Flood Resiliency of New York State Infrastructure

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Rainfall Induced Urban Non Urban Coastal Surge Non Urban
Strom Resiliency analysis through data fusion

- Historical data & Risk analysis
- Real time weather Data
- Community Driven Information
- Sensor Networks
Coastal Flooding

- With 1850 miles of tidal shoreline, New York State is heavily impacted by coastal storms.
- FEMA and other organizations provide detailed models and flood maps that can be utilized to identify vulnerabilities of transportation infrastructure.
SLOSH Category 1
Inundation Map

32 Subway Entrances
75 miles of Railroad
69 miles of Highway
44 square miles of Area
Are Flooded in
SLOSH Category 1 Flood
SLOSH Category 2
Inundation Map

70 Subway Entrances
157 miles of Railroad
150 miles of Highway
89 square miles of Area
Are Flooded in
SLOSH Category 2 Flood

Legend

<table>
<thead>
<tr>
<th>Category 2 Flood(ft)</th>
<th>Color</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 - 3.9</td>
<td>Blue</td>
</tr>
<tr>
<td>4 - 7.4</td>
<td>Green</td>
</tr>
<tr>
<td>7.5 - 10.9</td>
<td>Yellow</td>
</tr>
<tr>
<td>11 - 15.3</td>
<td>Orange</td>
</tr>
<tr>
<td>15.4 - 22.2</td>
<td>Red</td>
</tr>
</tbody>
</table>

- Subway Entrances Under Water
- Subway Entrances
- Subway Routes
- Highways in NYC
- Railroad in NYC
- Flooded Highways
- Flooded Railroads

N

0 1.25 2.5 5 7.5 10 Miles
SLOSH Category 3 Inundation Map

109 Subway Entrances
203 miles of Railroad
180 miles of Highway
114 square miles of Area Are Flooded in SLOSH Category 3 Flood
SLOSH Category 4
Inundation Map

157 Subway Entrances
236 miles of Railroad
203 miles of Highway
134 square miles of Area Are Flooded in
SLOSH Category 4 Flood
MOTF Sandy Inundation Map

31 Subway Entrances
88 miles of Railroad
80 miles of Highway
47 square miles of Area Are Flooded in MOTF Sandy Flood
SLOSH Category 1
Inundation Map

2240 miles of Streets
SLOSH Category 1 Flood

Legend
- Streets in NYC
- Streets Flooded in Category 1 Flood

0 1.25 2.5 5 7.5 10
Miles

N
SLOSH Category 3
Inundation Map

4529 miles of Streets
SLOSH Category 3 Flood

Legend
- Streets in NYC
- Streets Flooded in Category 3 Flood

0 1.25 2.5 5 7.5 10 Miles

N

Brooklyn
Queens
Manhattan
Bronx
Staten Island
MOTF Sandy Inundation Map

2049 miles of Streets
MOTF Sandy Flood

Legend
- Streets in NYC
- Streets Flooded in Sandy Flood

[Map showing streets in New York City with flood impact]
Hurricane Sandy Impact on Subway showing impacted ridership
Subsurface Structures not included
Work remaining: Coat Analysis for Rehabilitation
Rainfall Induced Flooding in NYS

- Return period based on Intensity Duration Frequency IDF curves are currently main tool for design of most infrastructure.
- Improvements in IDF is first step in state wide transportation resiliency
Improved Return Period Map for NYS-

Return Period of maximum rainfall Based on 60 yrs of Historical Gridded Rainfall Data

Similar exercise has been done for every 12x12 km
Leading to return period map for the state
10 Year Return Period

Precipitation
7.5 in
1.9 in

Normalized - 10 Year Return Period
Local Scale Flooding Informatics

- Limited information is available for determining the occurrence and impact of floods at the local scale.
- This is especially important in the case of heavily altered urban landscapes.
The Open Data Model

• NYC’s open data source offer the opportunity to provide actionable information.

• We are currently looking at this as valuable model for understanding extreme events state wide
Example: Community Reported Flood/Storm Related Data

- NYC Open Data
  - 311 Information
    - DEP Service Requests
      - Sewer Complaint Type
        - Catch Basin Clogged
        - Street Flooding
        - Highway Flooding
        - Manhole Overflow
        - Culvert Blocked
        - Sewer Backup
        - Sewer Break
        - ..................
        - ..................
Community Based Flood Reporting
Sewer Backup
Community Based Flood Reporting
Catch Basin Clogged
Community Based Flood Reporting
Street Flooding

Complaint Type: SJ
Street Flooding
Community Based Flood Reporting
Sewer Backup
Community Based Flood Reporting
Catch Basin Clogged
Community Based Flood Reporting
Street Flooding
Histogram of Flood Related Data in one day

Histogram showing the count of hour bins for each hour of the day, with different colors representing different descriptors of flood-related data:
- Sewer Backup (Use Comments) (SA)
- Catch Basin Clogged/Flooding (Use Comments) (SC)
- Street Flooding (SJ)
- Manhole Overflow (Use Comments) (SA1)
- Highway Flooding (SH)
- Culvert Blocked/Needs Cleaning (SE)
- Sewer Break (SBR)

The y-axis represents the count of hour, while the x-axis represents the hour of the day from 0 to 23.

Count of Hour for each Hour (bin). Color shows details about Descriptor.
Realtime Weather Data
Stage IV Long Island Radar
Sewer Backup
Flood and Non-flood Induced Occurrences

Historical 311 Data - SA Complaint Types

Historical 311 Data - SA Complaint Types
Street Camera Feeds
Street Camera Feeds
Summary

Local scale extreme event informatics through data fusion:

– Surge Models and geospatial analytics
– Historical data for risk based analysis
– Real time remote sensing
– Local scale community enables data acquisition

Better information for state wide decision making and asset management.