Integrated Water Management & Smart Growth

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Sandwich  Boston  Providence  Newburyport
On-Site Septic System

Septic Systems **Do Not** Treat Wastewater
Sprawl Versus Smart Growth Streetscapes

Source: Smart Growth America, Urban Advantage
Conventional Development
Source: Jeffery Tumlin, Nelson/Nygaard
Results:

- $<\frac{1}{2}$ the parking
- $<\frac{1}{2}$ the land area
- $\frac{1}{4}$ the arterial trips
- $\frac{1}{6}$ the arterial turning movements
- $<\frac{1}{4}$ the vehicle miles traveled
The map shows the percentage increases in very heavy precipitation (defined as the heaviest 1 percent of all events) from 1958 to 2007 for each region. There are clear trends toward more very heavy precipitation for the nation as a whole, and particularly in the Northeast and Midwest.

Future Design Storms?

Kirshen et al. (2008) project sea-level rise onto time-series of past surge events in the U.S. Northeast to estimate that the 2005 100-year-event will become the 30-70 year event by 2050.

By 2050, Boston could experience the current 100-year riverine flood every two to three years on average and, by 2100, the current 100-year riverine flood is expected to occur every one to two years under both the low- and high-emissions scenarios (MA Climate Change Adaptation Report).
# 100-Year Design Storms (inches)

<table>
<thead>
<tr>
<th></th>
<th>Springfield</th>
<th>Worcester</th>
<th>Boston</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>TP40 Design Storm</strong></td>
<td>6.5</td>
<td>6.5</td>
<td>6.6</td>
</tr>
<tr>
<td>(1930 – 1960)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Cornell Design Storm</strong></td>
<td>8.8</td>
<td>8.8</td>
<td>8.8</td>
</tr>
<tr>
<td>(1936 - 2008)</td>
<td></td>
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</tbody>
</table>

Hydrology Handbook for Conservation Commissions: Appendix F. Rainfall Data for Massachusetts from *Rainfall Frequency Atlas of the United States (TP-40)*. *Users of this Handbook should note that current MA DEP written guidance (see DEP Waterlines newsletter -- Fall 2000) requires the use of TP-40 Rainfall Data for calculations under the Wetlands Protection Regulations and the Stormwater Management Policy. More stringent design storms may be used under a local bylaw or ordinance.*
# Future Design Storms with Continued Climate Change

## Table 5.2: 25-Year, 24-Hour Precipitation (in.)

<table>
<thead>
<tr>
<th></th>
<th>1971-2000 (Baseline)</th>
<th>2046-2075 (A1b)</th>
<th>2046-2075 (A1fi)</th>
</tr>
</thead>
<tbody>
<tr>
<td>TP-40 +95% c.i.</td>
<td>7.46</td>
<td>9.53</td>
<td>12.22</td>
</tr>
<tr>
<td>&quot;most likely&quot;</td>
<td>5.1</td>
<td>6.86</td>
<td>8.35</td>
</tr>
<tr>
<td>-95% c.i.</td>
<td>3.85</td>
<td>4.92</td>
<td>5.66</td>
</tr>
</tbody>
</table>

Source: University of New Hampshire
Landmarks

A. Commonwealth Avenue
B. Newbury Street
C. Old South Church
D. Copley T Station
E. The Esplanade
F. Copley Square
G. Trinity Church
H. John Hancock Tower
I. Hatch Shell
J. Arlington T Station
K. Public Garden and Swan Boats

Legend:
- Current 100-year flood zone
- Projected 100-year flooded area (higher-emissions scenario)
LID Stormwater Management Techniques

- Rain Barrels and Cisterns / Water Re-use
- Stormwater Planters, Tree Planting
- Permeable Paving
- Open Channels
- Bioretention
- Stormwater Wetlands
- Green Rooftop Systems
- Vegetative Buffers
- Infiltration
Permeable Pavement
Dry Well Infiltration of Roof Runoff

Disconnection of Rooftop Runoff to Vegetated Swale
Vegetated Swales
Conveyance, Treatment, Infiltration

- Roadside swales ("country drainage") for lower density and small-scale projects
- For small parking lots
- Mild side slopes and flat longitudinal slopes
- Provides area for snow storage & snowmelt treatment
Bioretention Cell
Water Street, Plymouth Center, MA
NYC GI Design Criteria
New York City – Bioretention Retrofit
Rain Garden
Green Roofs

- Stormwater Runoff absorption/collection
- Reduced flooding of and damage to urban streets
- Interior heating and cooling benefits of 10 degrees or more
- Air purification
- Recreational amenity
- Improved aesthetics
- Extended roof life, estimated at 40 years
Stormwater Planters

- Vegetative uptake of stormwater pollutants
- Pretreatment for suspended solids before they reach water-treatment facilities
- Aesthetically pleasing
- Reduction of peak discharge rate

Source: City of Portland, OR.
Dry Well Infiltration of Roof Runoff

Disconnection of Rooftop Runoff to Vegetated Swale
LID Principles at The Pinehills

• Open Space Residential Design
• Reduce Impervious Areas
• Alternative Landscaping
• Stormwater Management
• Wastewater Re-use
• Nutrient Management
Stormwater Management
Integrated Water Management
WWTP Zone II

MAIN ENTRY

EXIT 3

Route 3

Cranberry Bog

Sacrifice Rock

N13

Crawford Trail

Weeds Ferry Trail

Glenwood Trail

Route 3

Boulder Ridge

Forest Edge

The Snowy Ridge Club

Route 3

Boulder Ridge

Zone II

WWTP

Great Island

Great Island Pond

Cloudy Crossing Pond

NE Bridge

Pineville Fire Station

Red Bank
Figure 1: Post Office Square Park and Garage Monthly Revenue
Figure 3: Summary of Water Usage at Post Office Square (Cubic Feet)
Subgroup Boundaries
208 Water Quality Management Plan Update

**Lower Cape**
- Herring River
- Pleasant Bay
- Stage Harbor Group
- Nauset and Cape Cod Bay Marsh Group

**Mid Cape**
- Cape Cod Bay Group
- Lewis Bay to Bass River
- Three Bays & Centerville River

**Outer Cape**
- Provincetown Harbor
- Wellfleet Harbor & Pamet River

**Upper Cape**
- Waquoit Bay & Popponesset Bay
- Upper Cape West & South
Rain Garden
Kellogg et al., Denitrification and nutrient assimilation on a restored oyster reef
Urine-diverting toilet: 90% of N in wastewater is in the urine!
Permeable Reactive Barriers
TDR: The Concept

Owner of “sending” parcel sells development rights in exchange for permanent conservation easement.

Owner of “receiving” parcel buys development rights to build at densities higher than allowed under base zoning.
THANK YOU!

QUESTIONS?