Considerations for Restoration of Industrialized Rivers in The United States: A Case Study of the Lower Passaic River in the New York/New Jersey Harbor Estuary

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Urban Waterway Issues

• Long histories of change and degradation
• Multiple stressors and constraints
• Cascade of change
• Multiple regulatory paradigms, agencies and stakeholders
• Economic and societal benefits and drivers
• Environmental liabilities
• Public and private culpability
• “Baseline” is a moving target—difficult to define
• Scope for potential restoration is often large
Lower Passaic River
Urban Waterway Decision-Making Considerations

• Value judgments are critical to achieve balanced mixed uses of waterways
• Superfund risk assessment and management for contaminants—does the current process accomplish what it intends to do?
• Source history, controls and allowances
• Resource/cost considerations
• Benchmarking – what restoration can the system support
• Creative engineering
Historical Impacts in the Lower Passaic River

- 1800 - 1825: Population growth, agriculture, timber
- 1825 - 1850: Habitat Loss – Filling/Destruction of Wetlands
- 1850 - 1875: Petroleum industry/oil spills
- 1875 - 1900: Heavy metal pollution from industry
- 1900 - 1925: Coal tar/PAH pollution
- 1925 - 1950: Dredging activity
- 1950 - 1975: Sewage comprises large volume of river
- 1975 - 2000: Organic chemical pollution
- 2000 -: Limited recovery of water quality

- Loss of Shad fishery
- Loss of numerous breeding birds
## Shoreline Impacts/Features

<table>
<thead>
<tr>
<th>Feature</th>
<th>Left*</th>
<th>Right*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bulkhead</td>
<td>51.9%</td>
<td>52.5%</td>
</tr>
<tr>
<td>RipRap</td>
<td>28.5%</td>
<td>32.3%</td>
</tr>
<tr>
<td>Vegetation with RipRap</td>
<td>13.8%</td>
<td>9.2%</td>
</tr>
<tr>
<td>Aquatic Vegetation</td>
<td>5.8%</td>
<td>6.0%</td>
</tr>
</tbody>
</table>

*Facing Up-River from Newark Bay
Wetlands Loss in the Region

Mid-19th Century

Today

LEGEND
- Blue mud
- Cedar swamp
- Peat
- Peat blue mud
- Open water

Wetland Study Area
25,090 acres total

Wetland 7,921 acres
## Loss of Tributaries in Region

<table>
<thead>
<tr>
<th>River/Creek</th>
<th>Estimated Length Lost (mi)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bound Creek and Tributaries</td>
<td>18.1</td>
</tr>
<tr>
<td>Maple Island Creek and Tributaries</td>
<td>13.2</td>
</tr>
<tr>
<td>First River and Tributaries</td>
<td>6.0</td>
</tr>
<tr>
<td>Unnamed Passaic Tributary Creeks</td>
<td>0.7</td>
</tr>
<tr>
<td>Kearny Marsh Tributaries</td>
<td>1.2</td>
</tr>
<tr>
<td>Great Meadow Brook and Tributaries</td>
<td>6.3</td>
</tr>
<tr>
<td>Oyster Creek and Tributaries</td>
<td>2.3</td>
</tr>
<tr>
<td>Upper Newark Bay Tributaries</td>
<td>10.9</td>
</tr>
<tr>
<td>Other Newark Bay Tributaries</td>
<td>20.2</td>
</tr>
<tr>
<td><strong>Total Lost</strong></td>
<td><strong>76.6</strong></td>
</tr>
</tbody>
</table>
Dundee Dam

- In place more than 150 years
- Changed the hydrology of the river
- Caused shifts in ecological communities
Expected Natural Habitats in the Lower Passaic River

- Mudflat
- Salt marsh – low marsh
- Salt marsh – high marsh
- Estuarine scrub-shrub
- Transitional tidal marsh
- Freshwater tidal marsh
- Transitional and freshwater scrub shrub
- Floodplain forest
Factors Controlling Potential Restoration in the Lower Passaic River

• Shoreline use/configuration
• Geomorphic setting
• Tidal zone
• Flooding/inundation
• Elevation
• Salinity
• Shade/sun
• Substrate
• Water velocity
Where is *Spartina*?

- Upper limit at about river mile 2.7
- Habitat conditions are a factor
Proposed Superfund Action

- Dredging/capping remedy proposed for lower 8 miles of the Passaic river
- *Very high costs*: at least $2+ billion
- Limited, if any, risk reduction due to ongoing sources of contaminants and apparent natural attenuation
- No restoration or improvement of ecological or human use conditions
- More information at: [www.ourpassaic.org](http://www.ourpassaic.org)
The Future—Moving Forward, Not Repeating History

• The Passaic River’s severe degradation makes it an ideal template for urban river renewal

• Scope for restoration is substantial

• How do we get it done?
  – Understand and address system constraints
  – Ecological benchmarking
  – Balance human/wildlife needs
  – Balance of value judgments
  – Set realistic goals
  – Creative ecological engineering

• Goal is to create an ecosystem balanced for biological production, and human and wildlife use
Conclusions

• Urban systems are particularly difficult and complex

• Quantifying and managing sources and incremental risks is a complicated process in urban waterways
  – Diverse sources (spatial and temporal)
  – Multiple stressors
  – Habitat considerations
  – Lack of appropriate reference

• “Big picture” restoration and baseline considerations are key

• Agencies, industry and stakeholder cooperation is key

• Public/private partnerships, cost- and liability-sharing is key