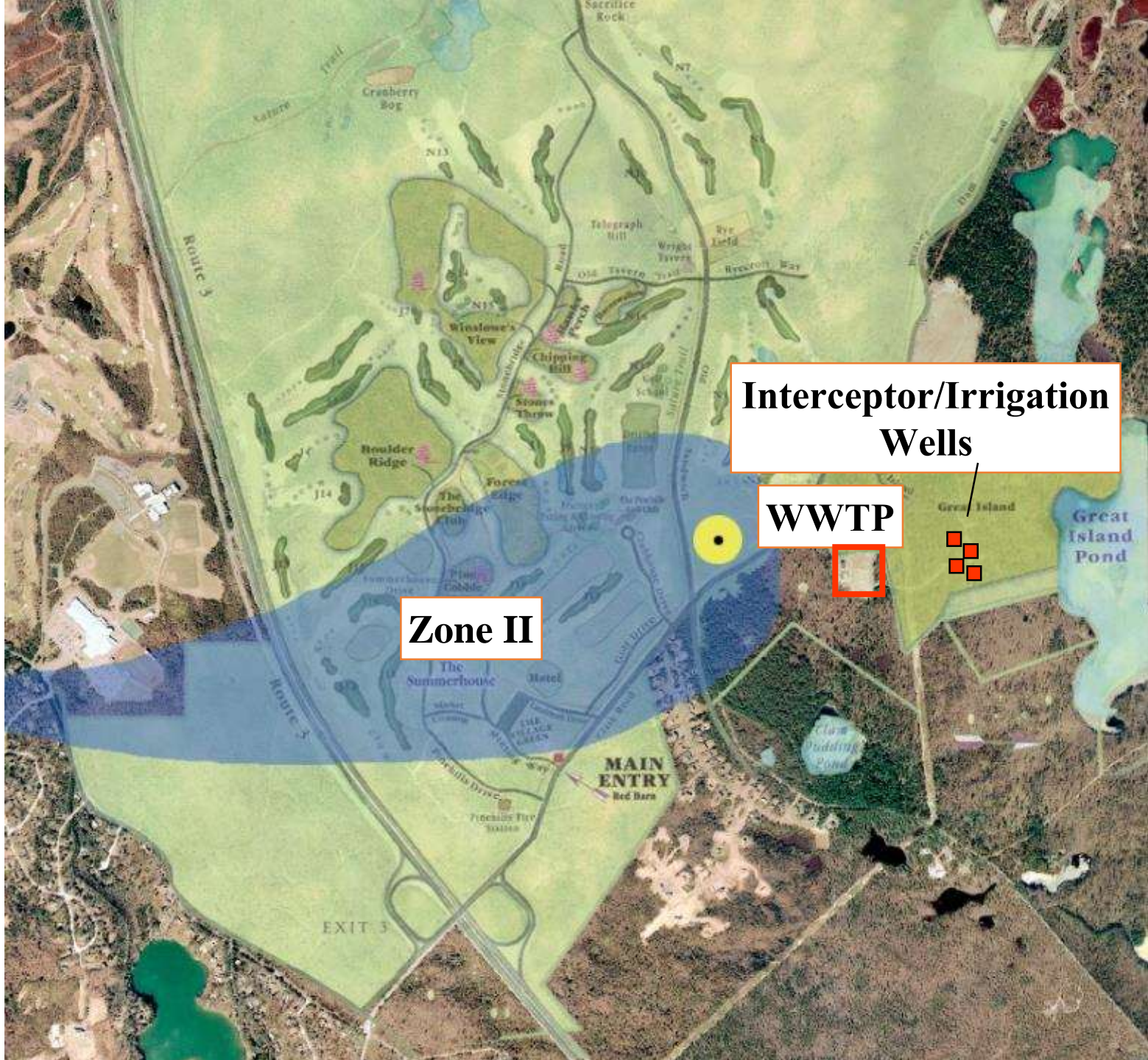












**Interceptor/Irrigation Wells**

**WWTP**

**Zone II**



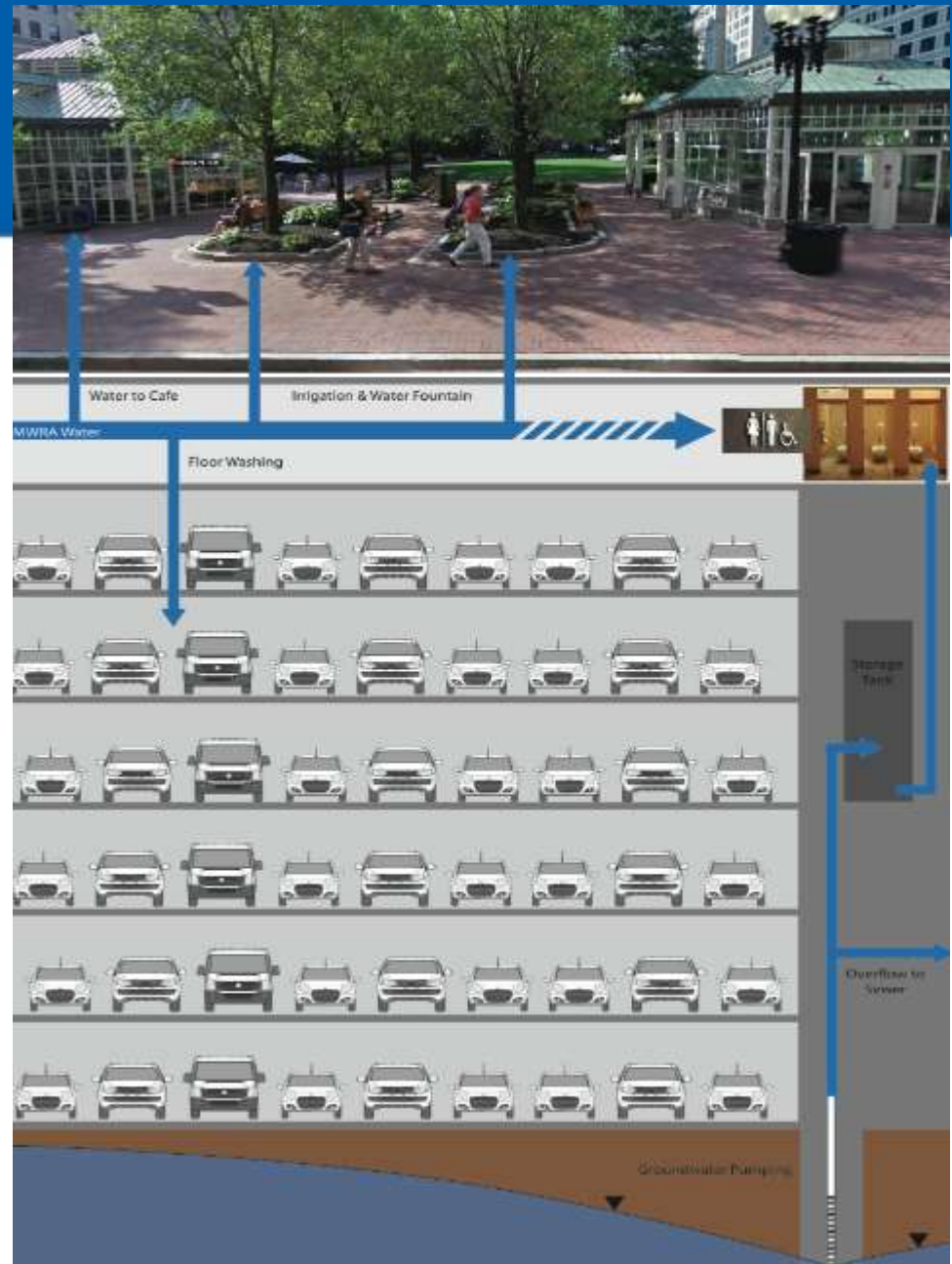
# Post Office Square Boston, MA



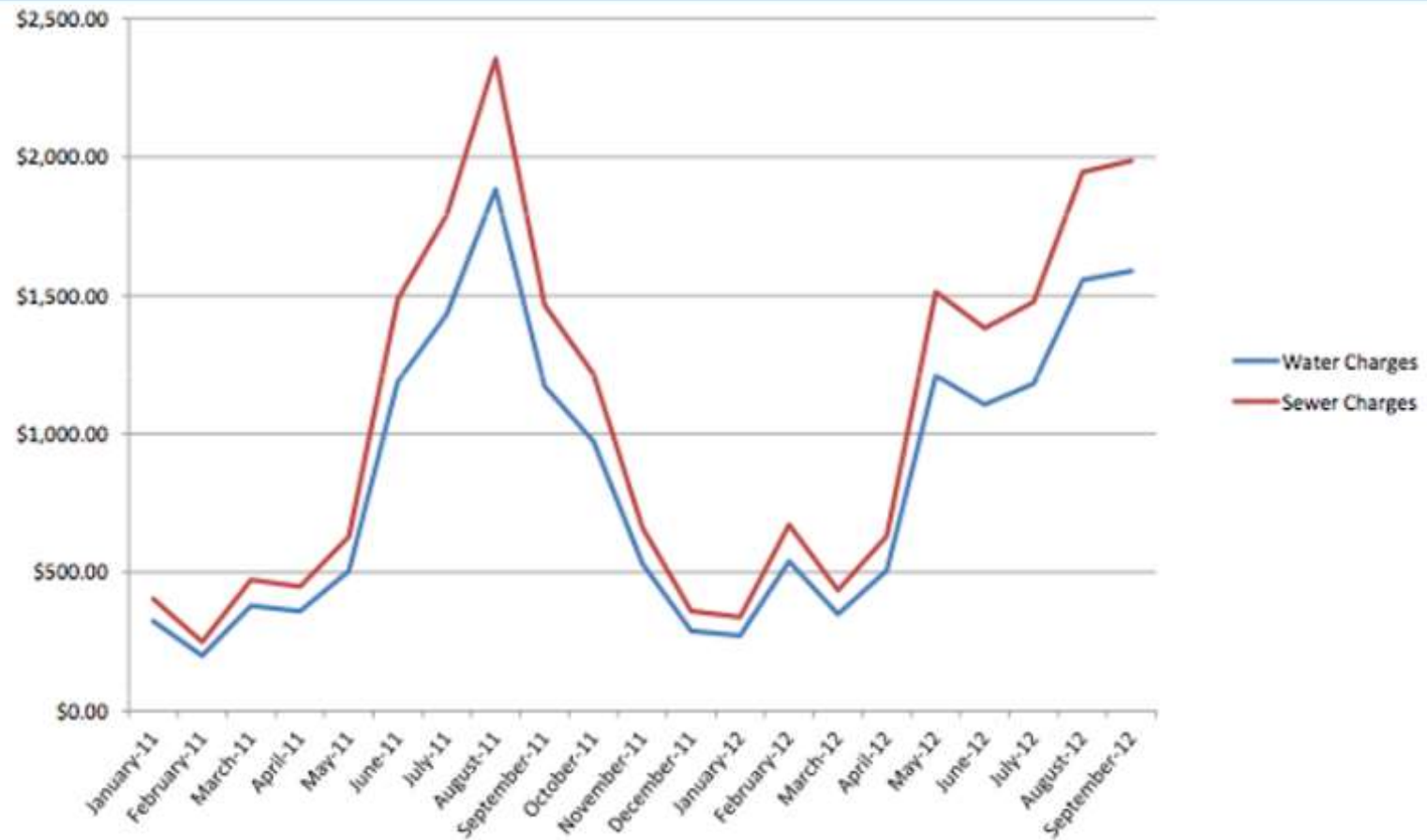


# From Waste to Resource

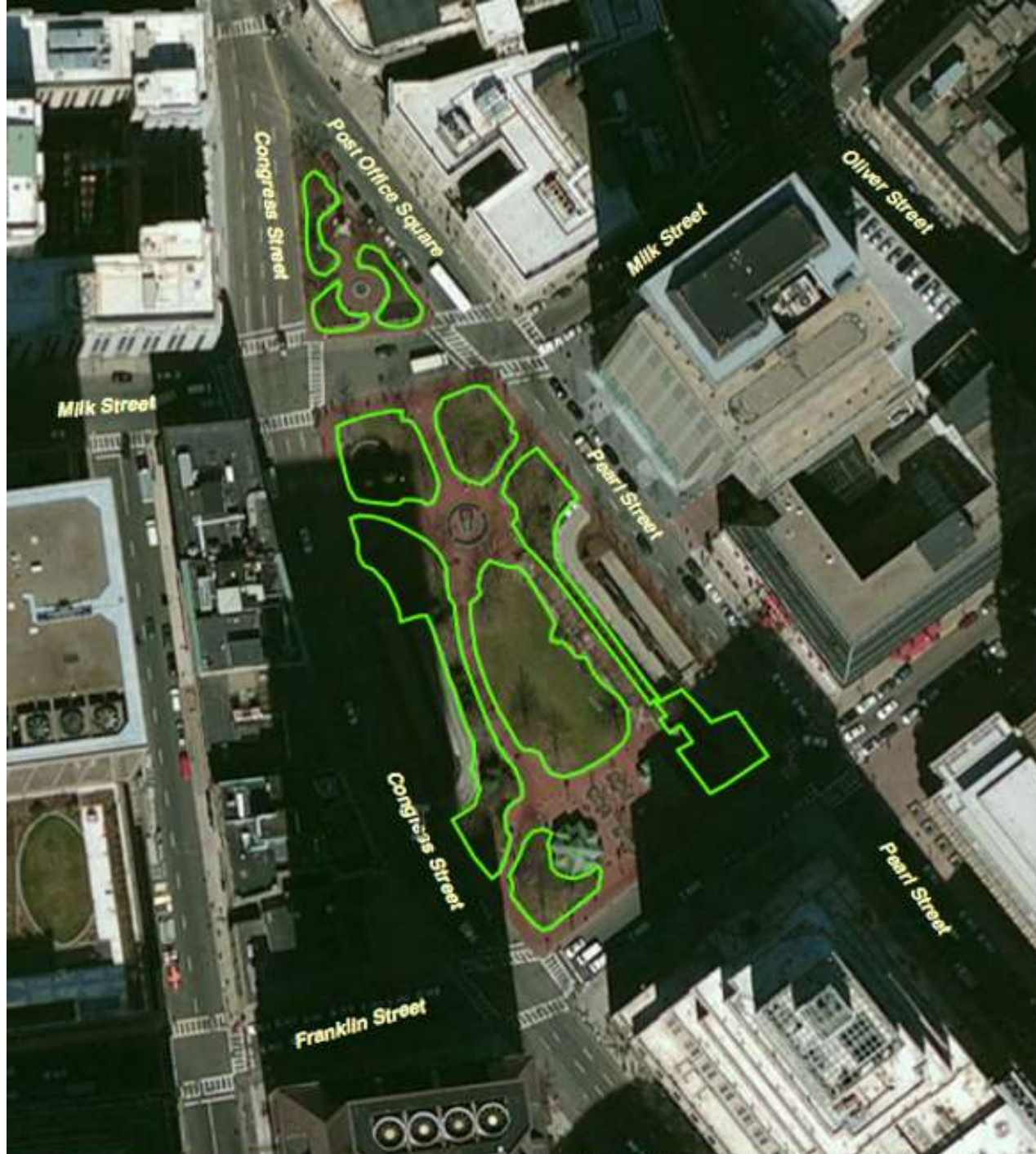
- What once was a costly waste product was reimagined as a helpful cost savings



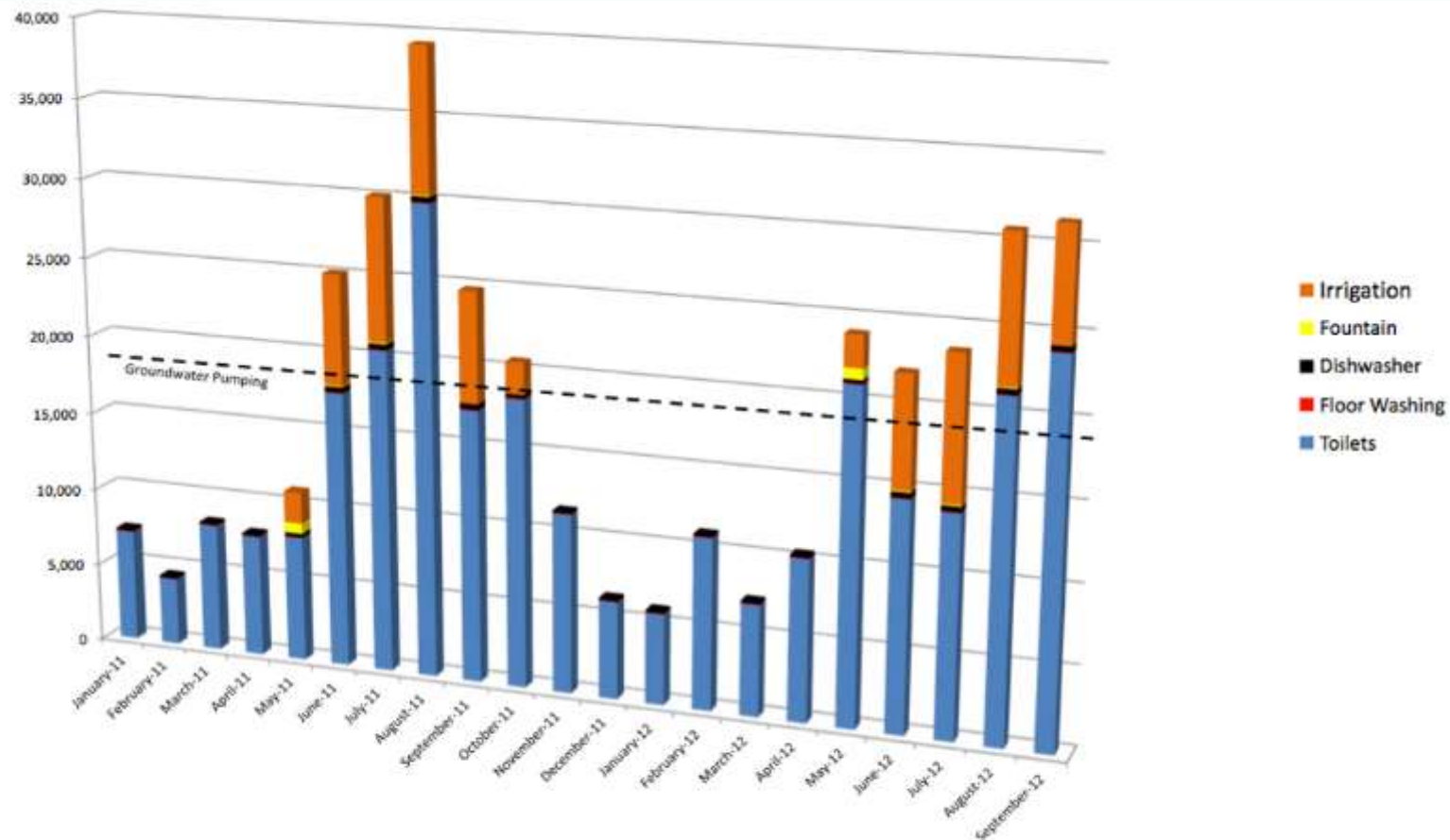
# Post Office Square Park and Garage Monthly Sewer and Water







# Post Office Square Summary of Water Usage (ft<sup>3</sup>/month)





# Cost Comparison of Conventional vs. LID: Bio-filtration Landscape Islands in Parking Lot



**Total Traditional Project Cost: \$1,004,000**

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LID Reduced site paving -\$32,000

LID Reduced curbing -\$50,000

LID Reduced stormwater piping -\$14,000

LID Reduced stormwater structures -\$68,000

LID Increased landscaping +\$12,000

LID Increased site preparation +\$10,000

LID Increased soil mix +\$18,000

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**Total Estimated LID Savings: -\$124,000 (12%)**

# Leominster, MA Urban Watershed

- Monoosnoc Brook impacted by phosphorus and other urban runoff issues
- Multiple LID features installed:
  - ▶ Bioretention
  - ▶ Tree planters
  - ▶ Infiltration systems
  - ▶ Gravel wetlands





# Cost Comparison of Conventional vs. LID: Bioretention system

Comparison of Present Value Costs: LID vs Conventional (Average)		
Type of Cost	Phosphorus (\$/lb)	Nitrogen (\$/lb)
<b><i>LID</i></b>		
Bioretention systems	2,935	339
<b><i>Conventional</i></b>		
Dry detention	21,143	4,597
Dry extended detention	10,571	1,149
Average detention	15,857	2,873

# EPA Summary of Cost Comparison: Conventional vs. LID Approaches

Project	Conventional Development Cost	LID Cost	Cost Difference <sup>b</sup>	Percent Difference <sup>b</sup>
2 <sup>nd</sup> Avenue SEA Street	\$868,803	\$651,548	\$217,255	25%
Auburn Hills	\$2,360,385	\$1,598,989	\$761,396	32%
Bellingham City Hall	\$27,600	\$5,600	\$22,000	80%
Bellingham Bloedel Donovan Park	\$52,800	\$12,800	\$40,000	76%
Gap Creek	\$4,620,600	\$3,942,100	\$678,500	15%
Garden Valley	\$324,400	\$260,700	\$63,700	20%
Kensington Estates	\$765,700	\$1,502,900	-\$737,200	-96%
Laurel Springs	\$1,654,021	\$1,149,552	\$504,469	30%
Mill Creek <sup>c</sup>	\$12,510	\$9,099	\$3,411	27%
Prairie Glen	\$1,004,848	\$599,536	\$405,312	40%
Somerset	\$2,456,843	\$1,671,461	\$785,382	32%
Tellabs Corporate Campus	\$3,162,160	\$2,700,650	\$461,510	15%

USEPA, Reducing Stormwater Costs Through Low Impact Development (LID) Strategies and Practices, December 2007



# Project Schedule/Next Steps

- **Summer 2015:** Case studies
- **Fall 2015:** Workshops
- **Fall/Winter 2015/6:**  
Competitive technical assistance program
- **2016:** Broad Meadow Brook demonstration project
- **Ongoing:** Networking and technical advice



# Cost Effectiveness Case Studies

**1. Local Land Use Rules:**  
Open Space Design Zoning  
and LID Regulations for New  
and Redevelopment

**2. Stormwater Utilities** and  
Other Financing

**3. Urban Stream  
Restoration** with LID  
Retrofits



**4. Pond Water Quality  
Improvement** with LID  
Retrofits

**5. Parking Lots** with LID



# Potential Topics for Local Assistance Projects

- Comparing current municipal land use regulations vs recommended best practices
- Reviewing planning and conservation rules – do they align?
- Green Infrastructure mapping
- Redevelopment site LID opportunities
- What will the new MS4 permit mean for my community and how can we minimize and address the costs?



# What Can You Do to Implement LID?

- Talk to other communities
- Work between organizations and committees
- Let us know how we can help!



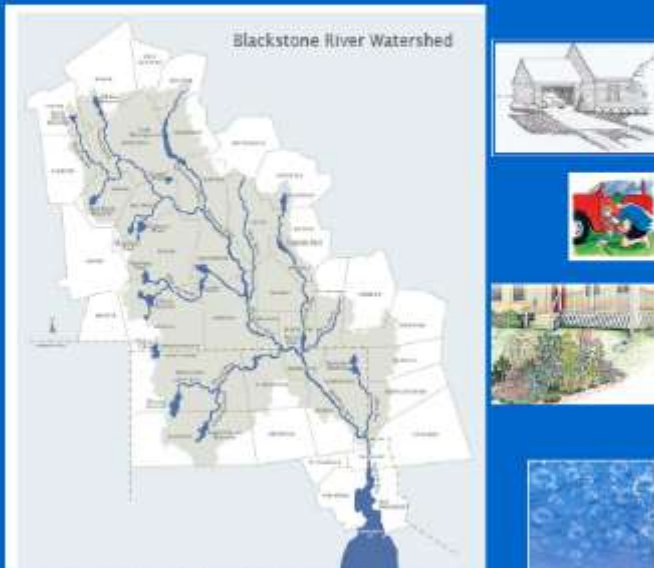


# Resources

## The Blackstone River Coalition

Campaign for a Fishable/Swimmable Blackstone River by 2015

### A Homeowner's Guide to Protecting Water Quality in the Blackstone River Watershed



If you live in the shaded area of the map, then you live in the Blackstone River watershed. You can help restore and protect its water quality. Look inside to learn how. A cleaner Blackstone River begins in your own backyard!

The Blackstone River Coalition

### Going Green with Storm Water

#### Rain Gardens



#### A Best Management Practice to:

- ♦ Reduce Stormwater Runoff
- ♦ Improve Water Quality
- ♦ Enhance Your Landscape

Make your own beautiful contribution to cleaner water in the Blackstone River Watershed.

Come visit Broad Meadow Brook's Demonstration Rain Garden



Campaign for a Fishable/Swimmable Blackstone River by 2015

### Blackstone Valley Guide to Low Impact Development Practices



New development can minimize the impacts on Blackstone Valley water resources through careful site planning that maximizes infiltration, reduces paved surfaces, and uses decentralized stormwater management techniques to handle runoff.

The Blackstone River Coalition

# Additional Resources

- Shaping the Future of Your Community
  - [www.MassAudubon.org/ShapingTheFuture](http://www.MassAudubon.org/ShapingTheFuture)
- Losing Ground
  - [www.MassAudubon.org/LosingGround](http://www.MassAudubon.org/LosingGround)
- CMRPC Data Common
  - [www.cmrpc.org/CentralMassDataCommon](http://www.cmrpc.org/CentralMassDataCommon)
- EPA's website on Green Infrastructure
  - <http://water.epa.gov/Infrastructure/GreenInfrastructure>
- UNH Stormwater Center
  - [www.unh.edu/unhsc](http://www.unh.edu/unhsc)
- Narragansett Bay Estuary Program
  - [www.nbep.org](http://www.nbep.org)





# For more information, please visit [www.massaudubon.org/LIDcost](http://www.massaudubon.org/LIDcost)

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