Stormwater Challenge:
A Call to Action

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The Truth of the Matter

- “Advancements” in civilization have left us with some old pipes and lots of concrete
- More 100-year storms in last 15 years than in the century before
Why is Stormwater a Problem?

Urban Runoff is the Source of Problems in:

34,871 miles or 13% of all Impaired Rivers and Streams

1,369,327 acres or 18% of all Impaired Lakes

5045 square miles or 32% of all Impaired Estuaries

* Note: The National Water Quality Inventory (305(b) Report) describes the quality of assessed waters. Many of the nation’s rivers, lakes and estuaries remain unassessed. The percentages above are based on assessed waters only.
Imperviousness vs. Storm Water Runoff

Natural Ground Cover

25% Shallow Infiltration
25% Deep Infiltration
40% Evapotranspiration
10% Runoff

10% - 20% Impervious Surface

21% Shallow Infiltration
21% Deep Infiltration
38% Evapotranspiration
20% Runoff

35% - 50% Impervious Surface

20% Shallow Infiltration
15% Deep Infiltration
35% Evapotranspiration
30% Runoff

75% - 100% Impervious Surface

10% Shallow Infiltration
5% Deep Infiltration
30% Evapotranspiration
55% Runoff

Changes in runoff flow resulting from increased impervious area (NC Dept. of Nat. Res. and Community Dev., in Livingston and McCarron, 1992.)
In watersheds with less than 5% impervious cover, streams are typically stable and pristine, maintaining good pool and riffle structure, a large wetted perimeter during low flow, and a good riparian canopy coverage.
At 10% impervious cover, the stream is more visibly impacted. The stream has approximately doubled its original size, tree roots are exposed, and the pool and riffle structure seen in sensitive streams is lost.
Active erosion becomes much more evident at 20% impervious cover with decreased substrate quality due to more material “flushing” through the system.
The surrounding area of this stream is also 20% impervious cover and shows stream erosion that is much worse than in the previous slide due to an absence of vegetation to hold together bank structure.
It’s all in the hydrology

The root causes are:

- imperviousness
- interruption of the hydrological cycle
- bypassing the water through and around the watershed by pipes
Consequences of Development to Urban Streams

- Large Storm
  - Higher Baseflow
  - Higher and More Rapid Peak Discharge
  - More Runoff Volume
  - Lower and Less Rapid Peak
  - Gradual Recession

- Small Storm
  - Pre-development
  - Post-development
EPA’s Small MS4 Permit

- Expires May 1, 2008
- Applies to:
  - 275 Cities and towns
  - 41 State agencies including Mass Highway Department and state universities
- Development of a Storm Water Management Program – including:
  - Public Education
  - Address illicit discharges and map outfalls
  - Implement good housekeeping practices
Outfall Mapping (% Complete)*

* 63% reporting (140 of the 224 year 3 annual reports received)
Regulatory Mechanism Status  IDDE*

* 92% reporting (205 of 224 year 3 annual reports received)
Regulatory Mechanism Status
Construction Site Runoff*

*98% reporting (221 of 224 year 3 annual reports received
Regulatory Mechanism Status
Post Development Runoff*

* 93% reporting (208 of 224 year 3 annual reports received)
UNH Stormwater Center
Comparison of GI and LID

- “Green Infrastructure (GI)” focuses on **where** we develop, and what uses are designated for different parcels of land.

- “LID” focuses on **how** we develop those areas that have been or will be developed, to protect water quality.

- Both are critically important!

- EPA’s “GI” strategy focuses on LID components of GI, to prevent/solve WQ threats/impairments from Stormwater, Non-point Sources & CSO
Climate Change and Stormwater

- Climate change will impact stormwater in New England
- EPA – NE planning science conference on climate change
Pollutant Surrogate - Impervious Cover (ME and CT)

- Compares IC% in impaired watershed to IC% in unimpaired reference watersheds
- ME uses IC% WLA targets of Class B 6 – 9% and Class C 8 – 13%
- CT uses IC% WLA target of 11% for all waters in the state (based on monitoring 125 sites in CT)
- Implementation Plan encourages disconnection of IC or mitigation of impact of IC for both future and existing development (Green Infrastructure BMPs, LID retrofits)
Pollutant Surrogate - Reference Stream (VT)

- Compares flow duration curves of impaired stream to reference streams
- VT uses the Q0.3% high flow value of both curves (approx. 1 year storm) to calculate flow reduction target as a daily percent
- Although not used as an approved TMDL target, VT also uses Q95% as a low or base flow increase goal
- Implementation will occur through watershed permits that will specify BMPs to achieve SW runoff flow reduction targets largely through infiltration
BMP Placement

- How do we select/place for optimum water quality
- Do we install one or multiple controls.....Where
- How do we predict
  - treated volume and load
  - effluent load at each point
  - How do we evaluate costs
- How do we determine load reductions at the receiving water
System for Urban Stormwater Treatment & Analysis INtegration

“SUSTAIN” Framework Manager

- Database
  - Tables
  - Queries

- Watershed Simulation
  - Land Processes
  - Flow/Pollutant Routing

- Optimization
  - BMP Scenarios
  - Decision Criteria
  - Cost Estimation

- BMP Simulation
  - BMP Configuration
  - BMP Processes

- Post-Processor
  - Results Display
  - Results Analysis

- ArcGIS Interface
  - BMP Locations
  - Land-use Types
Green Infrastructure

Classic Definition of **Green Infrastructure**

“An interconnected network of natural areas and other open spaces that conserves natural ecosystem values and functions, sustains clean air and water, and provides a wide array of benefits to people and wildlife” ("Green Infrastructure", Benedict and McMahon, p.1)
Do the Right Things… Right

- Develop a better municipal permit
- Develop effective tools for program implementation
- Develop better TMDLs
- Develop effective partnerships
Low Impact Development

Systems and practices that use or mimic natural processes to:

- Infiltrate
- Evapo-transpirate, or
- Reuse

stormwater or runoff where it is generated.
Jordan Cove
Waterford, CT

- Began 1995
- Residential Subdivision
- Longest standing LID
- Monitoring done over 10 years
Jordan Cove
Waterford, CT
Merrimack, NH

- Pennichuck Square, Merrimack, NH.
- Stormwater retrofit using LID techniques to capture and treat 88% of site runoff
- Techniques such as biofilters, pocket raingardens, pervious pavers and parking lot infiltration dividers
Common LID Management Practices

- Disconnectivity
- Bioretention (Rain Gardens, Infiltration Trenches)
- Permeable and Porous Pavements
- Green Roofs
- Planter Boxes
- Soil Amendment
- Open Swales
- Rain Barrels
### Construction Cost Comparison

<table>
<thead>
<tr>
<th>Category</th>
<th>Conventional</th>
<th>Low Impact</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grading/Roads</td>
<td>$569,698</td>
<td>$426,575</td>
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<tr>
<td>Storm Drains</td>
<td>$225,721</td>
<td>$132,558</td>
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<tr>
<td>SWM Pond/Fees</td>
<td>$260,858</td>
<td>$10,530</td>
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<tr>
<td>Bioretention/Micro</td>
<td>$175,000</td>
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<tr>
<td><strong>Total</strong></td>
<td><strong>$1,086,277</strong></td>
<td><strong>$744,663</strong></td>
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<tr>
<td><strong>Unit Cost</strong></td>
<td><strong>$14,679</strong></td>
<td><strong>$9,193</strong></td>
</tr>
<tr>
<td><strong>Lot Yield</strong></td>
<td>74</td>
<td>81</td>
</tr>
</tbody>
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Prince George’s County, Maryland
Funding Green Infrastructure

- The Clean Water State Revolving Fund
- CWA Section 319 (Non-point source) funds
- Community Development Block Grants
- Rural Utility Service
- Targeted Watershed Grants

http://cfpub2.epa.gov/npdes/greeninfrastructure/fundingopportunities.cfm
Cohasset Example

- Installation of bioretention facilities (raingardens, vegetated swales) to treat stormwater and protect a drinking water source
- Clean Water State Revolving Fund loan
- CWA Section 319 funds
EPA –NE work on LID/GI

- MS4 permit
- LID workshops
- CWSRF
EPA Program Contacts

**Green Infrastructure**
Jackie LeClair  (617)918-1549

**Low Impact Development**
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**Stormwater Program**
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EPA Program Contacts

Total Maximum Daily Load
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SUSTAIN
Anthony Tafuri  (732)321-6604
QUESTIONS???