Port of New York and New Jersey

Post Sandy Approach to Resiliency

AAPA - Energy & Environment Seminar
September 12, 2018
Our Port Facilities
Sandy Re-Cap
Based on Nov. 11, 2012 interim data from the FEMA Modeling Task Force Hurricane Sandy Impact Analysis, which combines detailed elevation data with U.S. Geological Survey inspections of high water marks.
Sandy - Damages Incurred
**Recent Storms Tropical Storms**

2011 – Irene Mostly a rain event with large amount of precipitation swelling the streams and rivers. Brought +11” of rain to NJ, causing 3 days of flooding over much of NJ, Upstate NY, and VT.

2012 – Sandy Damage mainly caused by storm surge and to a lesser extent wind. Nominal amount of rain.

2013 - Remnants of Tropical Storm Andrea impact New York with 4+ inches of rain and wind gusts of 45 mph.

2015 - Hurricane Joaquin briefly threatens to approach or strike the New York metropolitan area, forcing New Jersey and New York to begin storm preparations. No US landfall.

2016 - Hurricane Hermine meanders off the coast of southeastern New York as an extratropical cyclone. Strong waves and minor coastal flooding occur along the coastline.

2016 - Hurricane Matthew – came ashore in the Carolinas but we still saw heavy rain and minor flooding.
Tackling the Short Term and the Mid-Range Issues
Identifying Critical Infrastructure

- Assets (Tools, Machinery, Equipment used to support port operations)
- Operations and preparedness for the next event.
Long Term Planning
Design Guidelines Climate Resilience

- Used for all capital projects
- Addresses hazards:
  - Increased heat
  - Increased precipitation
  - Sea level rise
- Step-wise process for building flood resilience

Table 2 – Flood Protection Levels

<table>
<thead>
<tr>
<th>Asset Design Life</th>
<th>Non Critical Assets</th>
<th>Critical Assets</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Code Requirement</td>
<td>Sea Level Rise Adjustment</td>
</tr>
<tr>
<td>Up to 2020</td>
<td>12”</td>
<td>6”</td>
</tr>
<tr>
<td>2021-2050</td>
<td>12”</td>
<td>16”</td>
</tr>
<tr>
<td>2051-2080</td>
<td>12”</td>
<td>28”</td>
</tr>
<tr>
<td>2080+</td>
<td>12”</td>
<td>36”</td>
</tr>
</tbody>
</table>

Climate Change - Sea Level Rise

New York City Panel on Climate Change 2015
Regional Mean Sea Level Rise

Source: NASA Goddard Institute, Columbia University (2015),
Applicable to Port District and Recommended for Port Authority adoption by OEEP
Understanding Climate Change Risk – 50th Percentile

100 Year Storm
50th Percentile SLR Projections

Design Base Flood Elevation
2050 BFE with Freeboard (15.3')

2050 BFE (14.3')
Today's BFE (13.0')

50th Percentile SLR Projections
2100 MSL (+36'')
2085 MSL (+28'')
2055 MSL (+16'')
2025 MSL (+8'')
Today's MSL
Understanding Climate Change Risk

100 Year Storm
10th Percentile SLR Projections
Design Base Flood Elevation
2050 BFE with Freeboard (16.5')

2050 BFE (15.5')

Today's BFE (13.0')

90th Percentile SLR Projections
2100 MSL (+75')
2085 MSL (+58')
2055 MSL (+30')
2025 MSL (+10')

Today's MSL

Average Top of Wharf Elevation 8.6'
Understanding Climate Change Impacts
Sea Level Rise and Flood Risk

- Port Authority Design Guidelines for Climate Resilience considers the following projections of SLR for resilient planning:

  - Study evaluated 4 coastal flood return periods with these future conditions:
    - 10-year: ~90% chance within a 20-year period
    - 50-year: ~30% chance within a 20-year period
    - 100-year: ~20% chance within a 20-year period
    - 500-year: ~3% chance within a 20-year period

<table>
<thead>
<tr>
<th>Time Period</th>
<th>50th Percentile</th>
<th>90th Percentile</th>
</tr>
</thead>
<tbody>
<tr>
<td>2025</td>
<td>6”</td>
<td>10”</td>
</tr>
<tr>
<td>2035*</td>
<td>9”</td>
<td>17”</td>
</tr>
<tr>
<td>2055</td>
<td>16”</td>
<td>30”</td>
</tr>
</tbody>
</table>

* 2035 values are interpolated, following Horton et al. 2015
Identifying Critical Infrastructure

- Assets (Tools, Machinery, Equipment used to support port operations)
- Operations (Operational components used to carry out typical port function)
- What is a priority?
  - Discussion with port infrastructure and operations expert to determine assets and operations critical to tenant operations.
- What is the purpose of this asset or operation?
- Can the tenant function (and for how long?) with the asset or operation:
  - Impaired
  - Affected
  - Disabled
Example Hazard Results

Current Sea Level – Projected 10 Year Storm

- 12% of facility inundated
- 10% Annual Exceedance Probability
- Probability of storm event occurring in a given year.
- In 2025 - 23% of facility inundated
100-year Storm

500-year Storm

Flood Depth (feet)
- 0-2.0
- 2.1-4.0
- 4.1-6.0
- 6.1-8.0
- 8.1-10.0
- 10.1-12.0
Modeling Results for a 10-year Event (90% chance within a 20-year period)

Flood Depth (feet)

- 0-2.0
- 2.1-4.0
- 4.1-6.0
- 6.1-8.0
- 8.1-10.0
- 10.1-12.0

SLR: 6”
SLR: 9”
SLR: 16”
SLR: 17”
SLR: 10”
SLR: 30”
How Do We Adapt?
Adaptation Options

Elevation

Relocation

Protection

Adaptation
What We Are Doing Differently

• Incorporate Design Resiliency Guidelines in all capital projects going forward

• Evaluate electrical substations, traffic and rail signals, pump stations and other fire protection systems for latent damage

• Evaluate localized power/electric stations fueled by natural gas and/or diesel to service key infrastructure

• We are performing a complete asset inventory, assets useful remaining life and replacement costs

• Check valves on our storm water out falls to prevent water backing up through our drainage systems.

• Working with Stevens Institute, USAC, and other academic/scientific institutions to develop better modeling, prediction, and warning systems. As well as to develop better resilient strategies.
Thank You

Questions?

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