Forecasting Bay State Vulnerabilities: A case study of climate change adaptation and planning by the communities of Boston, New Bedford, Acushnet and Fairhaven

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National Harbor, Maryland
Outline

• Climate change vulnerability in Massachusetts and the Northeast

• Climate Change Vulnerability Assessment and Adaptation Planning Study for New Bedford, Fairhaven and Acushnet

• Tracking Progress: Boston Climate Change Indicators Project

• Lessons learned
Regional Vulnerabilities and Challenges

- Severe storms
- Coastal flooding
- Increasing temperatures
- Increased precipitation
- Coastal erosion
- Vulnerable wetlands
New Bedford Harbor Communities

- Potential hurricane barrier failure in severe storm coupled with SLR
- Hurricane barrier protects urbanized area, environmental justice communities, and a nationally-important fishing fleet
- Public property, especially wastewater infrastructure, at risk
- Discrepancies between FEMA FIRM BFEs and LiDAR data make it difficult to assess vulnerabilities in region
Inundation modeling using SLOSH

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Variations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Landfall Location</td>
<td>12</td>
</tr>
<tr>
<td>Pressure Deficit</td>
<td>5</td>
</tr>
<tr>
<td>Radius of Maximum Winds</td>
<td>6</td>
</tr>
<tr>
<td>Forward Speed</td>
<td>6</td>
</tr>
<tr>
<td>Track Direction</td>
<td>7</td>
</tr>
</tbody>
</table>

Matrix Total Cases: 15,120 per water level
5,120 per water level
60,480 total

Result: 20 summary depth grids (5 hurricane categories x 4 water level scenarios)
Risk quantification using Hazus
Develop engineering recommendations

<table>
<thead>
<tr>
<th>Structure Location in Acushnet</th>
<th>Inundation depth (NAVD88 ft) for Category 3 Hurricane with no SLR</th>
<th>Inundation depth (NAVD88 ft) for Category 3 Hurricane with 4-ft SLR</th>
<th>Preliminary Recommendations</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Blueberry Drive</td>
<td>0</td>
<td>0</td>
<td>None</td>
<td></td>
</tr>
<tr>
<td>Allen Street</td>
<td>0</td>
<td>4.74</td>
<td>Consider berm or wall with weir boards for access. Need for generator is unknown. Potential cost range is $25,000 to $75,000</td>
<td>Above ground structure type unknown, likely pre-manufactured housing for pump station. If so, likely cannot be floodproofed and earthen berm will be required.</td>
</tr>
<tr>
<td>Slocum Street</td>
<td>0.85</td>
<td>23.84</td>
<td>Add flood proof door and extend vents. Potential cost range is $10,000 to $25,000. On-site generator will be expensive and not included in these costs. Controlling water levels above roof line likely not feasible.</td>
<td>Below ground structure. Vents likely could be flooded with SLR scenario.</td>
</tr>
</tbody>
</table>
User chooses hurricane, parameters and location of interest

Economic damages are summarized for specified town and hurricane scenario

Dynamic map shows inundation extents for chosen hurricane parameters

“Flood fans” provide a summary of water levels for many storms at a single location

Exceedance probability curve shows the water level for the selected storm at the Newport station plotted against the NOAA exceedance probability

http://seaplan.buzzardsbay.org/risk/
Informational tool development

Map displays hurricane inundation extents and key infrastructure and population data features for each modeled hurricane category in the chosen sea level rise scenario.

User chooses sea level rise scenario from one of four tabs.

http://seaplan.buzzardsbay.org/
Major findings and next steps

• Inundation over and around hurricane barriers predicted in Category 2 storm with 4-ft SLR and in Category 3 storms

• Maximum inundation depths of 11 – 32 ft above sea level in a Category 3 storm

• Estimated economic damages to buildings range from $559 million to $3.5 billion in Category 3 storms

• 15 – 26 pump stations, and 1 wastewater treatment plant in floodplain in Category 3 storm

• Site visits to infrastructure and modeling of CSO system needed to refine recommendations to improve wastewater infrastructure
Lessons learned

• Use local expertise to prioritize assessments and vet recommendations

• Establish criteria for acceptable level of risk based on stakeholder feedback and engineering standards

• Apply tools at local level

• Create variety of informational tools (electronic and paper-based) to communicate results
Project Overview:

• Develop a climate change adaptation indicators framework for City of Boston to track progress on preparing for climate change

• Funded by the Barr Foundation

Project Partners:

• SeaPlan
• City of Boston
• The Boston Harbor Association
• EcoAdapt
Impetus for project:

- Climate change is a large risk to Boston

- Key threats:
  - Coastal flooding (saltwater)
  - Heat
  - Extreme storms/precipitation (freshwater)
Boston Climate Change Indicators

Legend

Historic Districts selection
- Back Bay Architectural District
- Bay State Road - Back Bay West Architectural
- Bay Village Historic District
- Beacon Hill Historic District
- Fort Point Historic District
- Saint Botolph Street Area Architectural
- South End Landmark District

MHHW +5 ft
MHHW +7.5 ft

Source: Boston Harbor Association
Boston Climate Change Indicators

Source: Neaq
Source: Boston Harbor Association
Source: Climate Ready Boston
Boston Climate Change Indicators

City’s Response to Climate Change:

Climate Action Plan (CAP):
• First developed in 2007; updated every 3 years
• Next update – end of 2014
  • Climate change mitigation
  • Climate change adaptation/preparedness

CAP has mitigation indicators:
• Community greenhouse gas emissions
• Street trees

City is interested in developing adaptation/preparedness indicators
Boston Climate Change Indicators

Literature Review:

• Boston’s articulated CCA priorities

• Guidebooks and academic papers on CCA indicators

• CCA programs, indices and rating systems; Examples: Notre Dame GAIN
  STAR Community Rating System

Lack of nationally consistent CCA indicators
Criteria for climate change adaptation indicators:

- Linked to Boston’s articulated climate change adaptation priorities
- Adaptive and flexible; focused on changing conditions
- Top level
- Complement mitigation goals in the CAP
- Avoid maladaptation
- Combination of Process and outcome indicators
- Data available
Boston Climate Change Indicators

DRAFT climate change adaptation indicators framework for Boston:

<table>
<thead>
<tr>
<th>FRAMEWORK</th>
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<tbody>
<tr>
<td>Institutional planning, capacity and coordination</td>
<td></td>
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<tr>
<td>Climate science and information</td>
<td></td>
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<tr>
<td>Public engagement and awareness</td>
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<tr>
<td>Public health and safety</td>
<td></td>
</tr>
<tr>
<td>Natural resources and ecosystems</td>
<td></td>
</tr>
<tr>
<td>Buildings/infrastructure and critical services (Commercial, residential, government, utilities, public)</td>
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Boston Climate Change Indicators

**Indicator:**
- Effectively prepare for and respond to climate/extreme events; Change mainstreamed into city/reg. plans; resources and finances are adequate

**Indicator Type:**
- Enhance preparedness/readiness

**Description:**
1) Govt./Instit.capacity and planning for climate change; 2) operational coordination, inter and intra-city coordination, regional planning, and coordination of resources/infrastructure not under city jurisdiction; 3) planning and capacity for emergency response; 4) support for mainstreaming climate change into planning, incentivizing resilience (businesses are prepared to continue operating during climate change related events)
Boston Climate Change Indicators

Example – Institutional Planning Capacity/Coordination

**Metrics:**

**Planning**
- # of plans with climate change preparedness integrated
- Governing structure has established policy definitions for 1) planning horizons 2) expected future conditions, and 3) “acceptable risk” defined for sectors and scenarios

**Emergency-related planning**
- Adequate capacity/supplies for emergencies (e.g., # shelters/per sq. mile of vulnerable area); Storm toolkits
- % population reached by early warning systems for hazards
Next steps:

• Assess data availability and metrics
• Vet framework with stakeholders and City of Boston
• Final framework – early 2015
• NOAA / ERG / SeaPlan Community Resilience Indicators Project
Next steps for Massachusetts

- Massachusetts legislature enacts $2.2 Environmental Bond Bill
  - $120 million for coastal infrastructure
  - New programs to support comprehensive climate change adaptation management planning

- MA CZM yearly Coastal Community Resilience Grants and Green Infrastructure Grants focus on identifying and responding to climate change vulnerability