REBUILD
BY DESIGN
- Resist
- Delay
- Store
- Discharge
Hudson River
Coastal Storm Surge Flood Modeling Results
Hoboken  Weehawken  Jersey City  New Jersey
Meeting Agenda

Introduction

Project Update

Introduction to Coastal Storm Surge Modeling

Coastal Modeling Scenarios

Modeling Results
Upcoming Meetings

Community Meeting (CAG) Alternatives Analysis .................................................. July 28
Public Meeting for Preferred Alternative ......................................................... Week of August 15th

www.rbd-hudsonriver.nj.gov
Coastal Storm Surge Modeling
Urban Coast Dynamic Flood Modeling

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and
Thomas O. Herrington

George Meade Bond Professor
Director, Davidson Laboratory
Stevens Institute of Technology
Stevens and NJDEP
RBD Hoboken “Resist”

• “Assist” Dewberry to perform coastal storm surge model validation
• Provide Dewberry with Hoboken data from Hurricane Sandy
• Review the final configuration of the Resist portion of the project
• Consider impacts to Jersey City and Weehawken
Project Drivers

What is **probability** of a flood event?

Where will the water be from a particular storm?
- what streets
- how deep

How would you **mitigate** against the event?

How best to **communicate risk and uncertainty**?
Severe Weather

Tropical Cyclones
(Hurricanes)

Extra-Tropical Storms
(Nor’ easters)
Water level = Tides + Meteorology

Tides are caused by the Sun and the Moon

Meteorology represents the “Storm Tide”
Probabilities

10 year event is 10% - 1 to 2 feet of water*
   chance of being left handed

50 year event is 2% - 3 to 6 feet of water*
   chance you will get Chickenpox after the vaccine
   or chance of getting bitten by a dog

100 year event is 1% - 5 to 8 feet of water*
   chance of earning more than $22,500/year

Hurricane Sandy’s storm tide was a
260 year event or 0.4% - 6 to 9 feet of water*

Same probability as having identical twins.

* On the ground in Hoboken
The Basis of Urban Coast Dynamic Flood Models
Isaac Newton - 1687

Depth Integrated Equations of Motion

\[
\bar{u} = \frac{1}{D} \int_{h}^{n} u \, dz; \quad \bar{v} = \frac{1}{D} \int_{h}^{n} v \, dz; \quad D = h + \eta
\]

\[
\frac{\partial \eta}{\partial t} + \frac{\partial}{\partial x} (\bar{u} D) + \frac{\partial}{\partial y} (\bar{v} D) = 0
\]

\[
\frac{\partial \bar{u}}{\partial t} + \bar{u} \frac{\partial \bar{u}}{\partial x} + \bar{v} \frac{\partial \bar{u}}{\partial y} - f \bar{v} = -g \frac{\partial \eta}{\partial x} + \frac{\tau_{sx} - \tau_{bx}}{\rho_o D}
\]

\[
\frac{\partial \bar{v}}{\partial t} + \bar{u} \frac{\partial \bar{v}}{\partial x} + \bar{v} \frac{\partial \bar{v}}{\partial y} + f \bar{u} = -g \frac{\partial \eta}{\partial y} + \frac{\tau_{sy} - \tau_{by}}{\rho_o D}
\]

\[m\ddot{a} = \sum \vec{F}\]
Data, Data, Data

*Models contain our ‘knowledge’ of the physics.*

*Data contains information about the ‘true’ state*

Data Requirements:

- Wind & Atmospheric pressure over NY/NJ metro area
- Tides in the adjoining offshore NY Bight
- Water level data in Hoboken, JC, Weehawken & NYC
Model Validation

- USGS HWM
- Crowd Sourcing
- Photo/Video

Observed Water Level over Ground (ft) vs. Hindcast Water Level over Ground (ft)
Is this Resilience?
Coastal Modeling Input and Output Parameters

Used FEMA accepted Danish Hydraulic Institute (DHI) MIKE 21 Coastal Model

**Major MIKE 21 Coastal Model Inputs**
- Topography
- Land Use
- Storm Surge Water Levels

**MIKE 21 Coastal Model Simulation Engine**

**Major MIKE 21 Coastal Model Outputs**
- Maximum Water Depth
- Time Series Plots
- Animations
- Difference Plots
Coastal Scenarios

- No Action Alternative (NAA)
- Alternative 1
- Alternative 2
- Alternative 3
RESIST ALTERNATIVES

Alternative 1 (Waterfront)
Alternative 2 (15th Street)
Alternative 3 (Alleyway)
Coastal Modeling Scenario

100 Year Coastal Storm (1%)
ANIMATION SHOWING 100-YEAR COASTAL STORM SURGE FOR NAA AND ALTERNATIVE 1

No Action Alternative

Alternative 1
Animation showing 100-year coastal storm surge for NAA and Alternative 2.
ANIMATION SHOWING 100-YEAR COASTAL STORM SURGE FOR NAA AND ALTERNATIVE 3

No Action Alternative

Alternative 3
NAA WITH 100-YEAR COASTAL STORM SURGE
MAX. WATER DEPTH IN FEET

Areas with water depth > 8 feet

Areas with water 4.5 -6.5 feet deep

Flood waters enter Hoboken & Jersey City via the NJT Hoboken Terminal

Flood waters enter the north via the Weehawken Cove area.

NHSA
Washington Street
Filled Long Slip Canal

NHSA
WWTP
Washington Street
Filled Long Slip Canal

Fill Long Slip Canal
NAA AND ALTERNATIVE 1 WITH 100-YEAR COASTAL STORM SURGE
MAX. WATER DEPTH IN FEET

No Action Alternative

- shows resist feature alignment
NORTH AREA CLOSE-UP COMPARISON OF NAA AND ALTERNATIVE 1 WITH 100-YEAR COASTAL STORM SURGE
MAX. WATER DEPTH IN FEET

No Action Alternative

Alternative 1
Ddifference in water depth (in inches) between NAA and Alternative 1 in the north study area for the 100-year coastal storm surge

**GREEN** shows decreases in flood depth in inches

**PINK** shows increases in flood depth in inches

--- shows resist feature alignment
SOUTHERN AREA CLOSE-UP COMPARISON OF NAA AND ALTERNATIVE 1 WITH 100-YEAR COASTAL STORM SURGE
MAX. WATER DEPTH IN FEET

No Action Alternative

Alternative 1
DIFFERENCE IN WATER DEPTH (IN INCHES) BETWEEN NAA AND
ALTERNATIVE 1 IN THE SOUTH STUDY AREA FOR THE
100-YEAR COASTAL STORM SURGE

**GREEN** shows decreases in flood depth in inches

**PINK** shows increases in flood depth in inches

--- shows resist feature alignment
NAA AND ALTERNATIVE 2 WITH 100-YEAR COASTAL STORM SURGE
MAX. WATER DEPTH IN FEET

No Action Alternative

Alternative 2

--- shows resist feature alignment

Washington Street
Hoboken Terminal
Filled Long Slip Canal

Washington Street
Hoboken Terminal
Filled Long Slip Canal

Weehawken Cove

Weehawken Cove

AREA NO STORMSURGE FLOODING
NORTHERN AREA CLOSE-UP COMPARISON OF NAA AND ALTERNATIVE 2 WITH 100-YEAR COASTAL STORM SURGE
MAX. WATER DEPTH IN FEET

No Action Alternative

Alternative 2
DIFFERENCE IN WATER DEPTH (IN INCHES) BETWEEN NAA AND ALTERNATIVE 2 IN THE NORTH STUDY AREA FOR THE 100-YEAR COASTAL STORM SURGE

Alternative 2

**GREEN** shows decreases in flood depth in inches

**PINK** shows increases in flood depth in inches

--- shows resist feature alignment
SOUTHERN AREA CLOSE-UP COMPARISON OF NAA AND ALTERNATIVE 2 WITH 100-YEAR COASTAL STORM SURGE
MAX. WATER DEPTH IN FEET

No Action Alternative

Alternative 2
DIFFERENCE IN WATER DEPTH (IN INCHES) BETWEEN NAA AND ALTERNATIVE 2 IN THE SOUTH STUDY AREA FOR THE 100-YEAR COASTAL STORM SURGE

GREEN shows decreases in flood depth in inches

PINK shows increases in flood depth in inches

— shows resist feature alignment
NAA AND ALTERNATIVE 3 WITH 100-YEAR COASTAL STORM SURGE
MAX. WATER DEPTH IN FEET

No Action Alternative

Alternative 3

--- shows resist feature alignment
NORTHERN AREA CLOSE-UP COMPARISON OF NAA AND ALTERNATIVE 3 WITH 100-YEAR COASTAL STORM SURGE MAX. WATER DEPTH IN FEET

No Action Alternative

Alternative 3
DIFFERENCE IN WATER DEPTH (IN INCHES) BETWEEN NAA AND ALTERNATIVE 3 IN THE NORTH STUDY AREA FOR THE 100-YEAR COASTAL STORM SURGE

GREEN shows decreases in flood depth in inches

PINK shows increases in flood depth in inches

— shows resist feature alignment
SOUTHERN AREA CLOSE-UP COMPARISON OF NAA AND ALTERNATIVE 3 WITH 100-YEAR COASTAL STORM SURGE

MAX. WATER DEPTH IN FEET

No Action Alternative

Alternative 3
DIFFERENCE IN WATER DEPTH (IN INCHES) BETWEEN NAA AND ALTERNATIVE 3 IN THE SOUTH STUDY AREA FOR THE 100-YEAR COASTAL STORM SURGE

**Alternative 3**

**GREEN** shows decreases in flood depth in inches

**PINK** shows increases in flood depth in inches

--- shows resist feature alignment
Coastal Modeling Scenario

50 Year Coastal Storm (2%)
NAA, ALT. 1, ALT. 2, AND ALT. 3 WITH 50-YEAR COASTAL STORM SURGE
MAX. WATER DEPTH IN FEET

No Action Alternative

Alternative 1

Alternative 2

Alternative 3

— shows resist feature alignment
Comparison of differences in water depth (in inches) between NAA and three alternatives in the north study area for the 50-year coastal storm surge

Alternative 1
Alternative 2
Alternative 3

GREEN shows decreases in flood depth in inches
PINK shows increases in flood depth in inches
--- shows resist feature alignment
COMPARISON OF DIFFERENCES IN WATER DEPTH (IN INCHES) BETWEEN NAA AND THREE ALTERNATIVES IN THE SOUTH STUDY AREA FOR THE 50-YEAR COASTAL STORM SURGE

Alternative 1

Alternative 2

Alternative 3

GREEN shows decreases in flood depth in inches

PINK shows increases in flood depth in inches

—- shows resist feature alignment
Coastal Modeling Scenario
10 Year Coastal Storm (10%)
NAA, ALT. 1, ALT. 2, AND ALT. 3 WITH 10-YEAR COASTAL STORM SURGE MAX. WATER DEPTH IN FEET

No Action Alternative

Alternative 1

Alternative 2

Alternative 3

--- shows resist feature alignment
Comparison of differences in water depth (in inches) between NAA and three alternatives in the north study area for the 10-year coastal storm surge.

<table>
<thead>
<tr>
<th>Alternative 1</th>
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**GREEN** shows decreases in flood depth in inches.

**PINK** shows increases in flood depth in inches.

--- shows resist feature alignment.
COMPARISON OF DIFFERENCES IN WATER DEPTH (IN INCHES) BETWEEN NAA AND THREE ALTERNATIVES IN THE SOUTH STUDY AREA FOR THE 10-YEAR COASTAL STORM SURGE

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REBUILD BY DESIGN HUDSON RIVER: RESIST DELAY STORE DISCHARGE

Dewberry DEPARTMENT OF ENVIRONMENTAL PROTECTION
Key Takeaways

We have 3 technically feasible alternatives that will provide flood risk reduction benefits for the project area in the 100-year, 50-year, and 10-year coastal storm events

Adjacent areas also recive Flood Risk Reduction

Approximately 1-inch increase in spot locations in the Weehawken Cove - Harborside Park Area

Community Meeting (CAG) Alternatives Analysis

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July 28
The End
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