Modeling Impacts of Green Infrastructure on Flood Level Reduction for the Raritan River

Qizhong (George) Guo

- Floods on Raritan River Basin
- Modeling of Green Infrastructure Impacts on Flood Level
- Costs and Benefits of Green Infrastructure Implementation
- Additional Examples of Modeling and Analysis
- Recommendations

RU on the Raritan – The 8th Annual Sustainable Raritan Conference
Douglass Student Center, New Brunswick, NJ
June 10, 2016
Flood Photos

Nor'easter Floods - April 2007 (during flood)

Hurricane Irene Floods – August 2011 (after flood)
HYDROLOGIC MODELING OF UPPER RARITAN WATERSHED

(USING HEC-HMS 3.5)

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MODELED FLOW IN RARITAN RIVER AT MANVILLE:
APRIL 2007 NOR’EASTER VS. GREEN INFRASTRUCTURE RETROFIT
(THE GI GOAL: ONE INCH RUNOFF DEPTH REDUCTION, FROM 4.65 TO 3.65 INCHES
THE OUTCOME: PEAK FLOW REDUCTION OF 10,000 CFS, FROM 29,601 TO 19,697 CFS)

(Source: Guo, Q., Kantor, P., Roberts, F. and Robinson, D., 2012: Risk Analysis for Flood Mitigation on the Raritan, Final Report, April 30, Command, Control and Interoperability Center for Advanced Data Analysis, Rutgers University, Piscataway, NJ 08854.)
Green Infrastructure that can be used to achieve one-inch runoff reduction and their costs per acre of land surface

<table>
<thead>
<tr>
<th>Green Infrastructure Technique</th>
<th>Area (ft²)</th>
<th>Capital Cost ($)</th>
<th>Annual Maint ($)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Permeable pavement</td>
<td>3,000</td>
<td>$19,020</td>
<td>$570</td>
</tr>
<tr>
<td>Swales in parking lot</td>
<td>400</td>
<td>$8,000</td>
<td>$50</td>
</tr>
<tr>
<td>Roadside swales</td>
<td>800</td>
<td>$16,000</td>
<td>$100</td>
</tr>
<tr>
<td>Rain gardens</td>
<td>600</td>
<td>$7,200</td>
<td>$205</td>
</tr>
<tr>
<td>Downspout disconnect</td>
<td>-</td>
<td>$70</td>
<td>-</td>
</tr>
<tr>
<td>Cisterns (500 gallons)</td>
<td>-</td>
<td>$725</td>
<td>$35</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td><strong>4,800</strong></td>
<td><strong>$51,015</strong></td>
<td><strong>$960</strong></td>
</tr>
</tbody>
</table>

Note: Cost estimates do not include demolition and removal fees for retrofits.

(Source: Guo et al., 2012)
INSURANCE PAYOUT VERSUS FLOOD WATER VOLUME FOR MANVILLE

(Source: Guo et al., 2012)
Additional Examples of Modeling and Analysis

Modeling of Long-Term Flow and Fecal Coliform Count for Whippany River (Li & Guo, 2003)

Modeling of Circulation Patterns in Barnegat Bay (Guo et al., 2000)

Framework for Developing Coastal Flood Risk Reduction Strategies (Guo et al, 2014)

Modeling of Stormwater Runoff and Tidal Flow for Marshes Creek (ongoing)
RECOMMENDATIONS

- Develop a watershed model to help quantify hydrology, hydrodynamics, water quality, water supply, flooding, geomorphology, ecology, economics, etc.

- Develop risk-based, green, and adaptive strategies for flood management in conjunction with grey infrastructure strategies, and use the developed watershed model to help quantify effectiveness, costs, and broader benefits.

- Establish an interactive platform and control center for faculty, students, managers, communities, et al. to test run the watershed management scenarios and emergency response actions, based on the developed watershed model.

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