



# Benefit-Cost Analysis of Coastal Flooding Hazard Mitigation

Climate Change Adaptation

March 16,  
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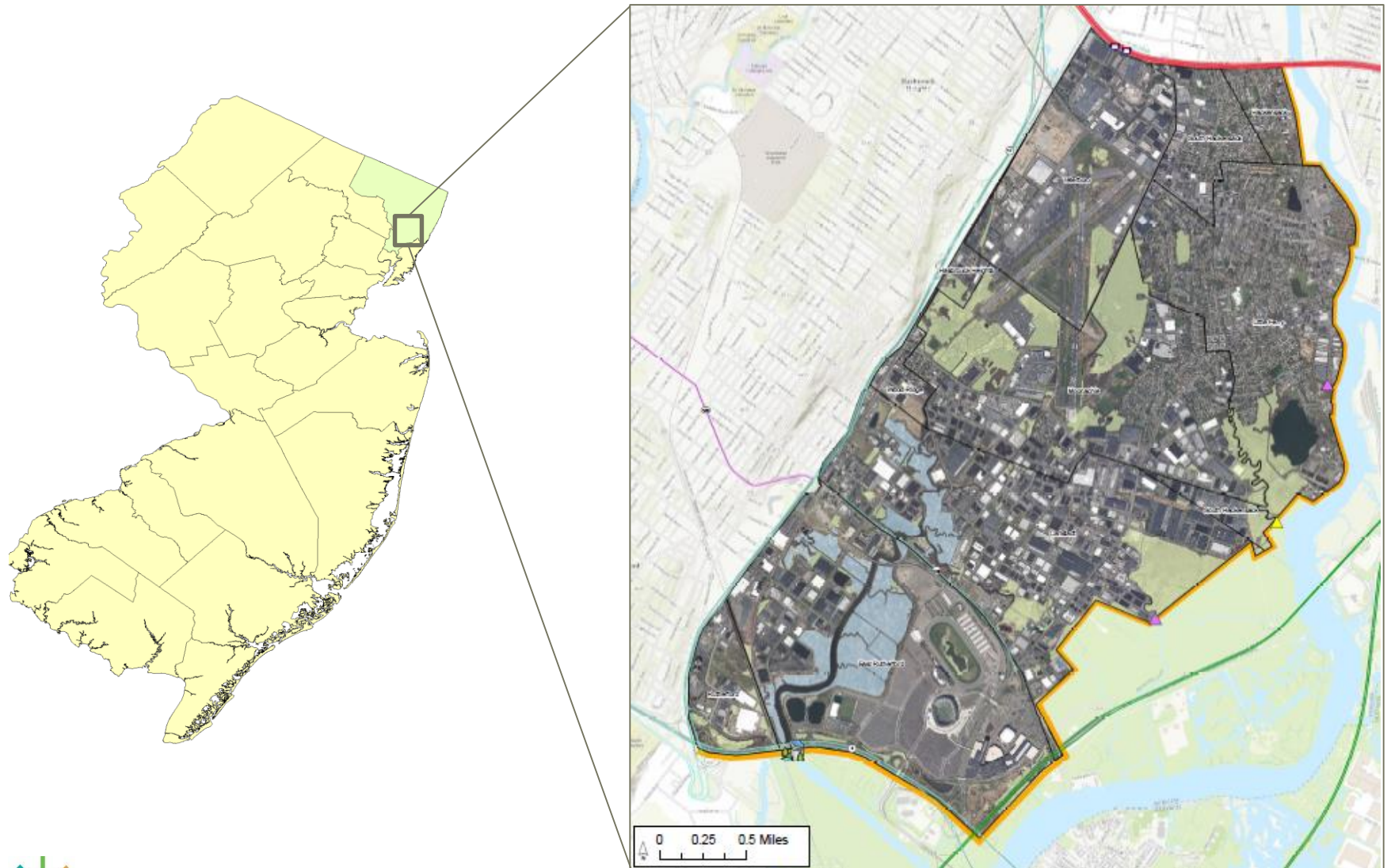


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# **Background and Objectives**

# Map of Project Area – Bergen County, New Jersey



# Bergen County



- Passaic and Hackensack watersheds
- Situated directly across the George Washington Bridge from Manhattan
- The most populous county in New Jersey
- Approximate 1M residents
- More than 12,900 housing units and 6,500 businesses



## Key Landmarks



MetLife Stadium



American Dream Meadowlands



Teterboro Airport



Superfund Site



New Jersey Meadowlands

# Superstorm Sandy in 2012

- Surges of 4-5 feet above average high tide
- Large populations of vulnerable residents and low- and moderate-income households
- Shutdown of sewage treatment, which led to release of hundreds of thousands of gallons of untreated sewage into the river
- Flooding of transit depot



# Analysis Objectives

- **Assess the costs and benefits of the project to mitigate impacts of similar floods**
- **Project components:**
  - Flood wall (berm)
  - Tide control gate
  - Water control structures
  - Wetlands
  - Satellite transit depot
  - Bike and walking paths and other recreational opportunities
- **Account for lifecycle costs**
- **Capture both private and social benefits**
- **Benefits should be based on flood depth, when possible**
- **Reflect the environmental impacts of the project**
- **Integrate the effects of sea level rise**



# Approach and Data



# Approach

## ■ Used Federal Emergency Management Agency's (FEMA) Benefit-Cost Analysis Tool

- Contains depth-damage curves
- Impact estimates of most common benefit categories:
  - Buildings (e.g., building damage, displacement, and loss of function)
  - Utilities (e.g., electricity, water supply, and waste water treatment)
  - Services (e.g., fire services, police services)
- Avoided damages to Teterboro Airport, MetLife Stadium, American Dream Mall



## ■ Leveraged 2014 Rebuild by Design study for New Meadowlands redevelopment that identified many of the avoided damages from flood

- Covered a large portion of the proposed project area
- Used damage-per-acre estimates for each land use type

## ■ Useful life

- 50 years for the flood protection investments: 2016 through 2065
- Analysis period start year of 2016 is for referential purposes only
- 40 years for the new transit depot

# Approach

- **Benefits and costs quantified and monetized where possible**
  - Some quantitative benefits excluded when not sufficiently reliable (e.g., tourism)
- **Two outcome metrics**
  - Net Present Value (NPV)
  - Benefit-to-Cost Ratio (BCR)
- **Discounted monetized benefits and costs to reflect the time value of money**
  - 7% and 3% following Office of Management and Budget (OMB) Circular A-94 guidance
- **Model incorporates increase in flood risk over time**
  - In years 26 to 50, the risk of a 100- and 500-year flood event (9-foot and-11 foot floods, respectively) doubled to reflect climate change mirroring the 2014 Rebuild by Design study for New Meadowlands

# Lifecycle Costs

- **Construction cost of the berm and layered flood protection**
- **Administration and contingency costs**
- **Annual berm and other flood control facility maintenance**
- **Transit depot construction**
- **Bus transit maintenance costs**
- **Land acquisition**
- **Wetland construction**
- **Recreation zone construction**

# Benefits

- **Avoided loss of function of transportation and commercial infrastructure**
- **Avoided fatalities**
- **Avoided residential and commercial damages**
- **Avoided utility and municipal damages**
- **Avoided debris removal**
- **Ecosystem services from wetlands**
- **Recreational and health benefits**
  - A park and nature system will be constructed along the berm



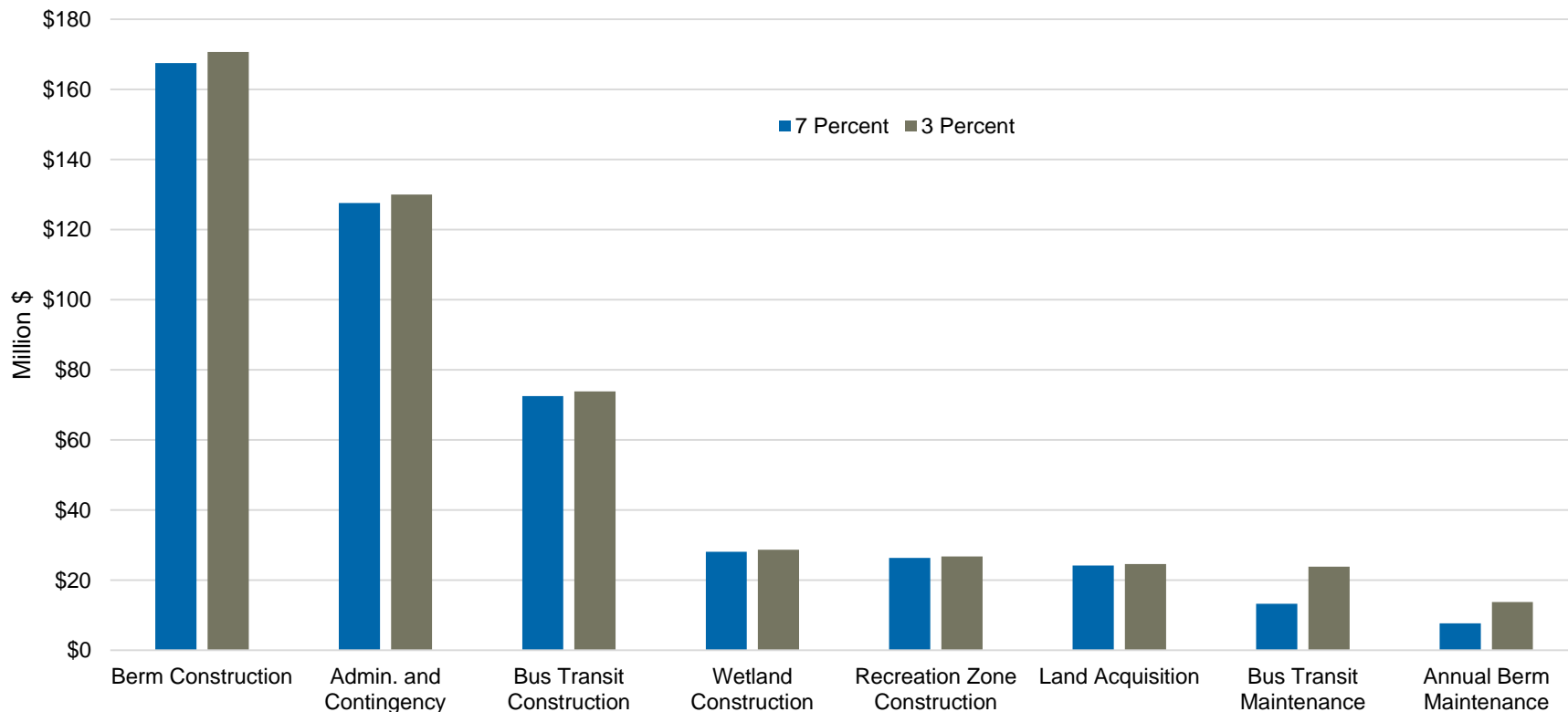
# Data Sources

- FEMA Benefit-Cost Analysis Toolkit
- Meadowlands study by Rebuild by Design (2014)
- New Jersey Departments of Environmental Protection; Transportation; Treasury
- Land Use and Zoning Data
- Municipal-level data for Teterboro, Little Ferry, Moonachie, South Hackensack, Carlstadt, and East Rutherford
- Port Authority of New York and New Jersey
- Federal data: Census Bureau, Department of Commerce, Department of Housing and Urban Development, Bureau of Labor Statistics
- Mantell, Nancy, et. al. (2013). The Economic and Fiscal Impacts of Hurricane Sandy in New Jersey: A Macroeconomic Analysis. Rutgers, 34, pgs. 1-16. Available at: <https://rucore.libraries.rutgers.edu/rutgers-lib/43467/PDF/1/>

# Findings

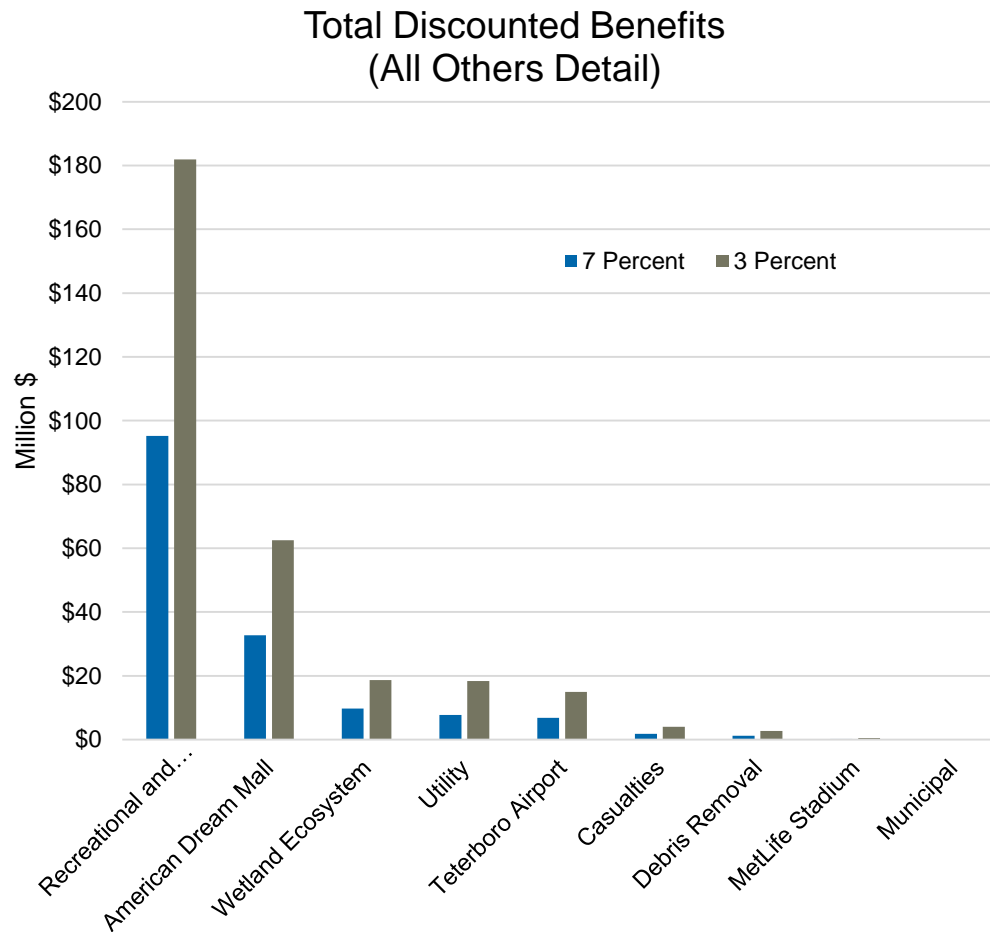
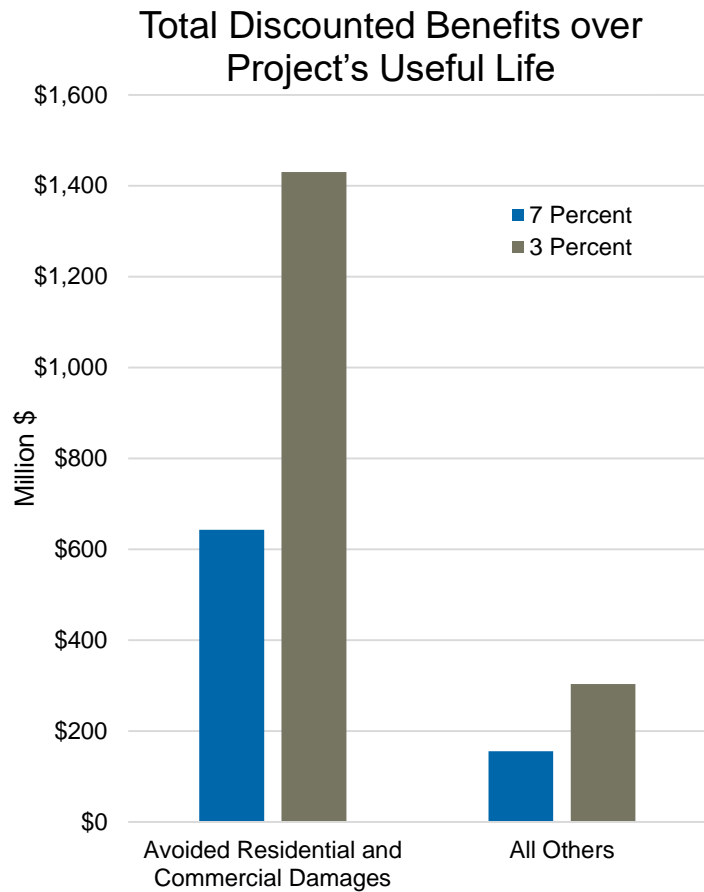
# Costs

Total Discounted Costs over Project's Useful Life (Million \$)



- Construction costs of \$168M and \$171M and administration/contingency costs of \$128M and \$130M are the largest costs and comprise more than 50 percent of the total impact at 7 and 3 percent, respectively.
- Discounted 50-year total costs equal \$467.3M and \$492.3M at 7 and 3 percent, respectively.

# Benefits

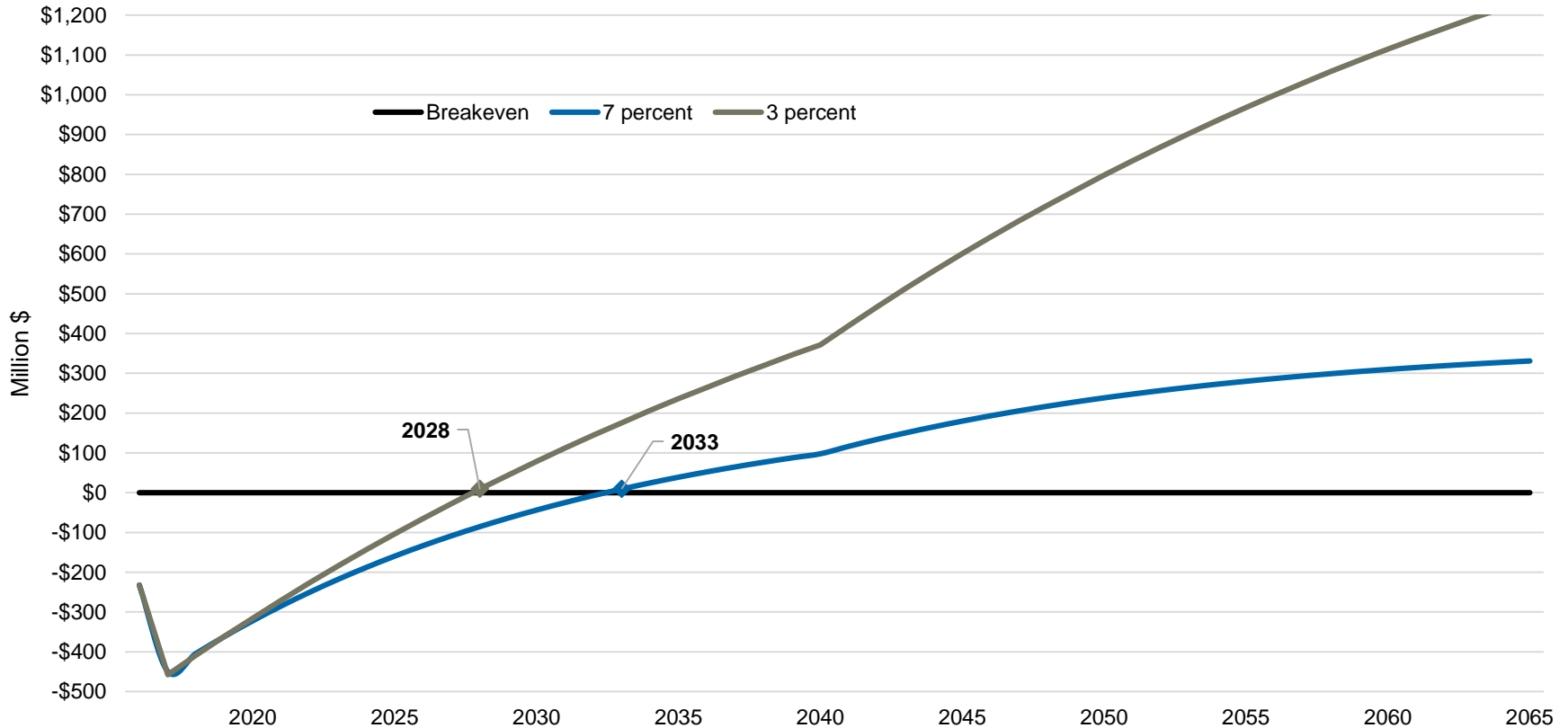


- Avoided residential and commercial damages of \$643M and \$1,429M at 7 and 3 percent, respectively, are the largest benefit and represent more than 80 percent of the total benefit.
- Discounted 50-year total benefits equal \$798.6M and \$1,733.7M at 7 and 3 percent, respectively.



# Net Benefits

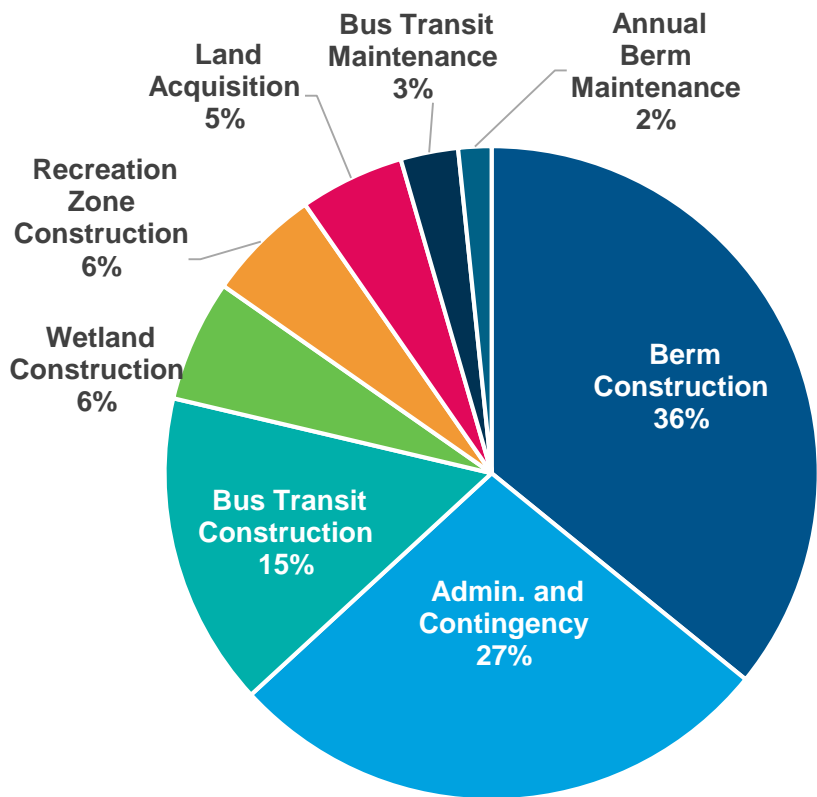
## Cumulative Net Present Value



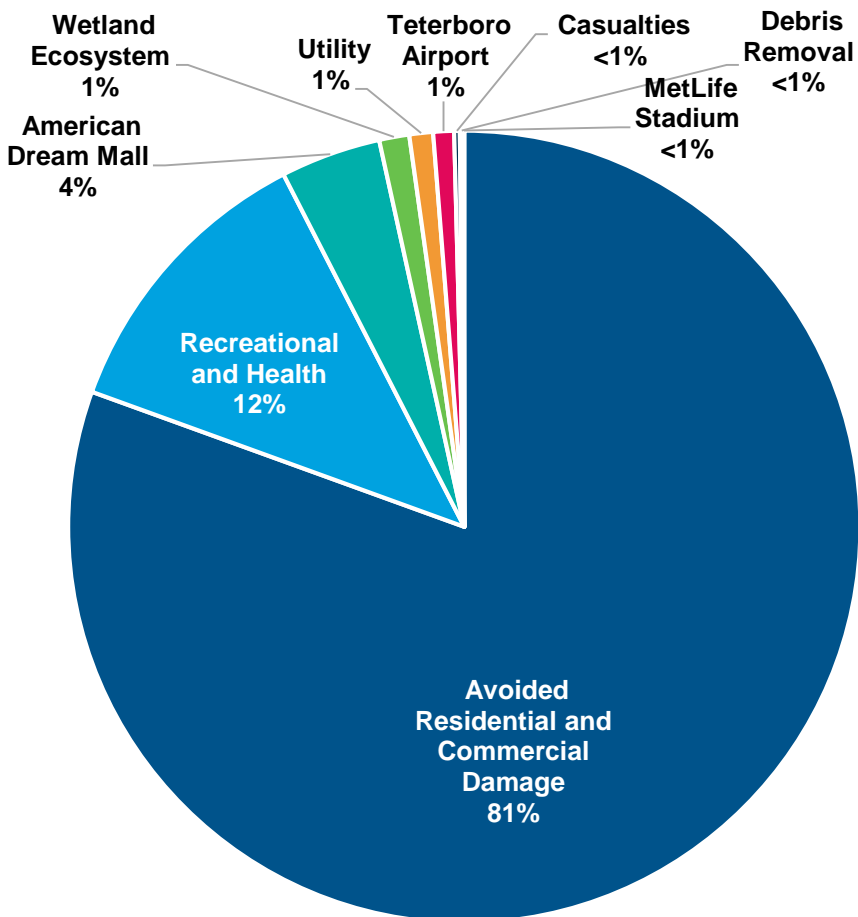
- Breakeven points are located where Cumulative Net Present Value line crosses the black breakeven line at \$0. Breakeven points occur at 2033 and 2028 at 7 and 3 percent, respectively.
- Analysis period start year of 2016 is for referential purposes only.

# Summary of Impacts

**Total Costs = \$467M**  
(7% discounting)



**Total Benefits = \$799M**  
(7% discounting)



**BCR = 1.7**

# Benefits and Impacts We Did Not Monetize

## ■ Environmental Value

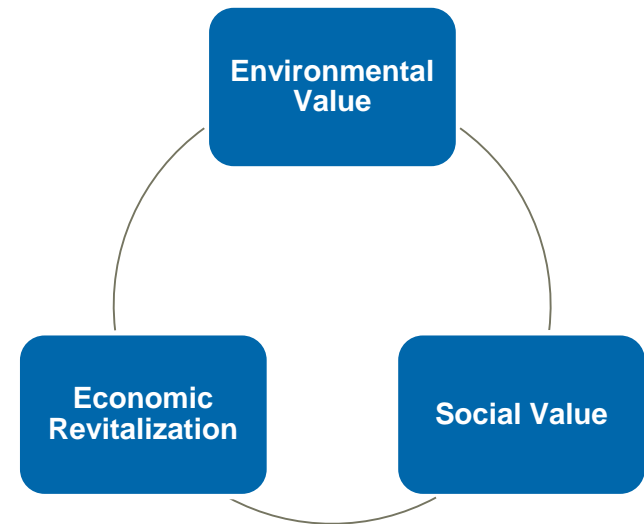
- Enhanced remediation efforts
- Reducing runoff and vehicle emissions
- Increasing wetland space and improving native habitats
- Providing new greenways and open space

## ■ Economic Revitalization

- Decreased insurance premiums
- Increased property values and tax revenues
- Tourism

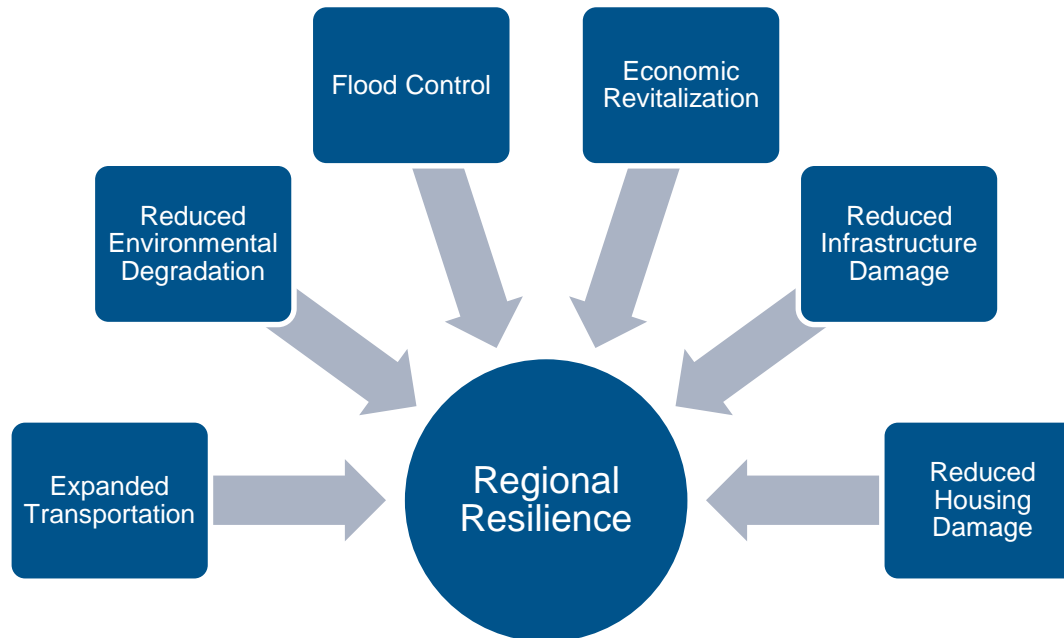
## ■ Social Value

- Bus transit benefits
  - Increased distribution of service
  - Air pollution and congestion reductions
  - Increased ridership capacity
- Developing parks and recreational opportunities in low and moderate income communities
- Reductions in combined-sewer overflows



# Overall Summary of Analysis

- Benefit-cost ratios of 1.7 and 3.5 at 7 and 3 percent, respectively
- Net present values of \$331M and \$1,241M at 7 and 3 percent, respectively.
- Largest benefits are the avoided residential and commercial damages at \$643M and \$1,429M at 7 and 3 percent, respectively
- Largest costs for the project's useful life are construction costs of \$168M and \$171M and administration / contingency costs of \$128M and \$130M at 7 and 3 percent, respectively.





## Questions?

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