REBUILD BY DESIGN

RESSIST • DELAY • STORE • DISCHARGE

HUDSON RIVER

Hoboken • Weehawken • Jersey City • New Jersey

ALTERNATIVES ANALYSIS
Meeting Agenda

Introduction ......................................................................................................................... 5 minutes

Project Status ..................................................................................................................... 5 minutes

Alternatives Analysis .......................................................................................................... 5 minutes

Evaluation Criteria (Matrix) .............................................................................................. 40 minutes
  - Flood Risk Reduction
  - Socioeconomics / Built Environment
  - Benefit Cost Analysis
  - Construction / Maintenance and Operations
  - Environmental Impacts

Takeaways / Next Steps ...................................................................................................... 5 minutes

Q&A ..................................................................................................................................... 20 minutes

Breakout Session ................................................................................................................ 30 minutes
Rebuild by Design Vision

RESIST

DELAY

STORE

DISCHARGE
How are we soliciting community input in this project phase?

**Opportunities to Participate**

- CAG Meetings
- Public Meetings
- Workshops

PUBLIC INVOLVEMENT
The Process

we are here

NOI
Purpose & Need
Scoping
Screening Criteria / Metrics
Concept Screening
Alternative Analysis
Draft EIS
Final EIS
ROD
June 2015
Aug 2015
Sept 2015
Oct 2015
Feb 2016
July 2016
Nov/Dec 2016
Mar/Apr 2017
Apr/May 2017

NEPA PROCESS

FEASIBILITY ASSESSMENT

PUBLIC INVOLVEMENT
Flood Risk Reduction
Flood Risk Reduction

Considers the impacts of the project on flood patterns in the community

• Coastal Storm Surge Risk Reduction
• Rainfall Flood Risk Reduction
• Critical Facilities
NAA AND ALTERNATIVE 1 WITH 100-YEAR COASTAL STORM SURGE

98% OF POPULATION NO LONGER FLOODS
NAA AND ALTERNATIVE 2 WITH 100-YEAR COASTAL STORM SURGE

86% OF POPULATION NO LONGER FLOODS

Shows resist feature alignment
NAA AND ALTERNATIVE 3 WITH 100-YEAR COASTAL STORM SURGE

85% OF POPULATION NO LONGER FLOODS

shows resist feature alignment
Stormwater Modeling - Input and Output Parameters

Used FEMA accepted Danish Hydraulic Institute (DHI) MIKE Urban Model

Major Stormwater Model Inputs
- Pipe, Manholes, Pumps
- Topography
- Rainfall
- DSD Alternatives

MIKE Urban Stormwater Model Simulation Engine
- Flooded Areas
- Time Series Plots
- Animations
- Flow Volumes
Baseline Conditions (NAA) for Stormwater Modeling

Ongoing or completed projects

- H1 Wet Weather Pump Station (Observer Highway)
- H5 Wet Weather Pump Station (11th Street)
- City Hall Green Infrastructure Projects
- Southwest Resiliency Park (Block 12)
- Washington Street Rain Gardens
Proposed underground detention facilities with green/open space on ground surface with discharge features such as pumps to manage rainfall runoff volume

**BASF site**
- Manages rainfall runoff for approx. 55 acres

**NJ Transit site**
- Manages rainfall runoff for approx. 15 acres

**Block 10 site**
- Manages rainfall runoff for approx. 8 acres

**ROW Green/Grey Infrastructure Practices**
- Total of 61 sites to manage street drainage for approx. 13 acres
Blue shows flooded areas simulated by model

● shows flooded spots observed by Emnet (company that monitored flooding during Irene)
COMPARISON OF FLOODING AREAS - HURRICANE IRENE (2011 CONDITIONS) WITH BASELINE CONDITIONS (NAA)

Blue shows flooded areas simulated by model

Hurricane Irene 2011

Baseline Conditions (NAA)

Shows flooded spots observed by Emnet

Washington Street Rain Gardens

City Hall Gl Project

Southwest Park

H1 Pump Station

H5 Pump Station
COMPARISON OF FLOODING AREAS WITH HURRICANE IRENE - BASELINE CONDITIONS (NAA) AND PROPOSED DSD ALTERNATIVE

Baseline Conditions (NAA)

- H5 Pump Station
- Washington Street Rain Gardens
- City Hall GI Project
- Southwest Park

Proposed DSD Alternative

- BASF Site
- NJ Transit Site
- Block 10 Site
COMPARISON OF FLOODING AREAS WITH 5-YEAR/LOW TIDE-
BASELINE CONDITIONS (NAA) AND PROPOSED DSD

Baseline Conditions (NAA)

- H5 Pump Station
- Washington Street Rain Gardens
- City Hall GI Project
- Southwest Park
- H1 Pump Station

Proposed DSD Alternative

- BASF Site
- NJ Transit Site
- Block 10 Site

LEGEND
- WET WEATHER PUMP STATION
- DRAINAGE AREA
- ROW GREEN/GREY INFRASTRUCTURE
- ESTIMATED FLOODED AREA

REBUILD BY DESIGN HUDSON RIVER: RESIST • DELAY • STORE • DISCHARGE
COMPARISON OF FLOODING AREAS WITH 5-YEAR/HIGH TIDE-
BASELINE CONDITIONS (NAA) AND PROPOSED DSD

Baseline Conditions (NAA)

- H5 Pump Station
- Washington Street Rain Gardens
- City Hall GI Project
- Southwest Park
- H1 Pump Station

Proposed DSD Alternative

- BASF Site
- NJ Transit Site
- Block 10 Site

LEGEND

- WET WEATHER PUMP STATION
- DRAINAGE AREA
- ROW GREEN / GREY INFRASTRUCTURE
- ESTIMATED FLOODED AREA
ROW - Typical Sidewalk Condition

UNDERGROUND WATER STORAGE UNIT

TYPICAL CONDITION
Socioeconomics and Built Environment
Socioeconomics and Built Environment

Looks at how project may impact the community – both to people as well as to the man-made environment (buildings and infrastructure)

• Environmental Justice and Public Health
• Viewshed Impacts
• Waterfront Access
• New or Improved Park Space
Rainfall and Environmental Justice

Legend
- Study Area
- Municipal Boundary
- Hudson-Bergen Light Rail (HBLR)
- Area of Reduced Flooding (Based on 5-Year Storm Model)
- Minority Block Groups
- Hispanic Block Groups
- Over 75 Block Groups
- Households in Poverty Census Tracts

ALT-1
48.1 acres flood during NAA (5-year rainfall):
- All receive rainfall flood reduction

ALT-2
- 35.5 acres no longer flood at all

ALT-3
ROW - Typical Bump Out Condition - Implementation
Alternatives Analysis Screening Criteria

- View Corridors
- Waterfront Access
- Park Space
- Connectivity/Circulation
Locations where existing view corridors are impacted by urban design

Impact to Residential View Corridor

Impact to Retail/Dining View Corridor
Length (in feet) of waterfront access that is impacted by urban design
Alternatives Analysis - Park Space

Area (in **acres**) of new or improved park space

New Park Space - Cove Park

Improved Park Space - Bloomfield St
Alternatives Analysis - Connectivity/Circulation

**Number of existing parking spaces impacted + Number of gate closures during storm**

Sidewalk Landscape = Parking impact

West Alleyway Gate Location
Toolkit - Performative Barrier

Technical Performance + Urban Performance

How does it perform as flood protection?
Height Performance
Construction Method
Scouring Performance

What urban amenities does it need to provide?
Context Integration
Functionality
Look & Feel
Zone 2 — Weehawken Cove
Alternative 1, 2, 3 @ Boathouse to Park Space

Zone 3 — Residential
Alternative 1 @ Waterfront along Tea Building
Alternative 2 @ 15th St to Washington St.
Alternative 3 @ Alleyway to Washington St.
<table>
<thead>
<tr>
<th>View Corridors</th>
<th>Waterfront Access</th>
<th>Park Space</th>
<th>Connectivity/Circulation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Residential impacts</td>
<td>Waterfront access impacted</td>
<td>Improved Park Space</td>
<td>0 Parking Impacted, 1 Gate</td>
</tr>
</tbody>
</table>

Weehawken Cove Promenade

- Elevated Promenade
- View Deck
- Lawn
- Gathering Spaces
15th St. Landscape

Sizing Gate Location
<table>
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<th>Connectivity/Circulation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Residential impacts</td>
<td>Waterfront access impacted</td>
<td>Improved Park Space</td>
<td>15-20 Parking Impacted, 2 Gates</td>
</tr>
<tr>
<td>Retail/Dining impacts</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
East Alleyway
Parking: 41 Spaces

14th St.

Bloomfield St.

Washington St.
### Alt. 3 - Garden St. and Alleyway

<table>
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<th>Waterfront Access</th>
<th>Park Space</th>
<th>Connectivity/Circulation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Residential impacts</td>
<td>No Waterfront access impact</td>
<td>New Park Space</td>
<td>0-10 Parking Impacted, 4 Gates</td>
</tr>
<tr>
<td>Retail/Dining impacts</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Image Description:**
- **View Corridors:**
  - Residential impacts
  - Retail/Dining impacts

- **Waterfront Access:**
  - No Waterfront access impact

- **Park Space:**
  - New Park Space

- **Connectivity/Circulation:**
  - 0-10 Parking Impacted, 4 Gates
Zone 4 — North Waterfront

Alternative 1 Only
Zone 4 - Alt. 1

Independence Court Waterfront

Maxwell Place Park
Maxwell Place Park

Waterfront Access Impacted

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Dewberry

New Jersey Department of Environmental Protection
### Independence Court Waterfront

#### View Corridors
- Residential impacts
- Recreational impacts

#### Waterfront Access
- Waterfront access impacted

#### Park Space
- Improved Park Space

#### Connectivity/Circulation
- < 10 Parking Impacted, 5 Gates

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**Dewberry**

[Image of logo]

**State of New Jersey Department of Environmental Protection**
Recreational Pocket Park

Waterfront Access Impacted
Recreational Pocket Park

View Corridors
- Residential impacts
- Retail/Dining impacts

Waterfront Access
- Waterfront access impacted

Park Space
- Improved Park Space

Connectivity/Circulation
- 0 Parking Impacted, 2 Gates

REBUILD BY DESIGN HUDSON RIVER: RESIST DELAY STORE DISCHARGE

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Zone 6 — Observer Highway
Alternative 1, 2, 3 @ Street or along rails

Zone 7 — Jersey Avenue Underpass
Alternative 1, 2, 3 @ Underpass
Flood Barrier + Amenities
Toolkit

Wayfinding

Seating

Bike Parking

Mural

Wall Planting

Shrub Planter
Alt. 1 Overview

- Uplighting
- Bike Parking
- Lighting
- Seating
- Table
- Texture
- Shrubs on Grade
- Wayfinding
- Mural

REBUILD BY DESIGN HUDSON RIVER: RESIST • DELAY • STORE • DISCHARGE

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NEW JERSEY DEPARTMENT OF ENVIRONMENTAL PROTECTION
<table>
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<th>Waterfront Access</th>
<th>Park Space</th>
<th>Connectivity/Circulation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Residential impacts</td>
<td>No Waterfront access impact</td>
<td>N/A</td>
<td>0 Parking Impacted, 2-5 Gates</td>
</tr>
<tr>
<td>Retail/Dining impacts</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Observer Highway**
<table>
<thead>
<tr>
<th>View Corridors</th>
<th>Waterfront Access</th>
<th>Park Space</th>
<th>Connectivity/Circulation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Residential impacts</td>
<td>No Waterfront access impact</td>
<td>N/A</td>
<td>0 Parking Impacted, 1-3 Gates</td>
</tr>
</tbody>
</table>
Zone 1 — Weehawken Tie In
Alternative 1 @ Waterfront to Lincoln Tunnel
Alternative 2, 3 @ Inland to 19th Street
### View Corridors
- Recreational impacts

### Waterfront Access
- No Waterfront access impact

### Park Space
- N/A

### Connectivity/Circulation
- 0 Parking Impacted, 3 Gates
Alt. 1 - Weehawken Park Space
Sloped + Sheltered

Waterfront Access Impacted
Benefit Cost Analysis
Benefit Cost Analysis (BCA) considers the project’s cost and the value of its benefits

- Benefits
- Cost
- Benefit/Cost Ratio
## Project Costs - Resist

<table>
<thead>
<tr>
<th>ALT-1</th>
<th>Option 1 ($M)</th>
<th>Option 2 ($M)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Construction Costs</td>
<td>$345-387</td>
<td>$354-395</td>
</tr>
<tr>
<td>Design, Engineering, and Project Management</td>
<td>$95</td>
<td>$97</td>
</tr>
<tr>
<td>Estimated Project Cost</td>
<td>$440-482</td>
<td>$451-492</td>
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<tr>
<td>Project Contingency</td>
<td>$96-107</td>
<td>$99-110</td>
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<tr>
<td>Total Project Cost</td>
<td>$537-589</td>
<td>$550-602</td>
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</table>
## Project Costs - Resist

<table>
<thead>
<tr>
<th>ALT-2</th>
<th>Option 1 ($M)</th>
<th>Option 2 ($M)</th>
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</thead>
<tbody>
<tr>
<td>Construction Costs</td>
<td>$145-168</td>
<td>$155-174</td>
</tr>
<tr>
<td>Design, Engineering, and Project Management</td>
<td>$56</td>
<td>$57</td>
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<tr>
<td>Estimated Project Cost</td>
<td>$201-224</td>
<td>$212-232</td>
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<tr>
<td>Project Contingency</td>
<td>$43-49</td>
<td>$45-50</td>
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<tr>
<td>Total Project Cost</td>
<td>$243-273</td>
<td>$258-282</td>
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</table>
## Project Costs - Resist

<table>
<thead>
<tr>
<th>ALT-3</th>
<th>Option 1 ($M)</th>
<th>Option 2 ($M)</th>
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</thead>
<tbody>
<tr>
<td>Construction Costs</td>
<td>$136-156</td>
<td>$144-168</td>
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<tr>
<td>Design, Engineering, and Project Management</td>
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<td>$56</td>
</tr>
<tr>
<td>Estimated Project Cost</td>
<td>$189-210</td>
<td>$200-225</td>
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<td>Project Contingency</td>
<td>$40-45</td>
<td>$43-49</td>
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<tr>
<td>Total Project Cost</td>
<td>$230-255</td>
<td>$243-274</td>
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<td>DSD ($M)</td>
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<td>--------------------------------</td>
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<td></td>
</tr>
<tr>
<td>Construction Costs</td>
<td>$85.9-100.2</td>
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<tr>
<td>Design, Engineering, and Project Management</td>
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<td>Estimated Project Cost</td>
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<tr>
<td>Project Contingency</td>
<td>$22.6-26.6</td>
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</tr>
<tr>
<td>Total Project Cost</td>
<td>$126.4-148.0</td>
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</tr>
</tbody>
</table>
The purpose of a Benefit-Cost Analysis (BCA) is to demonstrate that the benefits of a project outweigh its costs, or the Benefit-Cost Ratio (BCR) is greater than 1.0.

\[
\text{BCR} = \frac{\text{BENEFITS}}{\text{COSTS}}
\]

BCA can also provide a common basis for comparison of project alternatives.
**Benefit-Cost Analysis Methodology**

### Hazard Info
- Coastal flood analysis depth grids
- Rainfall/drainage flood analysis depth grids
- Event recurrence intervals

### Project Costs
- Construction costs
- Design, engineering, project management
- Operation and maintenance

### Project Benefits
- Avoided physical damages (structures, contents)
- Avoided loss of function (residential displacement, non-residential business, and/or service losses)
- Socioeconomics benefits (mental stress and anxiety, lost productivity)

### Inventory Information
- Structures and contents
- Displacement and service losses
- Depth-damage functions

**BCR = \frac{\text{BENEFITS}}{\text{COSTS}}**
Maintenance / Operations and Construction
Considers issues of constructability and maintenance and operation once the project elements are built

- Constructability
- Temporary Construction Impacts
- Estimated Annual Maintenance Costs
<table>
<thead>
<tr>
<th>Resist Feature: Operations and Maintenance Annual Cost (Estimate, $M)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>ALT-1</strong></td>
</tr>
<tr>
<td><strong>ALT-1</strong></td>
</tr>
<tr>
<td><strong>ALT-2</strong></td>
</tr>
<tr>
<td><strong>ALT-2</strong></td>
</tr>
<tr>
<td><strong>ALT-3</strong></td>
</tr>
<tr>
<td><strong>ALT-3</strong></td>
</tr>
</tbody>
</table>

**Delay Store Discharge Annual O&M Estimate:** $1 - $2M
Constructability - Potential Private Property Easement

Legend

- Study Area
- Proposed Resist Structure
  - Proposed Underground Tank
- Proposed Underground Piping
- Municipal Boundary
- Hudson-Bergen Light Rail (HBLR)
- Potential Private Property Easement

ALT-1
- 15 properties with potential easements
- Approx. 4,860-4,600 feet of utility relocation

ALT-2
- 6 properties with potential easements
- Approx. 2,300-2,060 feet of utility relocation

ALT-3
- 6 properties with potential easements
- Approx. 1,280-1,030 feet of utility relocation
Environmental Impacts
Compares the impacts of the Build Alternatives on the built and natural environment, including resources such as historic properties and species habitat

- Recognized Environmental Conditions
- Environmental Permitting
- Historic/Archaeological Resources
- Noise Receptors
Recognized Environmental Conditions

Legend:
- Study Area
- Proposed Resist Structure
- Proposed Underground Tank
- Proposed Underground Piping
- Municipal Boundary
- Hudson-Bergen Light Rail (HBLR)
- NJDEP Mapped Historic Fill (REC 1)
- Current and Historic Rail Area (REC 2)
- REC Site Impacted by Chlorinated Solvents
- REC Parcels
- NJDEP Mapped Classification Exception Areas
- NJDEP Mapped Deed Notice Parcels

- ALT-1
  - 43-46 RECs
  - Approx. 150,000 tons soil (total) potentially requiring off-site disposal

- ALT-2
  - 45-49 RECs
  - Approx. 138,000 tons soil (total) potentially requiring off-site disposal

- ALT-3
  - 45-49 RECs
  - Approx. 137,000 tons soil (total) potentially requiring off-site disposal

REBUILD BY DESIGN HUDSON RIVER: RESIST DELAY STORE DISCHARGE

Dewberry New Jersey Department of Environmental Protection
COMPARISON OF DIFFERENCES IN WATER DEPTH (IN INCHES) BETWEEN NAA THREE ALTERNATIVES IN THE NORTH STUDY AREA FOR THE 100-YEAR COASTAL STORM

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 THREE ALTERNATIVES IN THE SOUTH STUDY AREA FOR THE 100-YEAR COASTAL STORM

**ALT-1**
- **GREEN** shows decreases in flood depth in inches

**ALT-2**
- **PINK** shows increases in flood depth in inches

**ALT-3**
- **shows resist feature alignment**
Area of Archaeological Potential Impact

Legend:
- Study Area
- Municipal Boundary
- Hudson-Bergen Light Rail (HBLR)
- Area of Archaeological Potential Impact

<table>
<thead>
<tr>
<th>ALT</th>
<th>Impact Area</th>
</tr>
</thead>
<tbody>
<tr>
<td>ALT-1</td>
<td>Approx. 16.6 acres potentially impacted</td>
</tr>
<tr>
<td>ALT-2</td>
<td>Approx. 15.5 acres potentially impacted</td>
</tr>
<tr>
<td>ALT-3</td>
<td>Approx. 14.5 acres potentially impacted</td>
</tr>
</tbody>
</table>

REBUILD BY DESIGN HUDSON RIVER: RESIST DELAY STORE DISCHARGE

Dewberry State of New Jersey DEPARTMENT OF ENVIRONMENTAL PROTECTION
Legend
- Study Area
- Historic Properties with Potential Adverse Affects
- Municipal Boundary
- Hudson-Bergen Light Rail (HBLR)
- Proposed Resist Structure
- Proposed Underground Tank
- Proposed Underground Piping
- Southern Hoboken Historic District
- 3rd Street Historic District
- Central Hoboken Historic District
- Hoboken Historic District
- Hudson and Manhattan Railroad Transit System Historic District
- Old Main Delaware, Lackawanna and Western Railroad Historic District
- Stevens Historic District
- Northern Historic District
- Southern Hoboken Extension Historic District

| ALT-1   | 45 historic properties potentially impacted |
| ALT-2   | 61 historic properties potentially impacted |
| ALT-3   | 60 historic properties potentially impacted |

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State of New Jersey Department of Environmental Protection
Key Takeaways

- All three Build Alternatives provide a substantial level of flood risk reduction
- All three build alternatives screen with benefits and impacts and will continue to be assessed.
- Community input has and will continue to help shape the project
- Design process will continue
- The screening criteria results show that we have viable alternatives for advancement
Next Steps

Period for Alternatives Analysis  Aug. 18, 2016 (3 weeks)

Recommendation of Preferred Alternative Meeting  Sept. 8, 2016


www.rbd-hudsonriver.nj.gov
rbd-hudsonriver@dep.nj.gov
Breakout Stations

Station 1: Three Alternatives and Comment Table
Station 2: NEPA/Alternatives Analysis Process
Station 3: Flood Risk Reduction
Station 4: Built Environment / Socioeconomics
Station 5: Construction, Maintenance, and Operations
Station 6: Environmental Impacts
Station 7: Benefit Cost Analysis