# New Jersey
# Department of Community Affairs

**SUPERSTORM SANDY COMMUNITY DEVELOPMENT BLOCK GRANT – DISASTER RECOVERY**

**Public Law 113-2; January 29, 2013**
**FR-5696-N-01; March 5, 2013**
**FR-5696-N-06; November 18, 2013**
**FR-5696-N-11; October 16, 2014**

## ACTION PLAN AMENDMENT NUMBER 25-SUBSTANTIAL AMENDMENT FOR REBUILD BY DESIGN MEADOWLANDS PROJECT

- **Rebuild by Design Meadowlands Project Update**

PUBLIC COMMENT PERIOD: January 13 to February 11, 2018
DATE SUBMITTED TO HUD: March 28, 2018

DATE APPROVED BY HUD: May 18, 2018

Philip Murphy
Governor

Lt. Governor Sheila Y. Oliver
Commissioner

101 South Broad Street, P.O. Box 800
Trenton, NJ 08625-0800


This Substantial Amendment to the Action Plan (as proposed) is available for public review at www.state.nj.us/dca/. It is available in English, Spanish, and Korean.

For those who otherwise cannot obtain a copy of this Substantial Amendment to the Action Plan, the Department of Community Affairs will make copies available upon request. Requests for copies should be directed to the followingaddress:

New Jersey Department of Community Affairs
1st Floor Information Desk
101 South Broad Street
Trenton, New Jersey 08625

The State considered all comments received in writing or via email on the proposed Substantial Amendment to the Action Plan. Comments on the proposed Plan were accepted up until February 11, 2018 at 5:00 pm Eastern Standard Time (EST). Written comments were submitted to the Department of Community Affairs via email at sandy.publiccomment@dca.state.nj.us, or to the attention of Lisa Ryan, NJ Department of Community Affairs, 101 South Broad Street, PO Box 800, Trenton, New Jersey 08625-0800.

A summary of all comments received and written responses is included in this final version of this Substantial Amendment submitted to the US Department of Housing and Urban Development (HUD) for approval. HUD requires the State to hold a public hearing on any proposed Substantial Amendment to the Action Plan. The date, time, and location of the hearing for this Substantial Amendment were asfollows:

January 31, 2018
5 – 8 pm EST
Little Ferry Borough Hall
215-217 Liberty St
Little Ferry, New Jersey

The State has synthesized and provided written responses to the comments received in the final version of the Substantial Amendment to the Action Plan that is now submitted to HUD for approval.

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# SECTION 1: BACKGROUND

## 1.1 Procedural History

The Hurricane Sandy Rebuilding Task Force created the Rebuild by Design (RBD) competition in the summer of 2013 to develop ideas to improve the physical, ecological, and economic resilience of regions affected by Superstorm Sandy. The competition had two goals: (1) to promote innovation by developing flexible solutions that would increase regional resilience; and (2) to implement proposals with both public and private funding dedicated to the RBD effort. To realize the RBD initiative, the US Department of Housing and Urban Development (HUD) set aside Community Development Block Grant – Disaster Recovery (CDBG-DR) funds allocated through the Federal Sandy Supplemental legislation to develop and incentivize implementation of RBD projects.

HUD engaged multi-disciplinary teams composed of architects, designers, planners, and engineers. HUD charged these teams with proposing regional and community-based projects that would promote resilience in various Sandy-affected areas. The teams included experts from around the world. The teams' proposals, developed with and by the communities where the projects were focused, were submitted to HUD. HUD ultimately selected six "winning" projects. Two of those projects were in New Jersey: one focused in the Hudson River region (RBD Hudson) and the other focused in the Meadowlands region (RBD Meadowlands).

On October 16, 2014, HUD issued *Federal Register* Notice FR-5696-N-11 (effective October 21, 2014). This Notice allocated $881,909,000 of third round CDBG-DR funds to New Jersey. Of that total, $380 million was designated for the two RBD projects in New Jersey: RBD Hudson (allocated $230 million by HUD) and RBD Meadowlands (allocated $150 million by HUD). Comprehensive information about the RBD process and the winning projects is available on the RBD website (www.rebuildbydesign.org).

Pursuant to FR-5696-N-11, the State of New Jersey ("the State") prepared Substantial Amendment 12 to its CDBG-DR Action Plan. Substantial Amendment 12 was required to generally:

- Provide RBD Project Descriptions
- Identify Implementation Partnerships
- Identify Leveraged or Reasonably Anticipated Funds for RBD Projects
- Provide Project Timelines
- Include Citizen Participation Plans.

At the time of the submission of Substantial Amendment 12 in February 2015, the ability to provide specific project descriptions beyond the RBD proposals, identify other funding sources, and estimate project timelines was premature. Thus, FR-5696-N-11 required that each of the above elements be updated with a more detailed description for each RBD project in a subsequent RBD Substantial Action Plan Amendment (APA), in order to release funds for construction. Along with the subsequent Substantial APA, FR-5696-N-11 requires the State to certify that it will adequately fund the long-term operation and maintenance (O&M) of the RBD project from reasonably anticipated revenue, recognizing that O&M costs must be provided from sources other than CDBG and CDBG-DR funds.

FR-5696-N-11 and its clarifying guidance also required that the subsequent Substantial APA include an examination of the RBD project through a HUD-approved benefit-cost analysis (BCA).

HUD approved Substantial Amendment 12 on April 20, 2015. This current document provides the required Substantial APA that addresses the specific information required and now available concerning the RBD Meadowlands project.

## 1.2 Substantial Action Plan Amendment 22

Pursuant to FR-5696-N-11, the State was required to submit a Substantial APA to HUD by June 1, 2017 that reflected the updated RBD project overview as a condition for release of funds for project construction. The New Jersey Department of Community Affairs (NJDCA), on behalf of the New Jersey Department of Environmental Protection (NJDEP) submitted Substantial Action Plan Amendment (APA) 22 to satisfy the Federal Notice submittal requirements. However, at the time of the submittal the NJDEP had not selected a final RBD Meadowlands Project design; therefore, APA 22 could not satisfy all of the FR-5696-N requirements.

Consequently, HUD required the RBD Meadowlands Project to submit a Substantial Action Plan Amendment by March 31, 2018 to address all of the requirements of FR-5696-N-11. In accordance with FR-5696-N-11, this Substantial Action Plan Amendment submits the following updates to APA 22:

- Specific Project Description;
- Updated Implementation Partnerships;
- Identification of Leveraged or Reasonably Anticipated Funds;
- Updated Project Timeline;
- Specific Citizen Outreach Plan;
- Certification Regarding Operation and Maintenance Costs; and
- Benefit Cost Analysis Description and Narrative Approach.

Finally, to the extent required in order to ensure that RBD funding is used in compliance with applicable Federal and State laws and regulations, the State

incorporates here all applicable provisions of its CDBG-DR Action Plan, including provisions of Section 6 of the Action Plan applicable to RBD initiatives, as modified by Amendments 1 – 24. From here forward, the Substantial APA for the RBD Meadowlands Project is referred to as APA 25.

# SECTION 2: RBD MEADOWLANDS PROJECT: "PROTECT, CONNECT, GROW"

## 2.1 Purpose and Need

The purpose and need statement for the RBD Meadowlands Project: "Protect, Connect, Grow" (referred to herein as "the Project" or "the RBD Meadowlands Project") was formulated through a comprehensive process. This process began with the development of the original, award-winning proposal submitted to HUD for funding, continued through the scoping process, and is continuing through the concept and alternative development process for the Draft Environmental Impact Statement (DEIS). Key stakeholders, including local elected officials, agencies with regulatory authority, community leaders, and the general public, have been, are, and will continue to be involved at each stage of thisprocess.

The RBD Meadowlands Project Area (Project Area) is depicted in Appendix A. The Project Area includes the Boroughs of Little Ferry, Moonachie, Carlstadt, and Teterboro, and the Township of South Hackensack, all in Bergen County, New Jersey. The Project Area includes approximately 5,405 acres and has the following approximate boundaries: the Hackensack River to the east; Paterson Plank Road to the south; State Route 17 to the west; and Interstate 80 and the northern boundary of the Borough of Little Ferry to the north. The Project Area is vulnerable to flooding from both coastal storm surge and rainfall floodingevents.

### 2.1.1 Purpose

The Project includes the construction and operation of flood risk reduction measures in the Project Area. These measures will be designed to address the impacts of coastal and systemic inland flooding on the quality of the physical, natural, cultural, and socioeconomic environment of the Project Area due to both storm hazards and sea level rise. Therefore, the purpose of the Project is to reduce flood risk and increase the resiliency of the communities and ecosystems within the Project Area, thereby protecting critical infrastructure, residences, businesses, and ecological resources from the more frequent and intense flood events anticipated in the future. The Project could also deliver co-benefits through the protection of ecological resources and enhancement of water quality, which in turn could benefit regional biodiversity and ecosystem resiliency. In addition, the Project could integrate the flood hazard risk reduction strategy with civic, cultural, and recreational values to incorporate active and passive recreational uses, multi-use facilities, public spaces, and other design elements that integrate the Project into the fabric of the community to the extent practicable with the available funding.

### 2.1.2 Need

The Meadowlands are situated in a valley with ridges on its sides that run parallel in a southwest to northeast direction. In some locations, these ridges are over 100 feet above sea level. Comprised of mostly flat terrain, elevations within the Meadowlands do not exceed 10 feet above sea level (North American Vertical Datum of 1988 [NAVD 88]), with most areas less than 6 to 7 feet above sea level (NAVD 88). Flow of water within the Project Area is greatly affected not only by local topography, but also by patterns of urbanization and development. In addition, historic construction of dikes and tide gates in an attempt to control and reduce flooding events has further affected the integrity and spatial configuration of the Project Area and altered its biodiversity. Additionally, existing surface water conveyances within the Project Area are undersized, clogged with sediments, and/or under-utilized. These conditions further compound the drainage challenges within the ProjectArea.

The majority of the Project Area, including 49 critical facilities and other infrastructure, is within the Federal Emergency Management Agency (FEMA)-designated 100-year floodplain (see Appendix A). The Project Area's exposure to flood hazard risks is evident by the number of properties included in the FEMA National Flood Insurance Program (NFIP). Mortgage lenders for properties within the Special Flood Hazard Area (i.e., Zone AE) require property owners to obtain flood insurance from the NFIP. In addition, property owners receiving awards following presidentially declared disasters (such as Superstorm Sandy) are also often required to obtain NFIP insurance.

The interrelationship between coastal flooding and rainfall events contributes to the recurring flooding conditions throughout the Project Area. Each component represents challenges and needs to be addressed within the context of an overall flood reduction strategy for the Project Area. As such, the Project is needed to address: (1) systemic inland flooding from high-intensity rainfall/runoff events and (2) coastal flooding from storm surges and abnormally hightides.

In addition to reducing flooding in the Project Area, the Project is needed to deliver a comprehensive flood reduction strategy that will protect life, public health, and property in the Project Area. The Project seeks to include concepts and alternatives that are consistent with the local municipalities' overall effort to reduce FEMA Flood Insurance Rates.

The Project is further needed to increase community resiliency, including protecting accessibility to, and on-going operations of, critical health care services, emergency services, and transportation and utilityinfrastructure.

### 2.1.3 Key Goals and Objectives

The Project is an urban water management strategy designed to reduce the risk of floods from coastal storm surges and/or systemic inland flooding from large rainfall events within the Project Area, thereby protecting public health, public safety, and property. The ability to meet this purpose will be measured in terms of the following Project goals and objectives:

***Goal: Contribute to Community Resiliency.*** The Proposed Project would integrate a flood hazard risk reduction strategy with existing and proposed land uses and assets. The Proposed Project would reduce flood risks within the Project Area, leading to improved resiliency and the protection of accessibility and on-going operations of services (including protecting critical infrastructure such as hospitals, fire stations, and police department buildings; and roadways and transit resources). This would allow these key assets to support emergency preparedness and community resiliency during and after flood events.

***Goal: Reduce Risks to Public Health*.** In addition to providing protection to critical healthcare infrastructure (such as local hospitals and emergency services), the flood risk reduction strategy would reduce the adverse health impacts associated with these types of flood events, such as the spread of infectious diseases, compromised personal hygiene, and contaminated watersources.

***Goal: Contribute to On-going Community Efforts to Reduce FEMA Flood Insurance Rates.*** The NFIP's Community Rating System allows municipalities to reduce their flood insurance rates through implementation of comprehensive floodplain management. The Project would include concepts and alternatives that are consistent with the local municipalities' overall effort to reduce FEMA Flood Insurance Rates.

***Goal: Deliver Co-Benefits.*** Where possible, the Project would integrate the flood hazard risk reduction strategy with civic, cultural, ecological, and recreational values. The Project would strive to incorporate active and passive recreational uses, multi-use facilities, and other design elements that integrate the Project into the fabric of the community. In this way, the Project would be independent of, but would complement, local strategies for future growth, to the extent possible.

***Goal: Enhance and Improve Use of Public Space.*** The Project would strive to reduce risks to private and public property from flood impacts while also incorporating design elements that improve public and recreational spaces, thereby enhancing quality of life for thecommunity.

***Goal: Consider Impacts from Sea Level Rise.*** The Project would consider the projected impacts from sea level rise and its impacts on the frequency and degree of flooding.

***Goal: Protect Ecological Resources*.** The Project would strive to protect and enhance ecological resources by protecting wetlands and other habitats that contribute to regional biodiversity and ecosystemresiliency.

***Goal: Improve Water Quality.*** The Project may incorporate green infrastructure solutions into the design and construction of proposed flood risk reduction measures to manage stormwater runoff, reduce stormwater pollution, and improve water quality.

## 2.2 RBD Meadowlands Project Description

### 2.2.1 Original RBD MeadowlandsConcept

As originally proposed during the HUD RBD competition, the Meadowlands concept envisioned creating a system of natural areas, berms, and additional wetlands to reduce flooding risks. The original concept also articulated an integrated vision for protecting, connecting, and growing the Meadowlands District, as a critical asset, to both the rest of New Jersey and the metropolitan area of New York. By integrating transportation, ecology, and development, the awarded concept sought to transform the Meadowlands basin to address a wide spectrum of risks, while providing potential civic amenities and creating opportunities for newredevelopment.

The original RBD Meadowlands concept was divided into three pilot areas. As described in Section 1.1, HUD awarded $150 million in CDBG-DR funds to the State of New Jersey for the Project, specifically for the "Phase 1 Pilot Area." The Phase 1 Pilot Area is now referred to as the RBD Meadowlands Project Area, as shown in Appendix A. While additional pilot areas or phases were identified for the overall Meadowlands Program Area during the RBD competition, there is no plan to fund the Phase 2 and Phase 3 Pilot Areas at this time due to the need to remain within the Project's $150 million budget.

The original RBD Meadowlands concept took a multi-faceted approach intended to address flooding from both major storm surges and high tides, as well as from heavy rainfall events, with several potential ancillary benefits. The concept's comprehensive approach to resilience consisted of three integrated components for each Pilot Area: "Protect, Connect, and Grow." **Protect** would provide flood protection; **Connect** would increase modal connectivity among the towns and surrounding areas; and **Grow** would continue flood improvement goals through rezoning opportunities. The original concept as envisioned would cost approximately $850 million.

### 2.2.2 Moving from the Original, Broad Concept to a More FocusedConcept

Based on the $150 million in CDBG-DR funding provided by HUD, NJDEP has determined that the Project, in application, will focus primarily on reducing flood risk within the Project Area (i.e., the "Protect" component of the "Protect, Connect, Grow" concept). Potential ancillary "Connect" and "Grow" components of the original concept, while not funded specifically at this point, could be logical and reasonable future outcomes following implementation of the critical "Protect" function, if additional funding becomesavailable.

Early in the planning process, and as codified in the Public Scoping Document for the Environmental Impact Statement (EIS) released in August 2016 (see Section 2.2.3), NJDEP identified three broad RBD Meadowlands Project Alternatives that included the following:

- **Alternative 1 (Structural Flood Reduction):** This alternative analyzed various structural, infrastructure-based solutions that would be constructed to provide protection from both inland and tidal/storm surge flooding. This alternative, to the extent practical, evaluated a FEMA certifiable level of flood protection to a portion of the Project Area. This alternative would consist of a range of structures, including levees, berms, barriers, drainage structures, pump stations, floodgates, and/or other hard and soft infrastructure to achieve the required level of flood protection.

- **Alternative 2 (Stormwater Drainage Improvements):** This alternative analyzed a series of stormwater drainage projects aimed at reducing the occurrence of higher frequency, small- to medium-scale flooding events that impact the communities located in the Project Area. Together, these smaller drainage projects would have provided an improved stormwater management system that may have included both local drainage improvements and wetlands restoration to protect communities located in the Project Area. These improvements may have included: drainage ditches, pipes, and pump stations at strategic locations; increased roadway elevations; new green infrastructure (e.g., wetland drainage basins, bioswales, rain gardens), water storage areas, and water control structures; cleaning and de-snagging of existing waterways; and increasing and enhancing public open space.

- **Alternative 3 (Hybrid of Alternative 1 and Alternative 2):** This alternative analyzed a strategic, synergistic blend of new infrastructure and local drainage improvements to reduce flood risk in the Project Area. Components of Alternatives 1 and 2 would be combined to provide an integrated, hybrid solution that employs a combination of appropriate levees, berms, drainage structures, pump stations, and/or floodgates, coupled with local drainage improvement projects, to achieve the maximum amount of flood protection within the boundaries of the Project Area.

On January 11, 2018, during a Community Meeting at the Robert L. Craig School in Moonachie, New Jersey, the State recommended Alternative 3 as the "Preferred Alternative" for the RBD Meadowlands Project. A Preferred Alternative is the alternative of this project that is implementable and addresses both coastal surge and systemic inland flooding within the funding and schedule constraints while avoiding, minimizing or mitigating impacts to the natural and human environment. Alternative 3 was recommended as the Preferred Alternative because it provides a more holistic solution than the other Alternatives by addressing both coastal surge and systemic inland flooding.

A DEIS is being prepared to evaluate the environmental impacts, including indirect and cumulative environmental impacts, associated with all Alternatives considered (i.e., Alternatives 1, 2, and 3) as well as a No Action Alternative. The Preferred Alternative (i.e., Alternative 3) is described briefly in this document and will be

described in detail within the DEIS and Feasibility Report. Illustrations of Alternative 1 and Alternative 2 were described at a Community Meeting on January 11, 2018. The meeting materials and video can be viewed on the RBD Meadowlands website: www.rbd-meadowlands.nj.gov

Overall, Alternative 3 incorporates integral flood protection components of Alternatives 1 and 2. The drainage improvements selected for construction as part of Alternative 3 will provide resilience by helping communities in the Project Area to recover faster from nuisance flooding. This Alternative reflects the public input received including the suggestion that the Project have an increased focus on drainage improvements in the Project Area.

Because the full scope of Alternative 3 would exceed the Project's available funding and schedule (i.e., implemented by September 2022), it has been separated into a Build Plan and a Future Plan. Section 2.2.3.1 describes the Build Plan components that will be constructed by September 2022 within the Project's $150 million budget. The remaining components of the Alternative are referred to as the Future Plan. The Future Plan components could be constructed over time as other funding sources become available and as construction feasibility permits. Implementation of the Build Plan would remain within both the budget and the HUD schedule associated with the RBD funding.

### 2.2.3 Build Plan

The Build Plan is an integrated plan that primarily addresses the systemic inland flooding that results from heavy or frequent precipitation in the Project Area. The Build Plan includes both grey and green stormwater management infrastructure features. The grey stormwater management infrastructure features would be designed to reduce flooding damages by capturing and more rapidly evacuating stormwater in the Project Area. The green stormwater management infrastructure features would be designed to capture stormwater runoff from streets and sidewalks to reduce local flooding, treat water quality, and enhance the streetscapes with permanent vegetation or new porous paving. The Build Plan also incorporates community co-benefits through the enhancement and improvement of public spaces in the Project Area. Grey and green infrastructure elements that could be implemented in the Build Plan are listed in Table 1 below. Appendix B to this APA provides a detailed description, purpose, and function of each of type of grey or green infrastructure feature of the RBD Meadowlands Project. The Build Plan also incorporates community co-benefits through the enhancement and improvement of public spaces in the ProjectArea.

**Table1: Grey and Green Infrastructure Features Considered**

| GreyInfrastructureFeatures | Green InfrastructureFeatures | |
|---|---|---|
| PumpStations | Parks/ Open Space | |
| Backflow Preventers | Permeable Pavement | |
| ChannelImprovements | RainGardens | |

| GreyInfrastructureFeatures | Green InfrastructureFeatures |
|---|---|
| Berms around Ditches/Ponds | Bioswales |
| Force Main | Wetland Improvements |
| Settling Basins/Forebays | Storage Trenches/Tree Trenches |
| Off-channel Storage | |
| Local Drainage Improvements | |

#### 2.2.3.1 Build Plan for Grey Stormwater Management Infrastructure:

Generally, the grey stormwater infrastructure improvements will include two new pump stations, a force main, channel modifications, culvert and bridge improvements, operations and maintenance access ways and other associated structures and easements. Specific grey infrastructure elements included in the Build Plan consist of the following:

- **East Riser Components:** A new pump station would be installed upstream of the existing East Riser Ditch tide gate and Starke Road. Based on the Feasibility level design, it is anticipated that the station could include a screened intake bay, Archimedean screw pumps (or other pumps as to be determined in design), a discharge channel, a modified forebay inlet to the existing tide gate, and an energy dissipation structure on the downstream side of the tide gate. Flow discharged from the pump station would be conveyed through the existing tide gate at East Riser Ditch via culverts under Starke Road. An impervious access road and parking area would be provided for facility access and egress from the building, parking, and maintenance and operation.

  A forebay inlet to the existing tide gate would be installed upstream of Starke Road to receive discharge from the pump station and convey it to the existing culverts under Starke Road and out the existing tide gate. The forebay would tie into the existing culvert headwall on the upstream side of the Starke Road culverts. Four flap gates would be installed inside the forebay on the upstream side to allow low flow stream passage through the forebay when the pump is not operational.

  The East Riser Ditch channel would be dredged from the Stark Road culverts at the south, to the southern location outfall of culverts under Moonachie Avenue to increase flow conveyance capacity. Approximately 22,000 cubic yards (CY) of material would be removed from the ditch and disposed of off-site at a facility licensed to receive the dredged material. Channel boundaries and adjacent areas falling within the riparian zone would be re-vegetated with native plant species consistent with that habitat type in the Project Area. The Project Area associated with this improvement is estimated to be 9.5 acres. An O&M access way would be provided on one side of the channel throughoutthe improved reach. Access would be tied into local

residential roads where feasible, but in some cases, it would tie into parking areas on private property. Easements would be acquired to establish a permanent drainage corridor and O&M access where needed. Gates and adjacent hurricane fencing would be installed at access points to the O&M corridors to limit access to authorized personnel.

To improve water conveyance in East Riser Ditch, three existing culvert and bridge crossing structures would be removed and replaced with appropriately sized replacement culverts or bridges. The removed structures would be disposed at a facility licensed to receive thatmaterial.

- **Losen Slote Components:** A new stormwater pump station and associated force main are proposed in the Losen Slote drainage basin. A pump station would be located in the vicinity of 15 Liberty Street in Little Ferry, immediately east of the Liberty Bell Village. This pump station would have one 50 cubic feet per second (cfs) or similar sized pump, and would discharge stormwater through a force main in the vicinity of the Lorena Street, Liberty Street, Eckel Road, and Birch Street rights-of-way. This force main would be approximately 3,300 feet long, and would consist of a ductile iron pipe with manholes installed along the pipe for maintenance. It would discharge into Losen Slote at the western terminus of Birch Street. Additionally, a remnant concrete headwall, once part of a tide gate in the Losen Slote channel in the vicinity of Joseph Street, would be removed to improve natural channel flow.

  The Losen Slote pump station would additionally have a backup pump and a backup generator installed in case of pump malfunction or electricity outages. An energy dissipation structure would also be constructed at the discharge point for the force main to prevent erosion of the Losen Slote channel.

#### 2.2.3.2 Build Plan Green Stormwater Management Infrastructure and Open Space

The green infrastructure features could include bioswales, rain gardens, storage trenches/tree trenches, permeable pavement, wetland improvements, and parks/open spaces and other associated structures and easements. The locations associated with green infrastructure features in the Build Plan are as follows:

- **DePeyster Creek Area right-of-way** would be located primarily within the sidewalk of Monroe Street and Dietrich Street between Eckel Road and Industrial Avenue. Subsurface stone trenches would expand the storage footprint to manage runoff from roughly 0.5 acres of imperviousroadway.

- **Carol Place Area right-of-way** would be located primarily within the sidewalk of Moonachie Avenue and Empire Boulevard between Caesar Place and State Street. The vegetated portion of these bioswales would be located

within the lawn space between sidewalk and curb. Subsurface stone trenches would expand the storage footprint to manage runoff from approximately 1.4 acres of impervious roadway.

- **West Riser Ditch Area right-of-way** would incorporate rain garden median plantings to capture and treat adjacent roadway runoff from roughly 0.5 acres of impervious roadway.

- **Park Street Area right-of-way** would incorporate storage trenches along Moonachie Road, storage trenches along Liberty Street, and bioswales with internal check dams along Redneck Avenue to manage runoff from approximately 1.4 acres of impervious roadway.

- **Main Street Area** would incorporate several bioswales and storage trenches on side streets intersecting Main Street with rain gardens within medians at the intersection of Bergen Turnpike and Sylvan Avenue (US Route 46). In total, the Main Street area is expected to manage runoff from roughly 2.8 acres of impervious roadway.

The Build Plan also includes additional flood management measures integrated with new open space and improvements to existing open space, which also provide additional water quality benefits. The improvements include thefollowing:

- **Riverside Park Area Stormwater Management Improvements** includes open space acquisition of 2.59 acres. This riverfront park would transform an existing boat dock area and impervious parking lot into approximately 600 linear feet (LF) of pervious area including bioswales providing flood management and water quality improvement by allowing for stormwater infiltration and filtration. This area would also provide public recreational access to the riverfront open space and include a restored riparian wetland that would provide new intertidal wetland habitat. River access would be maintained through improved boat docks and boat launch to create recreational opportunities.

- **Caesar Place Park Stormwater Management Improvements** include open space acquisition of approximately 4.03 acres that would provide stormwater storage through creation of approximately 1.50 acres of wooded wetland and 1.39 acres of emergent wetland. This would improve and expand the existing wetland located on site. Passive recreation could include elevated boardwalks that would maintain public access. Rain gardens would help infiltrate runoff and filter stormwater from Caesar Place Road. Open lawn and nature play areas may be included in an existing upland area to provide active recreation and play while minimizing environmental impacts.

- **Avanti Park Stormwater Drainage Improvements** include open space acquisition of 0.97 acres on an existing open lot along Moonachie Road that would improve drainage through creation of a 0.29-acre wetland and collect and infiltrate stormwater from the site and the adjacent lot. The park would feature expanded wetlands, open space, passive and active recreation and native habitat. An elevated walkway could traverse this wetland, maintain public access, and connect back an area of permeable pavement at grade along Moonachie Road. Active recreation opportunities include a permeable play surface and play structure. Remaining elements could include woodland to screen adjacent warehouses and nativeplantings.

- **Willow Lake Park Stormwater Management Improvements** include improvements of an existing 7.02-acre public park. Proposed improvements would include rain gardens to store and filter stormwater from Pickens Street, thereby reducing flood damage risk and improving water quality. Native planting and low meadows with scattered trees would increase infiltration and provide habitat for pollinators and birds. The permeable area would be expanded, thereby increasing flood management through improved drainage. Proposed improvements include pedestrian circulation, recreation, and ecological benefits. Existing pedestrian trails would be expanded to connect the northern and southern portions of the park, active recreation, expanded playground with impervious pavement, and ecological benefits. Existing and new improvements would combine to create approximately 1.6 acres of plazas and circulation walkways that frame the park and provide access to people from Main Street, Pickens Street, and Washington Avenue, with a centralized plaza near Willow Lake.

- **Little Ferry Municipal Stormwater Drainage Improvements** for both Little Ferry Library and the Little Ferry Municipal Building including approximately 0.27 acres of native plantings and rain gardens, as well as the addition of native plants and replacement of existing asphalt parking with permeable paving. The improvements would increase stormwater infiltration to reduce runoff and thereby potential for flooding and improve stormwater quality of runoff into the adjacent open channel of upperLosen Slote.

- **Little Ferry Public Schools Stormwater Drainage Improvements** include campus improvements at Washington Elementary and Little Ferry Public Schools could include rain gardens along Liberty Avenue, approximately 0.83 acres of impervious pavement converted to permeable pavement at Washington Elementary, and approximately 0.96 acres of existing turf converted to native vegetation (with trees). This would increase stormwater infiltration and thereby flood risk, while also improving biodiversity. Approximately 0.39 acres of an existing sportsfield could be improved, with the existing active programming areasremaining.

- **Robert Craig Elementary School Stormwater Drainage Improvements** on campus could include improvements of approximately 1.74 acres including 0.30 acres of permeable play surface at an existing impermeable play surface, a rain garden at an existing open lawn, and approximately 1.36 acres of new sports field at an existing baseball diamond and open lawn to improve stormwater filtration and conveyance on site.

- **St. Joseph Park Stormwater Drainage Improvements** of an existing public park. Bioswales are proposed to improve stormwater filtration. An existing parking lot would receive treatment to improve its permeability and ability to infiltrate and filter stormwater. Landscapeimprovements would be made to 0.87 acres of the park through the planting of native vegetation. Active recreational opportunities that could also be incorporated into the park landscape include amenities such as basketball, sports courts, lawn, soccer, tennis, and a gazebo.

In summary, the Build Plan would reduce the depths and spatial extent of inland flooding in the East Riser Ditch and Losen Slote watersheds. Stormwater conveyance in East Riser Ditch would primarily be improved between the East Riser Ditch tide gate and US Route 46, while Losen Slote would experience reduced flooding between Bertollow Avenue and Niehaus Avenue. Under the Build Plan, the total acreage of new or improved parks and open space created would be approximately 7.6 acres.

### 2.2.4 Future Plan

The Future Plan includes the Alternative 1 line of protection (LOP) around the Project Area that would guard against flooding during coastal storm surges and spring high tides, as well as from overflow of associated inland ditches and channels. This LOP would provide protection to an elevation of 7 feet above mean sea level (amsl) (NAVD 88), and would consist of both compacted earthen structures (e.g., berms and levees) and engineered structures (e.g., floodwalls). A LOP at this height would be sufficient to provide protection against approximately the present-day 50-year storm (i.e., there would be an approximately 2 percent chance each year that the LOP would be breached), and against approximately the 10-year storm (i.e., 10 percent annual chance) in 50 years, based on intermediate sea level rise projections. The LOP would consist of a Northern, Central, and Southern Segment, as well as a storm surge barrier along Berry's Creek. The four main geographic components of the LOP are shown graphically in Appendix A**.** A proposed surge barrier would be installed on Berry's Creek just south of where Berry's Creek passes beneath Paterson Plank Road. The proposed surge barrier would be constructed to an elevation of 10 feet amsl (NAVD 88). Levees would connect the surge barrier to existing high ground on both banks of Berry's Creek. A proposed pump station would also be constructed with the surge barrier on the western bank. This pump would have an estimated capacity of 1,000 cfs. The LOP described above is part of the Future Plan and could be implemented with other funding sources.

To address the systemic inland flooding associated with the Project Area, the Future Plan carries over additional drainage improvements evaluated in Alternative 2 and,

would not be implemented with the HUD RBD CDBG-DR funding. These Future Plan drainage improvements, if constructed at a later date using other funding sources, may include:

**2.2.4.1 Upper East Riser Channel Improvements** extending along the upstream portions of East Riser Ditch (i.e., from Moonachie Avenue to Wesley Street) would receive improvements, including dredging of the entire channel (approximately 3 miles) and six culvert replacements. These improvements would occur within the Boroughs of Moonachie, Teterboro, and Little Ferry and the Township of South Hackensack. An O&M access road/easement would be constructed to facilitate O&M along the upstream portions of the East Riser Ditch.

**2.2.4.2 New Losen Slote Pump Station** and force main would be constructed near Garden Street to deliver water to the Losen Slote channel. A pump station would be located in an existing truck bay at an industrial complex, along West Park Street northwest of the intersection with Albert Street. This pump station would discharge stormwater through a 2,200-foot long, ductile iron pipe force main. An energy dissipation structure would also be constructed at the discharge point in order to prevent erosion of the Losen Slote channel. The force main would discharge into Losen Slote at the eastern terminus of East Park Street. A backup pump and a backup generator installed in case of pump malfunction or electricity outages.

Implementation of the Future Plan would further reduce inland flooding in the Losen Slote watershed along the Park Street Reach between the Main Reach and Union Avenue. Additionally, the Future Plan would protect against coastal storm surges and spring high tides. By implementing a hybrid solution of both coastal and inland flooding reduction, Alternative 3 provides the greatest overall flood reduction among the three Build Alternatives considered, while adhering to the feasibility constraints (i.e., budget and schedule) of the Proposed Project.

## 2.3 RBD Meadowlands Project Funding

### 2.3.1 Timeline and Budget

The preliminary estimated timeline and budget for the Project are shown in **Table 2**.

**Table 2: RBD Meadowlands Project Estimated Timeline and Budget (*in $ millions*)**
(*based on actual expenditures).

| Project Phase | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 | 2021 | 2022 | Total |
|---|---|---|---|---|---|---|---|---|---|
| Planning & Feasibility | $0.2* | $2* | $10.8* | $11 | | | | | **$24** |
| Design & Predevelopment | | | | $7 | $7 | $3 | | | **$17** |
| Site Development & Construction | | | | $3 | $12 | $37 | $34 | $23 | **$109** |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | **Total** | **$0.2*** | **$2*** | **$10.8*** | **$21** | **$19** | **$40** | **$34** | **$23** | **$150** |

### 2.3.2 Allocation for Activity

The allocation for this activity is $150 million of HUD CDBG-DR funds. Per HUD guidelines, up to 5% of the allocation ($7.5 million) may be utilized for administrative costs.

### 2.3.3 Eligibility for CDBG-DRFunding

The Project's eligibility for CDBG-DR funding is per Notice FR-5696-N-11(VII)(b) (Rebuild by Design). Final project design, as well as integration of results of ongoing environmental studies being conducted by the NJDEP, is expected to begin in Fall 2018. Construction is expected to begin in February 2019 and will take about 3.25 years to complete.

### 2.3.4 Project Coordination and Compliance

As the design of the Project's Build Plan continues, the NJDEP will identify partnerships and any leveraged or reasonably anticipated funds that could be used for components of the RBD Project, as required in Section VI of Federal Register Notice FR-5696-N-11. The Build Plan can be fully constructed with the available CDBG-DR funds. However, the State may seek to leverage funds through programs such as NJ Green Acres, NJ Blue Acres or NJ Environmental Infrastructure Trust (EIT) loans and/or grants.

Additionally, in the permitting and design phases of the Project, the Project may trigger local zoning and land use regulations that fall within municipal purview. The NJDCA has certified that the preliminary design will consider the appropriate code, industrial design standards, and construction standards, and that a registered Professional Engineer (PE) will certify the final design meets all relevant codes. To date, the known State and Federal permits that will need to be obtained for the RBD Project are as follows.

| Law &/or Regulation | Type of Permit | Issuing agency |
|---|---|---|
| **Federal Clean Water Act** | Individual Section 404 Permit | USACE-NYD |
| **Federal Clean Water Act** | Individual Section 401 Water Quality Certification | NJDEP DLUR |
| **Federal Rivers and Harbors Act** | Section 10 Permit | USACE-NYD |
| **Federal Coastal Zone Management Act** | Federal Consistency (issued through WFD permit) | NJDEP DLUR |
| **NJ Waterfront Development (WFD) Law/ NJ Coastal Zone Management Rules** | Individual Upland and In-Water Waterfront Development Permits | NJDEP DLUR |

| Law &/or Regulation | Type of Permit | Issuing agency |
|---|---|---|
| **NJ Flood Hazard Area Control Act/ NJ FHCA Rules** | Individual Flood Hazard Permit | NJDEP DLUR |
| **NJ Freshwater Wetlands Protection Act/ NJ FWWPA Rules** | Individual Freshwater Wetland Permit | NJDEP DLUR |
| **NJ Tidelands Law** | Tidelands License (for short term/construction)<br>Tidelands Lease (for long term/life of project) | NJDEP DLUR – Bureau of Tidelands |
| **NJ Soil Erosion and Sediment Control Act /NJ SESC Standards** | Soil Erosion / Sediment Control Plan Certification | Bergen County Soil Conservation District |
| **NJ Water Pollution Control Act** | NJ Pollutant Discharge Elimination System (NJPDES) Stormwater – Construction Activities General Permit (5G3) | NJDEP Division of Water Quality |
| **NJ Water Pollution Control Act** | Treatment Works Approval (for pump station, if combined sewer/stormwater) | NJDEP Division of Water Quality |
| **NJ Solid Waste Regulations (N.J.A.C 7:26)** | Approval for disruption of closed landfill site | NJDEP Division of Solid and Hazardous Waste |
| **Meadowlands District Zoning Regulations (N.J.A.C. 19:4-1.1 et. seq.)** | Zoning Certificate<br>Site Plan Approval<br>Construction Permit(s)<br>Stormwater Permit | NJ Sports and Exposition Authority |
| **Air Quality Permit (NJAC 7:27-8.2(c)1)** | Preconstruction permit and operational certificate for any fuel-burning equipment (i.e., emergency generators at pump stations). | NJDEP Division of Air Quality |

The Project is also addressing the long-term efficacy and fiscal sustainability outlined in Section VI(2)(g)(4) of the November 2013 Federal Register Notice (FR-5696-N-06). An O&M plan for the Project will be prepared describing the procedures and responsibilities for routine maintenance, communication and timing of activation in the event of an impending storm condition. In early 2019, NJDEP will form an O&M subcommittee with local and State partners that will develop an O&M Plan for the Project. The participants in the O&M planning and development currently includes, but is not limited to, entities such as the NJDEP, Bergen County, Bergen County Utilities Authority, Port Authority of New York and New Jersey, NJ Sports and Exposition Authority, the Boroughs of Little Ferry, Moonachie, Carlstadt, and Teterboro, and the Township of South Hackensack. The O&M Plan will be a critical component of the overall Project and will contain five very distinct functions: Operations, Maintenance, Engineering, Training, and Administration.

The State certifies, after construction is complete, that the State and the municipalities receiving flood protection benefits will provide an O&M plan that

identifies the entities performing routine, on-going maintenance. Before construction begins, the State will ensure that O&M costs are funded and that entities are in place to own, operate and maintain the Build Plan components. The State intends to fulfill fully its obligations under this Certification. Nothing herein shall constitute, nor be deemed to constitute, an obligation of future appropriations by the legislature of the State of New Jersey, where creating such an obligation would be inconsistent with New Jersey Constitution Article 8, Section 2, Paragraphs 2 and 3, N.J.S.A. 59:13-1 et seq., and N.J.S.A. 59:1-1 et seq. of the State of New Jersey.

The NJDEP has also taken steps to meet the resilience performance standards requirements identified in Section VI(2)(e) of the November 2013 Federal Register Notice (FR-5696-N-06). Through the NJDEP Flood Hazard Area Control Act (FHACA) (N.J.S.A. 58:16A-50 et seq.) and implementing Rules (N.J.A.C. 7:13), the State has taken steps to reduce the damage and risks to public safety and health and the environment caused by flooding while assuring the creation of a more resilient coastal community. These steps included incorporating the amendments issued in 2007, 2013 and 2017 to the FHACA Rules into the Project design.

FHACA Amendments issued in 2007 include:

**2.3.4.1** Regulation of all commercial, residential, industrial, and public development within the flood hazard area design flood, which is the 100-year (1 percent) flood plus a 25 percent factor-of-safety to account for potential future increases in flood discharges in fluvialareas;

**2.3.4.2** Restrictions on the loss of any flood storage volume within the flood hazard area of fluvial surface waters, which ensures continued protection from anticipated flood events of increasing intensity;

**2.3.4.3** Establishment of protected riparian zones around all regulated surface waters, which limit the removal of vegetation, thereby increasing water quality protection, reducing erosion, and preserving flood storage along these waters, all of which ensures continued protection fromanticipated flood events of increasing intensity; and

**2.3.4.4** The requirement that the lowest floor of buildings and the travel surface of roadways and parking areas be situated at least one foot above the flood hazard area design flood elevation to account for the possibility of impacts from future flood events that may be greater than the predicted levels.

Emergency FHACA amendments were issued in 2013 to facilitate rebuilding after Superstorm Sandy in a more resilient manner by:

**2.3.4.5** Ensuring that the best available flood elevation data is used to determine the flood hazard area design flood elevation for a given site, including FEMA's advisory flood maps and subsequently released preliminary maps for New Jersey's coast, which include revised A and V-Zone limits, as well as FEMA mapping issued as final (effective) that is developed in partnership with the NJDEP and depict the NJDEP's flood hazard area design flood elevation and floodway limit;

**2.3.4.6** Allowing flood proofing measures to be used instead of elevating buildings in certain, limited situations where elevating is not feasible or cost- effective; and

**2.3.4.7** Ensuring consistency between the NJDEP's standards for elevating buildings in flood hazard areas with the building standards of the Uniform Construction Code promulgated by the Department of Community Affairs at N.J.A.C. 5:23.

Further, the 2013 amendments to the NJDEP Coastal Zone Management Rules (N.J.A.C. 7:7E) allow for soft buffers through the establishment of living shorelines. Tidal wetlands are a major component of the coastal ecosystem. They provide multiple ecosystem services, as well as a first defense against storm surge. Living shorelines are a means to assist in restoring special areas, such as wetlands that have been lost, and can be designed to adapt to changing environmental conditions.

The 2017 FHACA amendments and new rules fall into the following sixcategories: improvements to riparian zone protections; improving consistency of the FHACA Rules with the Uniform Construction Code (UCC) and National Flood Insurance Program; improving consistency between the FHACA Rules and CZM Rules; facilitation of environmentally beneficial activities; clarification that permits-by-rule, general permits-by-certification, and general permits may not be used for activities qualifying as "major development;" and changes regarding the fees associated with the review of stormwatercalculations.

The flood mapping used by the State prior to this rulemaking was outdated and generally underestimated the actual 100-year flood elevation by approximately 1 to 4 feet and, in some circumstances, by as much as 8 feet. This was illustrated during Superstorm Sandy, when many people who had constructed a building with its lowest floor at the 100-year flood elevation shown on FEMA's effective Flood Insurance Rate Maps discovered that the portions of their building that lay below the advisory base flood elevation were subjected to severe flood damage. Had the NJDEP not taken steps to allow for the use of the best available flood mapping data, and to incorporate future FEMA mapping, residents would have been able to reconstruct their substantially damaged structures using the prior and inaccurate flood elevations, creating a potentially significant detriment to public health, safety and welfare during the next floodingevent.

The FHACA Rules are not the State's sole means of protecting residents and their properties from flooding and severe weather events. Many efforts are ongoing throughout the State and in the various other NJDEP Departments to assist in the recovery from Superstorm Sandy and Hurricane Irene. For example, the NJDEP's Blue Acres Program was established to acquire flood-damaged or flood-prone properties from willing sellers for conservation and recreation purposes, thus removing families from harm's way while creating natural buffers against future severe weather events and returning flood carrying capacity to vitalareas.

With respect to tidal areas, since 2011, the New Jersey Coastal Management Program (NJCMP) has developed two assessment tools to ensure that coastal communities have consistent and comprehensive guidance to assess their vulnerability to coastal hazards and capacity for resilience: the Coastal Community Vulnerability Assessment and Mapping Protocol and the Getting to Resilience questionnaire. Through the NJCMP, the NJDEP has developed the Resilient Coastal Communities Initiative to further develop these tools into a community-based planning program. The NJCMP has also initiated a Sustainable and Resilient Communities Grant Program to fund a comprehensive planning approach at the municipal level.

### 2.3.5 National Objective for Low- to Moderate-Income (LMI) Populations

The State has evaluated the benefits of the Project and has accordingly identified the service area to be provided by the Project. The service area meets the "primarily residential" standard as set forth by HUD and the LMI population within the service area exceeds the upper quartile exception of 39.57% for Bergen County. Therefore, the State has determined that the Project meets the LMI national objective.

## 2.4 Managing State Agency and Partner Entities

### 2.4.1 NJDEP's Role and Responsibilities

The NJDEP is the State agency responsible for overseeing and implementing the RBD Meadowlands initiative. The NJDCA, as the State's Grantee for CDBG-DR funds from HUD, transfers CDBG-DR funding for RBD projects to NJDEP under a Memorandum of Understanding, and NJDEP administers those funds.

Over the course of implementing this Project, NJDEP has developed a team with expertise needed to meet the challenge. NJDEP has staff experienced in the planning, permitting, design, and construction of flood risk reduction projects as well as other large construction projects including wetland enhancement, landfill closure, park development, site remediation, etc. Information about NJDEP's experience with various types of environmental issues and projects is available on its website at http://www.state.nj.us/dep/.

The Bureau of Flood Resilience within the Engineering and Construction Program of the NJDEP will be managing the day-to-day implementation of the Project. As the design phase of the RBD Meadowlands Project continues, and all the way through implementation, NJDEP will routinely assess its own staffing needs and, if additional staffing is required, will use program delivery funds to bring on resources to meet needs (subject to applicable Federal laws and regulations on the permissible use of CDBG-DR funds). The NJDEP will be responsible for monitoring and evaluating the efficacy and sustainability of the Project, as described in Sections 2.3.3 and 2.3.4, and will add staffing or resources as required in order to perform this function in a manner compliant with Section VII(a)(iv) of FR-5696-N-11.

In addition, NJDEP worked with the NJ Department of Treasury to release a Request for Proposal (RFP) that secured an engineering team to complete feasibility, environmental impact statement, design, and construction administration services. The NJDEP, in conjunction with the Department of Treasury, has also successfully bid and awarded a contract for a Construction Management Firm (CMF). The CMF has been engaged to provide additional engineering support to the NJDEP team. The Department of Treasury will also work cooperatively with NJDEP and its partners to solicit bids for Project construction. NJDEP, Treasury, and the design contractor will oversee Project construction to ensure adherence to plans, specifications, permits and all other State and Federal requirements.

### 2.4.2 Other State Agency Involvement

While NJDEP will be the primary agency involved in designing and implementing the Project, it will not be the only relevant State agency. Roles of other agencies in this process include:

- **Department of Treasury/Office of State Comptroller.** NJDEP will continue to work closely with these two agencies in order to procure services and materials needed to realize the Project. The State procurement process is a necessary condition of ensuring cost reasonableness and the compliance with Federal and State law, which could add significant time to the Project.
- **NJ Sports and Exposition Authority.** NJSEA plays an important role as a stakeholder in the Project Area and is participating in the Project's Executive Steering Committee (ESC) and CAG. Ongoing coordination will be required given NJSEA's authority over development in the Meadowlands District.

### 2.4.3 Coordination with Partner Entities

Coordination and communication with potential partners is critical in the implementation of this Project. The RBD Meadowlands project team (project team) conducted early coordination, as described below, with the following partners: the Sandy Regional Infrastructure Resilience Coordination (SRIRC) Federal Review and Permitting (FRP) Team, Meadowlands Technical Coordination Team (TCT),

Meadowlands Interagency Mitigation Advisory Committee (MIMAC), and other municipal governments and stakeholders.

- **SRIRC FRP Team:** The project team met with the SRIRC FRP Team on May 17, 2016 and December 14, 2017, to provide the FRP with an overview of the Project's concept development process including the approach to public and stakeholder outreach and to announce the selection of the RBD Build Project. The SRIRC FRP Team members are Federal officials with responsibility for Federal review and permitting of complex Sandy infrastructure projects. The mission of this interagency team is to facilitate expeditious and efficient reviews of the most complex projects funded by the Disaster Relief Appropriations Act of 2013 through early engagement and identification of issues, studies, and overall development needs of the projects.

**2.4.3.1 Meadowlands TCT:** The project team met with the Meadowlands TCT on September 4, 2014 for an initial Project kickoff meeting, which included background on the Project, an overview of the Project schedule, and review of Project milestones. On February 24, 2015, the RBD Meadowlands project team met for a TCT to provide a brief Project update and begin coordination with US Environmental Protection Agency (EPA) on the Berry's Creek Study Area/Superfund Site. Since this meeting, the EPA and NJDEP project teams have met regularly to provide Project updates and coordinate efforts. The project team will continue to update the Meadowlands TCT on the Project.

The TCT is comprised of Federal, State, and local officials with subject matter expertise in resilience, planning, environmental review, and permitting in the Study Area. It was formed by the federally convened SRIRC Group and includes members from NJDEP, HUD, U.S. Army Corps of Engineers (USACE), EPA, U.S. Fish and Wildlife Service (USFWS), National Oceanic and Atmospheric Administration (NOAA), National Marine Fisheries Service (NMFS), FEMA, Federal Transit Administration (FTA), Federal Highway Administration (FHWA), Port Authority of New York and New Jersey (PANYNJ), and representatives from the local municipalities.

**2.4.3.2 MIMAC:** The RBD Meadowlands project team met with the MIMAC on June 15 and December 7, 2016, and more recently on February 21, 2018, to provide MIMAC with Project updates and to solicit early Project feedback from the involved agencies. MIMAC is a group of agencies that includes USACE, USEPA, NJSEA, USFWS, NMFS, and NJDEP (Land Use). MIMAC is charged with reviewing wetland mitigation proposals in the Meadowlands District. The Project team will continue coordination efforts with MIMAC.

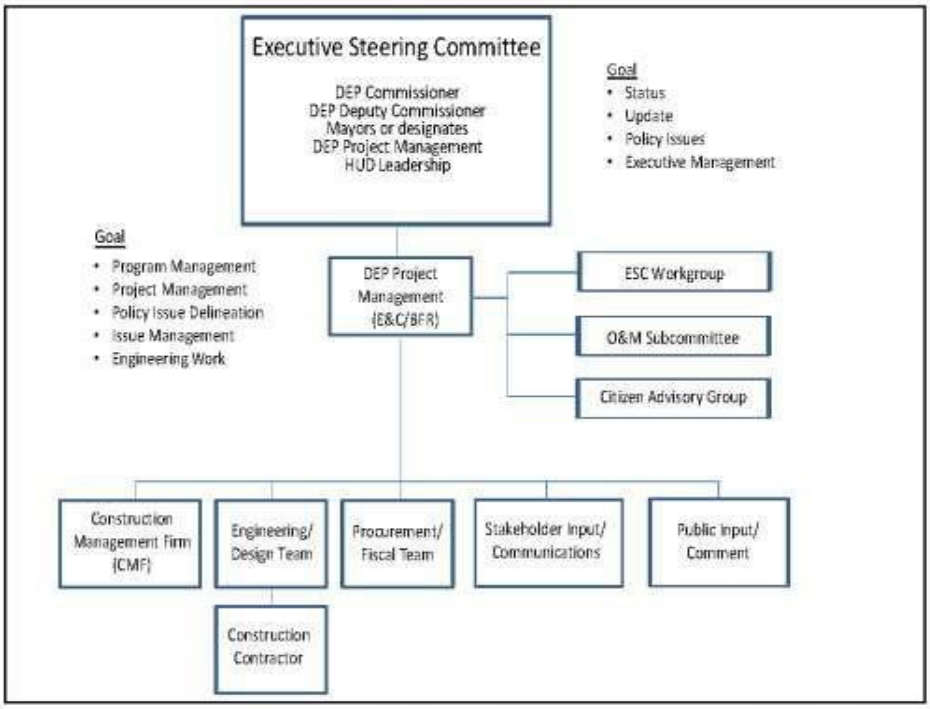
**Municipal Governments and Other Stakeholders:** The Project also requires ongoing agency outreach and coordination for permits and approvals. The following is a list of ongoing coordination needs:

- Section 106 Consultation - Consultation with the NJ Historic Preservation Office (HPO) Advisory Council of Historic Preservation (ACHP), Native American tribes and identified consulting parties would be undertaken, as needed, for potential effects on those historic properties identified by NJDEP in consultation with the HPO and in accordance with the Section 106 process.
- FEMA and USACE consultation and review has been ongoing and will continue throughout the design and required permitting processes.
- NJ Transit for further coordination of impact on existing rail line during design and construction.
- Port Authority of NY & NJ for compliance with Federal Aviation Administration (FAA) regulations will continue through design and construction.

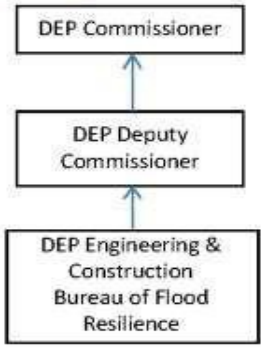
- NJDEP Division of Land Use Regulation and Division of Fish Wildlife forwetlands and State T&E species.
- NJDEP Green Acres Program if existing parkland is impacted duringconstruction and coordination for new open space listing on recreation and open space inventories.
- NJDEP Bureau of Dam Safety for coordination related to impoundments (tidegate, levee, floodwall segments).

As was proposed in APA12 and APA22, municipal governments and stakeholders in the project area are also playing a critical role in realizing the Project. Section 4 describes the roles of these stakeholders related to the Citizen Outreach Plan (COP). The chart below shows the Advisory Structure and the Decision-Making Structure for the Project.

**RBD Meadowlands Project Organizational Chart: Advisory Structure**




**RBD Meadowlands Project Organizational Chart: Decision-Making Structure***




* Advice from the Executive Steering Committees is considered by E&C/BFR and reported up to the Commissioner who has final decision-making authority. The Commissioner also chairs the Executive Steering Committees and is directly informed of the Committee's advice. E&C/BFR's role in the Advisory Structure is primarily a staffing function to facilitate the synthesis and transmission of issues and considerations to the Executive Steering Committee for input. Separate from its role in facilitating the Executive Steering Committee's advisory role, E&C/BFR also is involved in NJDEP's RBD decision-making process, which includes evaluating the input provided through the advisory structure.

# SECTION 3: RBD Meadowlands Performance Schedule

**Table 3** summarizes the schedule for the RBD Meadowlands Project. Under the proposed schedule, the Project will proceed in a timely manner and is currently on schedule for completion of construction by September 30,2022.

**Table 3: RBD Meadowlands Project Schedule**

| Milestone | Time Period by Month/Year |
|---|---|
| Recommendation of Preferred Alternative | January 2018 |
| Draft Environmental Impact Statement (DEIS) Public Hearing | June2018 |
| Final Environmental Impact Statement (FEIS) | October 2018 |
| Record of Decision (ROD) | December 2018 |
| Design Completion (all contracts) | June 2020 |
| Construction Contract Awards (Multiple contracts anticipated) | December 2018 through completion |
| Construction Completion | September 2022 |

The Project includes four main phases: (1) planning and feasibility, (2) design and predevelopment, (3) site development and construction, and (4) post construction. The project team has completed the DEIS and conducted the Feasibility Study. Once the EIS process is completed and the ROD is signed, the Project would proceed directly into the design phase with the existing contractor. The Project predevelopment phase began in 2015 when the first RFP was awarded and will be complete in 2019 when construction is estimated to begin. Predevelopment refers to all design and engineering work required for the Project and culminates with complete construction specifications.

Under the proposed schedule, the Project will proceed in a timely manner and is currently on schedule for completion of construction by September 30, 2022. Given that the Project has not yet entered the construction phase, these budget estimates and timeframes remain preliminary estimates, which are subject to change. These estimates will be refined following completion of the Final Environmental Impact Statement.

This overview of the four project phases includes but is not limited to the following:

## 3.1 Planning and Feasibility

- **Scope of work:** overall project/sub-component feasibility, identification of available and potential resources, project timeline, initiation of the environmental review process, project scoping, critical issues/obstacles analysis, alternatives analysis, general cost-benefit analysis, bid packages for design phase, permit identification, EIS and ROD, initiation of the master planning process and community engagement/outreach, and identification of necessary land acquisition andeasements.
- **Key tasks:** conduct data collection and analysis, evaluate overall project feasibility, assess and confirm feasibility of RBD team's conceptual design, create concept drawings, publish Notice of Intent, develop purpose and need for project, develop scoping document, meet with stakeholders, identify necessary permits, prepare and publish the DEIS, receive and respond to public comments, hold a public hearing, prepare and publish the FEIS, prepare and post the ROD, identify the environmental consequences, identify and analyze critical issues/possible obstacles, identify necessary real estate/easements, develop more detailed timeline and budget estimates, and analyze feasibility of sub-components as stand-alone projects.
- **Key deliverables:** development of concept drawings, DEIS, FEIS, ROD, a list of necessary permits, feasibility study, general timeline and budget for various project phases, general BCA, plan for addressing critical issues, and bid packages for design and engineering services (including issuance of them).

## 3.2 Design and Predevelopment

- **Scope of work:** development of engineering and design documents, real estate/easement acquisition, development of construction bid package, completion of environmental review process, and issuance/approval of all necessary permits
- **Key tasks:** pursue the identified financing/funding opportunities, draft engineering and design documents, develop construction bid packages, obtain necessary permits, obtain real estate/easements, identify and secure funding source and partners for operations and maintenance, and identify long-term ownershipentity/structure
- **Key deliverables:** concept drawings, complete engineering plans and design documents, approval of all necessary permits, completion of necessary easements and land acquisition, issuance of construction bid packages, completion of procurement of construction services contract, detailed construction timeline and cost estimate, and comprehensive BCAreport.

## 3.3 Site Development and Construction

- **Scope of Work:** begin and complete site development and construction activities.
- **Key Tasks:** prepare identified areas of the Project Area for the construction phase on time, on budget, and in accordance with plans and specifications; and construct the Project on time, on budget, and in accordance with the construction plans and specifications.
- **Key Deliverables:** complete site development in areas required in order to begin construction, and complete construction of the Project components.

## 3.4 Post Construction

- **Scope of work:** all ongoing operations and maintenance to ensure continued effectiveness of project components.
- **Key tasks:** create maintenance agreements.
- **Key deliverables:** well-maintained project components and funding in place to ensure continued effectiveness of the Project.

# SECTION 4: OUTREACH AND PUBLIC COMMENT FOR RBD MEADOWLANDS PROJECT

## 4.1 Citizen Outreach Plan (COP)

NJDEP has committed to a robust community and stakeholder outreach process throughout the course of this multi-year effort to realize the Meadowlands RBD Project. The primary goal of NJDCA's Citizen Participation Plan (CPP) is to provide all New Jersey citizens with an opportunity to participate in the planning, implementation, and assessment of the State's CDBG-DR Sandy recovery program(s). The CPP required that a Citizen Outreach Plan (COP) specific to the Project be developed to serve as a supplement to NJDCA's existing CPP.

NJDEP developed the RBD Meadowlands COP in accordance with Section VI of Federal Register Notice FR-5696-N-11, the National Environmental Policy Act (NEPA), the Council of Environmental Quality's (CEQ) NEPA regulations (40 CFR Part 1506.6), and NJDCA's Language Access Plan (LAP; available at http://www.renewjerseystronger.org/). Community stakeholders will be engaged during all Project phases (see Sections 3.1 through 3.4).

The COP guides the engagement of stakeholders in the Meadowlands region and solicits their input on the Project through a multi-faceted public participation process that includes: the establishment of an ESC, Outreach Subcommittee, CAG, Public Meetings, dedicated websites, an email listserv, a citizen complaint procedure, and press releases. The outreach strategies and techniques specific to the RBD Meadowlands Project are further described below. A copy of the RBD Meadowlands COP is available on the Project website atwww.rbd-meadowlands.nj.gov.

### 4.1.1 Executive Steering Committee

The RBD Meadowlands Project has an ESC. The role of the ESC is to collaborate, exchange information and offer a forum for ESC members to provide input to the NJDEP throughout all phases of the RBDM Meadowlands Project. The ESC discusses the direction of the Project, the Project schedule, Project related policy issues, and any concerns raised by the public to the mayors and NJDEP. The ESC is chaired by the NJDEP Commissioner and/or his delegates; it includes representatives from HUD, the NJDEP RBD Meadowlands project team, the Meadowlands Commission, and most importantly the mayors and/or their designees from the municipalities affected by the Project. Other entities may be incorporated into the ESC as needed.

The ESC is an advisory board. All final Project decisions will rest with the Commissioner of NJDEP. Additionally, the ESC consults with and reports to the NJDCA, as the HUD CDBG-DR Grantee, as issues arise.

### 4.1.2 Citizen Advisory Group

The RBD Meadowlands Project has a regional CAG. CAG members represent a variety of communities within the Project Area, and are composed of representatives appointed by both the municipalities participating on the ESC and the NJDEP RBD Meadowlands project team. The project team works to incorporate CAG members that represent regional interests.

The purpose of the CAG is to provide a forum for the exchange of information between the project team, key citizens, and citizen groups representative of the community. CAG members supplement the knowledge of local government officials; they will provide input throughout the development and implementation of the Project.

The role of NJDEP is to provide Project updates, explain processes and procedures on the various Project phases, solicit input from stakeholders and the public, and answer questions during major milestone CAG meetings. CAG members are responsible for bringing issues and concerns to the attention of the project team as well as sharing information presented to the CAG through their networks to their constituents, including members from vulnerable populations. The CAG members communicate the information obtained from their constituents to the project team, who in turn communicate this information to the larger ESC. Specifically, CAG members are expected to:

- Share information about the Project goals and objectives with their constituents;
- Share the processes and procedures that will be followed in implementing the Project;
- Determine what community priorities or concerns exist about the Project as it develops; and
- Bring the priorities, issues and concerns of the larger community to the attention of the project team.

### 4.1.3 Environmental Impact Statement Outreach

The EIS public participation process is conducted in accordance with the requirements of NEPA. In addition to engaging with the public, NEPA requires thorough and complete documentation of participation by all involved government agencies and other interested parties in the process. Throughout the NEPA process, the public participation effort focuses on gathering input and dispersing information about the following key areas addressed in the EIS:

- Purpose of and need for the Project.
- Potential range of reasonable alternative actions, including the No Action Alternative.

- Methodologies that may be used to assess impacts on various resources. This typically includes reviewing baseline information and conducting surveys, modeling, or other analyses to estimate the impacts on resources (including, but not limited to, biological resources, socioeconomics, cultural resources, hazardous materials/waste, traffic conditions, air quality, and noise) as result of the Project.
- Potential impacts associated with implementing the considered alternatives and potential avoidance, minimization, reduction, compensation, and mitigation measures.

To date, the Project has involved significant local, State, and Federal coordination, as well as collaboration with the public, to build an understanding among stakeholders in the Project Area. This coordination has taken place in accordance with NEPA, 40 CFR Part 1506.6, and other agency regulatory requirements to ensure the public remains well informed and engaged throughout the Project.

## 4.2 Outreach Accomplishments to Date

The public has consistently been engaged in the development of the RBD Meadowlands Project. To date, NJDEP and its partners have held several community meetings for the Project. Information on these meetings and the materials presented to the public at each meeting are available on the Project website at www.rbd-meadowlands.nj.gov. A list of these events is provided below:

- ☐ **January 11, 2018** - Community Meeting for Preferred Alternative
- **October 17, 2017** – CAG Meeting #11 (Alternatives 1, 2 and 3)
- **June 27, 2017** – CAG Meeting #10 (Alternative 3: Hybrid Alternative)
- **May 24, 2017** – CAG Meeting #9 (NEPA Process and Ecological Resources Update)
- **March 29, 2017** – CAG Meeting #8 (Alternative 1: Coastal Storm Surge Protection and Alternative 3: The Hybrid Option)
- **January 31, 2017** – CAG Meeting #7 (Alternative 2: Stormwater Drainage Improvements)
- **December 6, 2016** – CAG Meeting #6 (Alternative 1: Structural Flood Reduction Concept Development)
- **October 24, 2016** – CAG Meeting #5 (Ecology and Drainage Basin Opportunity Areas)
- **September 20, 2016** – CAG Meeting #4 (Concept Component Development Workshop)
- **August 11, 2016** – CAG Meeting #3 (Public Scoping Results and Alternative Screening Criteria and Metrics Meeting)

- **July 6, 2016** – Public Scoping Meeting for the RBD Meadowlands Project
- **May 17, 2016** – CAG Meeting #2B (Scoping and Data Gathering)
- **April 26, 2016** – CAG Meeting #2A (Community Workshop)
- **March 23, 2016** – CAG Meeting #1 (Purpose and Need, NEPA Process Overview)

Community involvement has been an integral part of the entire Project process. In order to facilitate communication with the community, NJDEP is making extensive use of the Project website (www.rbd-meadowlands.nj.gov). The Project website is an important tool used to communicate with the public by serving as a repository for documentation and information related to the Project. The website features resources such as presentations, videos, public notices, monthly newsletters and documents for public review, which are made available for download within a few days following public meetings. The website will continue to function as a valuable resource for the community as the Project moves forward through the design and construction phases.

NJDEP is also utilizing an electronic mailing list (listserv) to facilitate ongoing contact with the community, transfer information, and invite people to public meetings. The database contains the names and addresses of the Project Area representatives, media organizations, representatives from the business community, and other interested stakeholders who signed up to receive updates via the website. At meetings, members of the public have been encouraged to add their email address to the listserv so that they can be notified of Project updates and schedules for upcoming meetings. In addition, the Project website also features a link allowing individuals to subscribe to the Project's listserv.

## 4.3 Public Comment

Consistent with HUD requirements, APA 25 was made available for public review and comment for a period of thirty (30) days. Written public comments were submitted to the Department of Community Affairs via email at sandy.publiccomment@dca.nj.gov or via regular mail to the attention of Constituent Services, Sandy Recovery Division, NJ Department of Community Affairs, 101 South Broad Street, P.O. Box 823, Trenton, NJ 08625. The State also solicited public comments at a public hearing held on January 31, 2018 from 5 pm-8 pm in Little Ferry, New Jersey.

The State reviewed the public comments provided during the comment period. All comments received equal consideration regardless of whether they were submitted by email, U.S. mail, or in person at the public hearing. Per HUD guidelines, the State has synthesized the public comments received through this process. The comments and written responses prepared by the State are provided below.

**COMMENT 1**: THE BUILD PLAN DOES NOT INCLUDE BACKFLOW PREVENTERS ON OUTFALLS ALONG THE HACKENSACK RIVER

Commenter states that the Alternative 3 Build Plan fails to provide backflow preventers on multiple outfalls along the Hackensack River, specifically on outfalls located at the North Village I, LLC and North Village II, LLC properties.

**Response:** Backflow preventers are not included in the Alternative 3 Build Plan, which is the project that can be implemented within the constraints of the existing budget. The Project is a multi-municipality response to the increasing risks of storm surge and storm water damages impacting the region. There were many options considered across the 5000-acre (plus) project area and many were eliminated because they did not meet the required criteria set forth in the screening matrix. Ultimately, the Alternative 3 Build Plan was recommended because it best addresses stormwater protection while producing a positive benefit cost ratio.

While features such as backflow preventers are not designed or required as part of the Alternative 3 Build Plan, some backflow preventers could be integrated as part of the Future Plan final design, if it is implemented.

It is important to note that Bergen County received Federal funding to implement a project that includes the construction of backflow preventers on outfalls along the Hackensack River. No change to the APA is made as a result of this comment.

**COMMENT 2:** THE FUTURE PLAN INCLUDES A LINE OF PROTECTION ALONG THE HACKENSACK RIVER TO PROTECT AGAINST STORM SURGE.

Commenter opposes construction of a line of protection on said commenter's property, should the Future Plan be implemented. Commenter requests that the line of protection proposed on his property be eliminated from the Future Plan.

**Response**: The State has no current plan to implement the Alternative 3 Future Plan or line of protection described in the future plan at this time. If the line of protection is implemented, it must be constructed as a complete system in order to provide storm surge protection. It should be noted however, the line of protection is a feasibility level concept and could be subject to revision if and when it is designed. No change to the APA is made as a result of this comment.

**COMMENT 3:** NJDEP REGULATIONS DO NOT REQUIRE OR ENCOURAGE SIGNIFICANT IMPROVEMENTS TO FLOOD PROTECTION AND RESILIENCY AND THEREFORE DO NOT RESULT IN ANY SIGNIFICANT IMPROVEMENT TO FLOOD PROTECTION AND RESILIENCY.

Commenter suggests that the Project should recommend that all affected municipalities in the study area "…amend municipal Master Plans and land development ordinances (including zoning, subdivision/site plan, flood plain, and stormwater management ordinances), to ensure that redevelopment projects and

proposed significant expansions or changes to existing developments within flood prone areas result if significant improvements to flood protection and resiliency."

**Response:** The Build Plan includes construction of intended flood reduction structures but does not make recommendations to the municipalities within the project area that encourages changes to Municipal Master Plans. No change to the APA is made as a result of this comment.

**COMMENT 4:** COMMENTER OPPOSES BUILD PLAN AND SUPPORTS CONSTRUCTION OF THE FUTURE PLAN LINE OF PROTECTION ALONG THE HACKENSACK RIVER TO PROTECT AGAINST STORM SURGE.

Commenter suggested that the Line of Protection (LOP) included in the Future Plan should be constructed prior to the interior drainage features that are proposed in the Build Plan.

**Response:** The Alternative 3 Build Plan primarily addresses systemic inland flooding that results from heavy or frequent precipitation in the Project Area. These rainfall events have an approximate 50 percent probability of occurring in the project area each year.

The Build Plan is the means to evacuate the rainfall. Because there is inadequate funding and time to implement both the interior drainage features in the Build Plan and the LOP features in the Future Plan, the Build Plan has been prioritized over the Future Plan.

Due to funding constraints, the LOP proposed in the Future Plan would be built to an elevation that would protect from storm surge up to a 50-year storm. A 50-year storm has an approximate 2 percent probability of occurring in the project area each year. If a LOP is constructed, rainfall accumulating behind the LOP must have a means to be evacuated from the project area. No change to the APA is made as a result of this comment.

**COMMENT 5:** ENCOURAGE MUNICIPALITIES TO RECAPTURE GREEN SPACES ALONG THER WATERWAYS BY RESTRICTING DEVELOPMENT IN THE MOST FLOOD PRONE AREAS

Commenter suggests that the Project could encourage positive change toward effecting flood mitigation and habitat enhancement in the municipalities' planning initiatives.

**Response:** There is potential that educational value can be achieved through the extensive outreach and interaction with local residents and officials through the planning, design and implementation of the Build Plan. No change to the APA is made as a result of this comment.

**COMMENT 6:** OPERATION AND MAINTENANCE (O&M) COST, PLANNING AND OVERSIGHT

One Commenter expresses concern that adequate planning and funding for O&M of the Build Plan will not be secured. A second commenter suggested that a new or outside agency should be created to oversee O&M.

**Response:** Please see Section 2.3.4 in this APA for details regarding required O&M planning and funding. Creation of an outside agency to oversee O&M is one of many options that will be considered when the O&M plan is created. No change to the APA is made as a result of this comment.

**COMMENT 7**: INCORPORATE MORE GREEN INFRASTRUCTURE IN THE BUILD PLAN

Commenter suggests incorporating more green infrastructure in the final design of the Build Plan to add more flood mitigation benefits to the project.

**Response:** Components of the Build Plan include green infrastructure. If additional funding is identified from other sources or if the Build Plan is constructed under budget, some additional green infrastructure or other components of the Future Plan could be incorporated in the final Build Plan design. No change to the APA is made as a result of this comment.

**COMMENT 8:** INDUCED DOWNSTREAM FLOODING

One commenter expresses concern that the proposed force main on Eckel Road and outfall into Losen Slote may induce flooding at the outfall or downstream.

**Response:** As part of the upcoming project design phase, the pump system and force main will be designed so as to move water only when capacity is available downstream. Additionally, the Flood Hazard Control Act and Implementing Rules, N.J.A.C. 7:13, prohibit any activity that would induce flooding. Appropriate FHA permits will be obtained for this project prior to construction. The permit applications will be required to demonstrate that the project will not induce flooding downstream. No change to the APA is made as a result of this comment.

**COMMENT 9**: RIGHTS OF ACCESS

Commenter expressed concern that easements, rights of entry agreements must contain language that ensures they remain in perpetuity.

**Response:** All easements and access agreements will contain appropriate language to retain access rights as appropriate for each property. No change to the APA is made as a result of this comment

**COMMENT 10:** BENEFIT COST ANALYSIS (BCA)

Commenter questioned how benefits were calculated in the BCA and whether calculations are available for public review.

**Response**: The BCA was prepared in accordance with the Guidance for Benefit-Cost Analysis included with the HUD Notice: CPD-16-06, and adheres to the principles articulated within the document entitled *OMB Circular A-94 – Guidelines and Discount Rates for Benefit-Cost Analysis of Federal Programs*. The analysis is based on 2017 price levels and the application of a base 7% annual discount rate pursuant to OMB Circular A-94. Appendix C of the APA contains a full narrative that describes how benefits were assessed. The Feasibility Report for this Project will also have detailed information on the BCA calculations including references to the models used for these calculations. The Feasibility Report will be available to the public on the project website at the same time as the DEIS is posted for public review. No change to the APA is made as a result of this comment.

**COMMENT 11**: HAZARDOUS, TOXIC AND RADIOACTIVE WASTE (HTRW)

Commenter questioned why HTRW costs are not included in the cost estimate.

**Response:** HTRW is accounted for in the contingency as stated in a footnote to Table 5 in the APA. This assumes that any "hot spots" of HTRW will either be avoided or any additional HTRW costs incurred would be covered by the contingency and a corresponding reduction in volume of the ID-27 estimate. No change to the APA is made as a result of this comment

# SECTION 5: RBD MEADOWLANDS BENEFIT COST PROCESS SUMMARY

Pursuant to FR-5696-N-11 and its implementation guidance, the State is required to submit with its Substantial APA a benefit cost analysis or BCA, as well as a clearand concise narrative description of the BCA for the HUD-funded Project. Per CPD-16-06, HUD requires that CDBG-DR grantees examine RBD projects through the lens of a BCA because it is a valuable tool to help inform decision-making regarding public infrastructure investments. The full narrative of the BCA is attached hereto as Appendix C. The narrative description below describes the RBD Project and expected costs and benefits, according to the categories outlined in HUD Notice CPD-16-06, issued on April 20, 2016. The BCA was prepared in accordance with HUD BCA Guidance for APA for RBD Projects outlined in HUD CPD-16-06. The analysis used generally accepted economic and financial principles for BCA as articulated in OMB Circular A-94.

The purpose of the Project is to reduce flood risk and increase the resiliency of the communities and ecosystems in the Project Area, thereby protecting infrastructure, facilities, residences, businesses, and ecological resources from the more frequent and intense flood events anticipated to occur in the future. Therefore, the Proposed Project will be designed to meet the following objectives:

1) Contribute to Community Resiliency
2) Reduce Risks to Public Health
3) Deliver Co-Benefits
4) Enhance and Improve Use of Public Space
5) Consider Impacts from Climate Change
6) Protect Ecological Resources
7) Improve Water Quality

Alternative 3 was selected as the Recommended Plan because it addresses both coastal surge and systemic inland flooding. Due to project funding and timeline to construct, Alternative 3 was separated into two components: a Build Plan, which includes all features to be constructed as part of the Proposed Project, and a Future Plan, which includes the remaining features of Alternative 3 that could be constructed over time as funding and construction feasibilitypermit.

Implementation of the Build Plan would remain, and would be implementable within both the budget and schedule associated with the RBD funding. The Build Plan is an integrated plan that primarily addresses systemic inland flooding that results from heavy or frequent precipitation in the Project Area. The Build Plan includes both grey and green stormwater management infrastructure features described under Section IV.

The Benefit Cost Analysis demonstrates that the Build Plan (Proposed Project) is economically feasible at a discount rate of 7%. The Proposed Project will generate net benefits (benefits exceed costs over its useful life).

**Table 4: Executive Summary**

| **Meadowlands Proposed Project: Benefit Cost Analysis Summary Cumulative Present Values (2018-2072**)-Constant 2018 Dollars | | |
|---|---|---|
| | **Cumulative Present Values** (Discount Rate = 7%) | **Cumulative Present Values** (Discount Rate = 3%) |
| **A-LIFECYCLE COSTS** | | |
| Project Investment Costs \a | $79,500,000 | $91,267,000 |
| Operations & Maintenance | $11,520,000 | $25,244,000 |
| Total Costs | **$91,020,000** | **$116,511,000** |
| **B- BENEFITS** | | |
| **B1) Resiliency Values** | **$84,771,000** | **$203,541,000** |
| Flood Damage Reduction Benefits | | |
| East Riser Ditch | $72,752,000 | $176,460,000 |
| West Riser Ditch | $7,834,000 | $16,501,000 |
| Losen Slote | $4,185,000 | $10,580,00 |
| | | |
| **B2) Environmental Values** | **$180,000** | **$424,000** |
| Air Quality | $139,000 | $333,000 |
| Pollination | $37,000 | $82,000 |
| Nutrient Pollution | $4,000 | $9,000 |
| | | |
| **B3) Social Values** | **$8,990,000** | **$20,134,000** |
| Recreation | $7,179,000 | $16,059,000 |
| Avoided Stormwater Treatment Costs | $1,559,000 | $3,511,000 |
| Aesthetic Value | $206,000 | $460,000 |
| Water retention/flood hazard risk reduction | $46,000 | $104,000 |
| | | |
| **B4) Economic Revitalization Benefits** | **$11,077,000** | **$15,895,000** |
| Property value premium | $10,677,000 | $13,419,000 |
| Energy conservation | $151,000 | $449,000 |
| Residual value of land | $249,000 | $2,027,000 |
| | | |
| **Total Benefits = B1+B2+B3+B4** | **$105,018,000** | **$239,994,000** |
| | | |
| **Benefits less Costs (Net Present Value, = B-A)** | $13,998,000 | $123,483,000 |
| **Benefit Cost Ratio (BCR, = B/A)** | **1.15** | **2.06** |

Note: \a Because design, predevelopment, site development, and construction are scheduled to occur over the period spanning from 2018 to 2022, and capital construction expenditures are phased in over these years, the cumulative present value calculation of costs (as of 2018) will appear to be lower than the nominal project investment costs shown in the total project cost (See Table 6 below) due to the application of the 7% discount rate. The nominal value of total project capital costs is $101,680,000 (Table 6 below), while the discounted cost is $79,500,000 (shown above in the Project Investment Costs row for the discount rate of 7%).

Source: AECOM, RBDM Feasibility Cost Estimates - Alt 1-2-3 Build Comparison; 2018

Table 4 shows the cumulative present value of the monetized benefits and costs for the Proposed Project. The largest group of benefits consists of resilience values related to flood risk protection. In summary, the lifecycle costs required to build and operate the Project (amounting to $91 million, in cumulative present value, 2018 dollars) will generate the following benefits:

Total Benefits of $106.7 million, of which:

- Resiliency Values are: $84.8 million
- Environmental Values are: $0.2 million
- Social Values are: $9.0 million
- Economic Revitalization: $11.0 million

The Project's cumulative present value of net benefits (benefits minus costs) is $14.0 million, and the benefit cost ratio is (BCR: Benefits divided by Costs) is 1.15. These net benefits demonstrate that the Project has significant value to the community and Meadowlands region.

## 5.1 BCA Process Description

Louis Berger was tasked to provide the BCA narrative write-up and Quality Assurance/Quality Control (QA/QC). The analysis incorporates BCA Quality Control/Quality Assurance independent third-party peer review provided by Louis Berger. The cost and benefit data was developed by AECOM and also incorporated QA/QC answers to comments from Louis Berger. Louis Berger did not separately estimate any lifecycle costs or benefit streams. Louis Berger did, however, provide BCA formatting and project evaluation advice, and a project resource statement tool for use by the entire team. The project resource statement tool was essential for independently checking the BCA results: the measures of project merit (i.e., the net present value and the benefit cost ratio). The project resource statement tool also enables other reviewers to independently recreate the results of the BCA in a transparent manner. In addition, applying the tool, Louis Berger also provided a sensitivity analysis of the benefit cost analysis results at varying discount rates. The project resource statement tool developed by Louis Berger addresses the HUD requirement that "The BCA must all include all pertinent data and quantifiable calculations for benefits and costs in single spreadsheet tab (or table). Benefits and costs must be estimated for each year after the project's start date and for the analysis period" (HUD, Notice: CPD-16-06, p. 4). After this report is provided, NJDEP will have custody of the project resource statement (and all work files listed in the References section below) for use in the future, should project elements change after the submission of this report.

As noted above, the BCA was prepared by following the Guidance for Benefit-Cost Analysis included within the HUD Notice: CPD-16-06, and also adheres to the principles articulated within the document entitled OMB Circular A-94 – Guidelines and Discount Rates for Benefit-Cost Analysis of Federal Programs. The analyses presented herein are based on 2017 price levels and the application of a base 7% annual discount rate pursuant to OMB Circular A-94.

Many of the major Proposed Project features, such as pump stations, and drainage pipes/channels have the potential to be effective for a period well beyond 50 years. To account for the additional benefits expected to persist beyond the 50-year project planning horizon, only the residual value of property right of way (ROW) is included

within the BCA as a present value amount. For analytical purposes, costs and benefits have been evaluated over a 50-year period. The present value of futurereplacement costs for features with less than a 50-year life is evaluated as part of the operations and maintenance (O&M) costs (AECOM, 2017).

The Proposed Project incorporates a wide range of technologies to provide increased resiliency, environmental, social and economic revitalization values. Given the Project Area's high vulnerability to flooding, the majority of Proposed Project benefits are associated with increased resiliency. A number of flood risk evaluation models were considered for use in the resiliency analysis and were assessed for their potential application in this BCA exercise. The BCA Appendix discusses the pros and cons of these tools (AECOM, 2017).

The flood risk modelling approach selected for the Proposed Project's resiliency analysis and benefits monetization was the Hydrologic Engineering Center - Flood Damage Analysis (HEC-FDA) model developed by the Hydrologic Engineering Center of the United States Army Corps of Engineers (USACE). Given the Project Area's high vulnerability to flooding, the majority of benefits are associated with increased resiliency. The HEC-FDA model was developed to perform integrated hydrologic engineering and economic analysis of flood risk. The economic module of the HEC- FDA analysis includes information regarding the location, value, and vulnerability of every building falling within the modeled study area (Project Area) floodplain. The economic consequence of flooding has been calculated using guidance developed by both the USACE and the Federal Emergency Management Act (FEMA). Appropriate FEMA and USACE guidance and references are cited as appropriate throughout this document (AECOM, 2017).

Economic revitalization, social values and environmental value benefits generated under the Proposed Project were quantified and where possible monetized. Where these benefits were not monetized, they were assigned qualitative point factors (e.g.++) per HUD's qualitative rating criteria guidance provided in HUD Notice: CPD-16- 06 (See BCA Appendix). The benefits analysis was conducted using the Phase 2 Instructions for Community Development Block Grant National Disaster Resilience (CDBG-NDR) Applicants (Appendix H) as a guide for preferred methods and monetized values. The parameters of the benefits analysis follow the protocols set by OMB Circular A-94 as well as the recommended benefit quantification methods by the U.S. Department of Transportation, USACE, and FEMA except in cases where more Project-specific values or prices were available. By adhering to a strict standard of what could be included in the benefits analysis, actual total benefits may be greater than depicted within the monetized benefits analysis (AECOM, 2017).

A custom model was developed by AECOM to estimate the future benefits for each alternative and for the Proposed Project (Build Plan). Benefits were estimated over a 50-year period beginning in 2023 and spanning until 2072. The base year is 2018 and all values (costs and benefits) were discounted to the base year. While it was assumed that 2023 would be the first year that the project would be complete and benefits would begin accruing at the beginning of the year, some benefits are included that

would start in late 2022. These annual benefits were therefore prorated and included within that year. All benefits are expressed in constant 2018 dollars (AECOM, 2017).

## 5.2 Description of Proposed, Funded Project

The Build Plan is an integrated plan that primarily addresses the systemic inland flooding that results from heavy or frequent precipitation in the Project Area. The Build Plan includes both grey and green stormwater management infrastructure features. The grey stormwater management infrastructure features will be designed to reduce flooding damages by capturing and more rapidly evacuating stormwater in the Project Area. The grey infrastructure improvements would include two new pump stations, one force main, channel modifications, culvert and bridge improvements, operations and maintenance access ways and other associated structures and easements.

The Build Plan includes approximately 41 green infrastructure retrofit systems (approximately 37,000 SF) within the public right-of-way that are designed to reduce damages from flooding by capturing stormwater runoff from streets and sidewalks, treat water quality, and enhance the streetscapes with permanent vegetation or new porous paving. Additionally, approximately 18 green infrastructure systems (approximately 26,000 SF) are also included in the open space and park concepts. The green infrastructure features could include bioswales, rain gardens, storage trenches/ tree trenches, permeable pavement, wetland improvements, and parks/open spaces and other associated structures and easements. The green stormwater management infrastructure features, will be designed to capture stormwater runoff from streets and sidewalks to reduce local flooding, treat water quality, and enhance the streetscapes with permanent vegetation or new porous paving. Specific features and practices include bioswales, rain gardens, storage trenches, permeable pavement, new improved parks/open spaces, and wetland improvements, designed to capture stormwater runoff from streets and sidewalks to reduce local flooding, treat water quality, and enhance the streetscapes with permanent vegetation or new porous paving. Green infrastructure features can be found in streets and parks. The Build Plan also incorporates community co-benefits through the enhancement and improvement of public spaces in the Project Area (AECOM, 2017). Under the Build Plan, the total acreage of new parks created would be approximately 7.6 acres. A full description of the Build Plan is under Section 2.1 of this APA.

Construction for the Build Plan would begin in February 2019 and last 3.25 years. The Project is planned to be completed by September 2022. The estimated useful life of the Project is 50 years, or approximately 2022 through 2072.

## 5.3 Full Project Cost

Table 5 shows the elements of the capital construction costs for the Proposed Project (Build Plan) as well as the full program costs including NJDEP program administration and the Feasibility Study/EIS. More detailed capital cost tables are included within the

BCA Appendix. The summary below includes adjustments for inflation and contingencies embedded within the totals shown.

**Table 5: Build Plan Total Project Capital Costs**

| Project Features | ESTIMATED TOTAL WITH CONTINGENCY & ESCALATION (2017$) |
|---|---|
| **Construction** | |
| Grey Infrastructure Features | $65,153,000 |
| Green and Open Space Features | $14,385,000 |
| Allowances | $5,749,000 |
| General Requirements | $5,637,000 |
| **Construction Costs** | **$90,924,000** |
| **Additional Capital** | |
| Real Estate | $10,300,000 |
| Engineering and Design | $9,270,000 |
| Construction Administration | $4,006,000 |
| **Additional Capital Costs** | **$23,576,000** |
| **Total Project Capital Costs (Construction + Additional Capital)** | **$114,500,000** |
| **Feasibility Study/EIS** | **$20,500,000** |
| **NJDEP Program Delivery** | **$13,100,000** |
| **NJDEP Administration** | **$1,900,000** |
| **Total Program Costs:** | **$150,000,000** |

Notes:

1- Estimate includes 25% contingency on Construction Costs.
2- Estimate includes escalation to a construction mid-point of 2021, at 3.5% per yearcompounded.
3- Estimate assumes all excess soils generated by construction will be classified as non-hazardous ID27 solid waste. These excess soils are assumed to be transported/Disposed from the site at a cost of $85 per ton. The weight of excavated material was conservatively estimated to be 2 tons per cubic yard, resulting in a disposal cost of $170 per cubicyard.
4- Estimate EXCLUDES costs for HTRW mitigation. Assumes that any "hot spots" of HTRW will either be avoided or any additional HTRW costs incurred would be covered by the contingency and also likely reductions in the volume of the ID-27 T&Destimate.
5- Allowances provide for utility relocations/protection and wetland mitigation costs.
6- Estimate assumes force mains, storm water piping & box culverts will require deep foundation support.
7- GENERAL REQUIREMENTS - 6.5% of construction cost that covers contractor PM and Supervision (3%), Mob/Demob (1%), Traffic Maintenance (2 %), and Erosion-sedimentation controls (0.5%)

Source: AECOM;RBDM Feasibility Cost Estimates - Alt 1-2-3 Build Comparison;2018

It should be noted that the total costs shown in Table 5 are treated as expenditures that will be phased in, in annual increments over the construction period spanning from 2018 to 2022. Therefore, within the BCA, these future year amounts are discounted to present value by applying the project discount rate of 7%. Consequently, the cumulative present value costs shown in the BCA summary tables will appear lower than the nominal (undiscounted) costs shown in Table5.

In addition, HUD Benefit Cost Guidance specifies that the price level be held constant (at 2018 constant prices) throughout the project evaluation period, 2018-2072. (HUD CPD 16-06, p.8). Because of this convention, the capital cost price escalation contingency to the year 2021 was removed within the BCA. Explanatory tables showing the adjustments made to all costs, and the reconciliation to nominal budgeted amounts are provided below in tables 6 and 7. Table 6 below removes the 2021 price escalation adjustment to express all costs in 2018 constant dollars, per HUD BCAGuidelines.

**Table 6: Build Plan Total Project Capital Costs Modelled in Benefit Cost Analysis**

| Project Features | Estimated Cost Before Physical Contingency | Physical Contingency | Total with Contingency |
|---|---|---|---|
| **Construction** | | | |
| Grey Infrastructure Features | $45,422,000 | $11,355,000 | $56,777,000 |
| Green and Open Space Features | $10,029,000 | $2,507,000 | $12,536,000 |
| Allowances | $5,010,000 | $0 | $5,010,000 |
| General Requirements | $3,930,000 | $982,000 | $4,912,000 |
| **Total Construction Costs** | $64,391,000 | $14,844,000 | $79,235,000 |
| Real Estate | $10,300,000 | $0 | $10,300,000 |
| Engineering and Design | $7,727,000 | $927,000 | $8,654,000 |
| Construction Administration | $2,791,000 | $700,000 | $3,491,000 |
| **TOTAL PROJECT COSTS** | $85,209,000 | $16,471,000 | $101,680,000 |
| | | | |
| Total Price Contingency (removed from BCA) | | | $12,820,000 |
| Feasibility Study/EIS | | | $20,500,000 |
| NJDEP Program Delivery | | | $13,100,000 |
| NJDEP Administration | | | $1,900,000 |
| Total Program Costs | | | $150,000,000 |
| Source: AECOM;RBDM Feasibility Cost Estimates - Alt 1-2-3 Build Comparison;2018 | | | |

Table 7 shows the results of the process of discounting the future nominal Total Project Cost expenditures by construction phase year (in 2018 to 2022) to the present value basis of 2018, to account for the time value ofmoney.

**Table 7: Build Plan: Nominal and Discounted Total Project Costs by Construction Year**

| | Total / Cumulative Present Value-2018: (Sum of 2018-2022) | 2018 | 2019 | 2020 | 2021 | 2022 |
|---|---|---|---|---|---|---|
| Capital Cost Phase-in Shares, % | 100.0% | 2% | 6% | 36% | 33% | 22% |
| Total Project Costs: Nominal Capital Costs ($) | $101,680,000 | $2,466,403 | $6,429,055 | $36,195,120 | $33,783,678 | $22,805,745 |
| Discount Factor (I = 7.0%) | | 0.9346 | 0.8734 | 0.8163 | 0.7629 | 0.7130 |
| Discounted Capital Costs \a | $79,500,377 | $2,305,100 | $5,615,136 | $29,546,076 | $25,773,568 | $16,260,496 |
| Source: AECOM, 2018 and BCA calculations applying 7% discount rate<br>\a rounded total value is $79,500,000 | | | | | | |

## 5.4 Description of Existing Problem

As demonstrated by Superstorm Sandy, the Project Area is subject to periodic, devastating flooding during large storm surges. In addition, repetitive flooding occurs throughout the Project Area due to both intense rainfall events and from smaller storm surges that block the existing tide gates. In general, there are three distinct sources of flooding in the Project Area:

- Storm surge overwhelming the existing Line ofProtection;
- Rainfall trapped behind the existing gates and levees at high tide;and
- Limits in the capacity of the existing drainage structures, resultingin flooding during rainfall-onlyevents.

The BCA Appendix describes how flooding is currently affecting the Project Area. The Project Area is not specifically or particularly susceptible to wind, fire, or earthquake damage; as such, the Build Plan focuses on reducing flood risk. Climate change and associated sea level change would exacerbate the flooding risks associated with the Project Area, as discussed in detail within the BCA Appendix (AECOM, 2017).

## 5.5 Risks If RBD Meadowlands is Not Implemented

This section identifies the key risks and uncertainties that may affect the Proposed Project, either in a positive or adverse way. In addition, the Proposed Project's ability to adapt to, or to accommodate any of these risks is discussed, as applicable.

The Proposed Project is designed to provide resilience and community benefits to the residents and businesses in the Project Area. The risks, as described in this section, are events or issues that would influence the Proposed Project's projected benefitsduring the project lifecycle such that those benefits would not be realized or recognizable, or would not be realized to the level anticipated. These risks could arise either from within the Proposed Project' marshalling of resources, or from various external reasons or unpredictable events. Below is a description of potential risks that may occur and how they may impact the Proposed Project's realization of benefits (AECOM,2017).

- **Rapid Sea Level Change** - A rapid sea level change that increases at rates substantially higher than the estimates used for this BCA analysis could impact the Project Area to an extent that the benefits from the Proposed Project are not realized to the level anticipated. Overall, this would result in a reduction in resiliency benefits. If sea level change were to increase at historic rates for the Project Area (which is lower than the predictions used in this analysis), predicted damages would be lower than analyzed and the Proposed Project would likely still be effective.
- **Relocation or Closure of Industrial/Commercial Establishments** - If a significant number of business or warehouses in the Project Area were to leave the Project Area or close-down for various reasons (e.g., increased maintenance or insurance costs, changes in management, down-sizing, etc.), the benefits associated with reduced flood risk would not be realized to the extent projected in the BCA. While the Proposed Project would still reduce flood risk for the small number of business that may still be operating within the Project Area, the flood risk reduction benefits assume the retention of establishments and their maintenance, or a growing business environment over time. These assumptions are required for all associated benefits of the Proposed Project to be fully realized over the evaluation time horizon (AECOM,2017).

- **Decline in Population** - If there were a significant decrease in the population within the Project Area for unforeseen or unanticipated reasons (e.g., natural disaster, large emigration from the Project Area, significant decrease in birth rates, etc.), the expected benefits of the Proposed Project would not be fully realized. With a significant decrease in population, the Project Area could also experience a decrease in business employment and maintenance, the use and maintenance of open spaces and public areas, and the number of residents that need protection from future flood events. Some of the aspects of the Proposed Project that may not be realized with a significant decrease in the population are: emergency response and preparedness, demand for open space and recreational, and decrease in public health risks.

## 5.6 List of Benefits and Costs of the RBD Meadowlands Project

This section summarizes the lifecycle costs and benefit / values that are included within the benefit cost analysis. For a more detailed description of these costs and benefits refer to the BCA Appendix.

1. Lifecycle Costs

The lifecycle costs of the Proposed Project consist of the both the full project investment capital construction costs and the long-term annually recurring operational and maintenance costs (O&M). Within the BCA the annually recurring O&M costs are modelled as being incurred when the construction period is complete (estimated at year: 2022) and operations commence (estimated at year: 2023). Table 8 below shows the summary of the main O&M groupings for the Proposed Project. The Project Capital Construction Costs and shown above in Table 7.

**Table 8: Proposed Project-Annual Operational and Maintenance Costs (O&M)**

| O&M Cost Category: | East Riser Ditch \a | Losen Slote \b | Total |
|---|---|---|---|
| Grey Features | $446,300 | $87,400 | $533,700 |
| | | | |
| Green Features -Open Space (not including equipment and replacement of park features) | | | $520,700 |
| Green Features – Street side GreenInfrastructure | | | $21,300 |
| Total Annual O&M Costs: | | | $1,075,700 |
| **Total Annual O&M Costs rounded: ≈** | | | **$1,100,000** |

Notes:
a\ 500 cfs pump station, discharge channel, modified forebay inlet to existing tide gate, culvert upgrades, ditch dredging)
b\ 50 cfs pump stations, forcemains
Source: AECOM, <<20171116_RBDM_Build Plan- O&M_Cost_Estimate.xlsx>>

Table 8 shows the annual O&M costs broken out by the Proposed Project's grey and green features. Slightly over one half of the annual O&M will be required to sustain the 500 cfs pump station, discharge channel, modified forebay inlet to the existing tide gate, culvert upgrades and ditch dredging for the East Riser Ditch, and the Losen Slote project elements. The remaining half of annual O&M will be required to sustain the green infrastructure stormwater management features relating to open spaces but not including equipment and replacement of park features.

2. Resiliency Value

The benefits calculated for the Proposed Project are based on a comparison of future conditions with and without implementation of the Proposed Project. The benefit analysis assumed that certain conditions would exist in the future. Theseconditions are fully described in the BCA Appendix and summarized in Section VI of this document. Changes in the future condition assumptions from those anticipated in the BCA calculations could result in higher or lower benefits than currently estimated.

The main resiliency benefits consist of avoided flood damages. The Proposed Project will provide direct resiliency benefits by reducing flood damages to structures and their contents. These structures consist of residences, apartments, commercial, industrial, municipal and utility buildings. In addition, resiliency benefits consist of avoided flood damages to motor vehicles, avoided debris/disposal costs, avoided mortality and injuries to the population, avoided public emergency costs, and avoided critical facility disruptions. Flood damage reduction benefits were calculated using the HEC-FDA model. About 69% of the annual resiliency benefits were derived from damage reductions to structures (i.e., residential, commercial, municipal, and utilities), and the remaining 31% are associated with reductions in death/injury/mental/health, emergency response, motor vehicles, debris disposal, and critical facility disruption (Appendix C). **Table 9** shows a breakout of expected annual values, anticipated in 2023, and in 2073, by flood damage reduction benefit category (AECOM, 2018).

**Table 9: Resiliency Values: Expected Annual Benefits under the Proposed Project- Build Alternative 3**

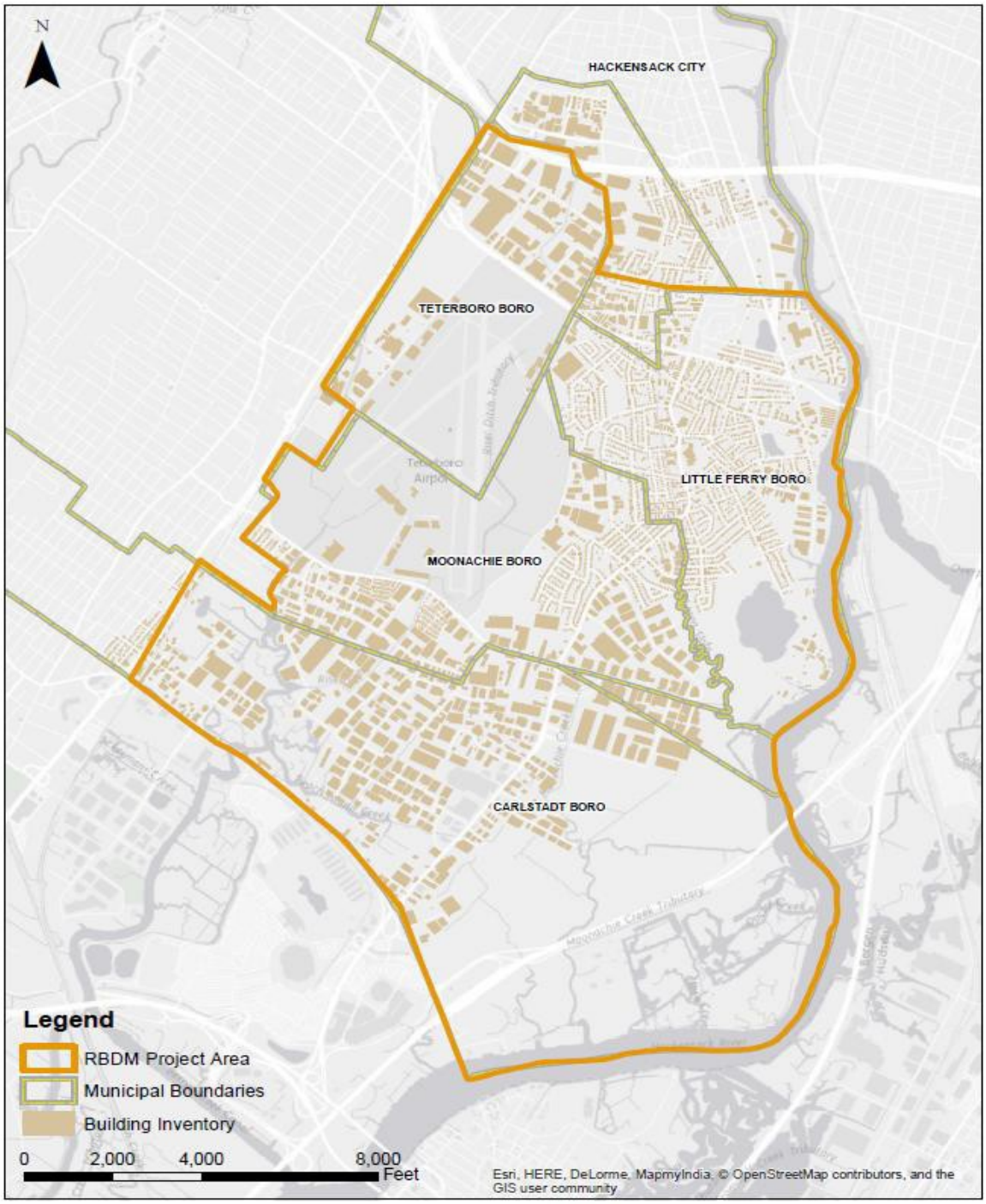
[1.2 Feet Sea Level Rise at the Battery, 0.8 Feet Assumed for ProjectArea]

| Flood Damage Reduction Benefit Category | Expected Annual Damage Reduction Value 2023 | Expected Annual Damage Reduction Value 2073 |
|---|---|---|
| **Structures:** | | |
| Residential | $54,520 | $131,670 |
| Apartment | $2,540 | $4,820 |
| Commercial | $1,946,670 | $3,600,400 |
| Industrial | $2,157,610 | $4,600,060 |
| Municipal | $92,750 | $149,000 |
| Utility | $100 | $20 |
| **Other:** | | |
| Motor Vehicles | $98,320 | $177,060 |
| Debris Disposal | $5,550 | $8,300 |
| Death/Injury | $1,807,210 | $4,168,190 |
| Public Emergency | $40 | $30 |
| Critical Facility Disruption | $30 | $90 |
| **Project Total:** | **$6,165,340** | **$12,839,640** |

Source: AECOM, 2018

Figure 1 shows a map of the area and the assets at risk from which flood reduction damages were calculated based on the projected sea level rise scenario for the Project Area.

**Figure 1: Map of Project Area and Assets at Risk**




Source: AECOM <<RBDM_Feasibility_FDA_Vulnerable Areas Map.pdf>>

3. Social Value

The BCR reflects the cumulative present value of the combined annual value of monetizedsocial benefits, consistingof the followingcategories: Recreation, Avoided Stormwater Treatment Cost, Aesthetic Value, and Water retention related/flood hazard risk reduction benefits. These categories are furthered explained below:

- **Recreation -** The recreational values associated with the Project Area are based on the value that visitors place on the open space and new park amenities. The annual value of recreation benefits is based on the estimated number of annual visits for populations residing within one-quarter mile from the new parks. From a former study, it was observed that 43% of park users lived within ¼ mile of the park, 21% lived between ¼ and ½ of the park, and 23% lived between ½ and 1 mile of the park surveyed (Cohen, 2007). Since some of the new parks are located near each other, only the estimated number of users within ¼ mile of the park was used for the analysis as a conservative estimate (AECOM, 2017).

  The estimated number of users for the new parks was based on a study conducted by Active Living Research (2011). It was assumed that 10% of the population living within ¼ mile of a proposed park would be daily users, 40% would use the park once a week, 20% would use the park once a month, 10% would use the park less than once a month, 10% would use the park once, and 10% would never use the park (AECOM 2017).

  The recreation benefits were monetized using the USACE recreational day use value for fiscal year 2017 of $5.94 based on the expected characteristics of the new parks (2016). The seasonal usage of the new parks is assumed to span the period from mid-April to mid-October (26 weeks) and because of inclement weather, it is conservatively assumed that daily users would only use the park 122 days per year. Using these assumptions, it is calculated that for every person living within ¼ mile of a new park, there would be 24 days of park use per year for an estimated annual use-value of about $144 (AECOM 2017).

  The projected number of annual visits (concentrated within Little Ferry, Moonachie and the Outer Boroughs) was multiplied by the USACE 2017 unit day value for recreation to arrive at the annual monetized value of recreation associated with the incremental recreational use within the Project Area arising under the Build Alternative. Table 10 shows the distribution of the annual recreational benefits across the Project Area (AECOM, 2017).

**Table 10: Annual Recreational Benefits from New Parks – Proposed Project**

| Area | Number of Annual Visits | Annual Value |
|---|---|---|
| Carlstadt | - | $0 |
| South Hackensack | - | $0 |
| Little Ferry | 71,823 | $426,631 |
| Teterboro | - | $0 |
| Moonachie | 43,162 | $256,380 |
| Other Boroughs | 5,655 | $33,591 |
| Total | 120,640 | $716,602 |

Source: AECOM, << Meadowlands GIModel_13Nov17.xlsx>>

- **Avoided Stormwater Treatment Costs** - To estimate the value of rainfall intercepted on-site and potential cost reductions in stormwater- management control, a value that includes the avoided cost of collection, conveyance, and treatment was applied. The average price of stormwater runoff reduction ($0.089 per gal) (USDA, 2014) was applied to the estimated gallons of stormwater that would be intercepted by the Build Alternative's Green Infrastructure stormwater management project elements (i.e., rain gardens, urban vegetation, bioretention/bioswales, new green space, permeable paving, as well as tree plantings).

  Green infrastructure measures can vary in the level of effectiveness. This variability is accounted for in the model using minimum and maximum values for the number of gallons of stormwater that can be reduced. The average value of the low and high estimates was used to estimate the number of gallons of stormwater runoff that would be captured by the green infrastructure stormwater management measures and tree plantings. The factors used to calculate the minimum and maximum volume of stormwater that would be reduced by each green infrastructure measure (in gallons) were obtained from the Center of Neighborhood Technology (2010) and the formula was adapted to the local Meadowlands climatic conditions by applying the average annual rainfall in Teterboro (U.S. Climate Data, 2017). The stormwater benefits associated with the newly planted trees were calculated using the i-Tree Tool. The value of reduced stormwater was monetized as the product of the gallons of stormwater runoff that wouldbe reduced annually and the avoided treatment cost (associated with traditional stormwater management control) (AECOM, 2017).

- **Aesthetic Value** - Green infrastructure interventions can help to not only prevent debris from being carried away with runoff throughout the streets in higher-volume storms but can also include plantings that create pockets of color and texture throughout the landscape. In addition to new green infrastructure features, the Build Alternative will also improve existing elements of the area's storm drainage networks. Existing ditches that undergo day-lighting are cleaned and re-landscaped to function more efficiently in conveying stormwater can also become a unique and attractive feature in the local landscape.

  Redesigned parks, an activated waterfront, and other landscape-based interventions create a more visually appealing system of open spaces throughout the Project Area. Green infrastructure implementations within streetscapes establish more attractive conditions along transportation corridors. A literature derived or benefits transfer aesthetic value per acre was applied in the BCA. The aesthetic value from green open space applied is $1,787 per acre of new green open space per year as established by FEMA and updated to 2017 dollars (FEMA, 2012) (AECOM, 2017).

The per-acre value reflects a cultural/aesthetic related benefit, not captured elsewhere in the benefit cost analysis. The annual monetized aesthetic benefit was calculated based on multiplying this per acre value times the number of acres for project features that would provide this aesthetic value within the Project Area.

- **Water retention related/flood hazard risk reduction benefits** - The value of water retention was calculated by converting the total square feet of all green infrastructure features combined, converting this square foot value to acres, and then applying a FEMA sustainability value per acre (updated to 2017 US$) that is a national average value that captures the benefits for this feature (See BCA Appendix). Green open space is a provisioning area for stormwater retention and floodwater storage and conveyance and contributes to replenishing groundwater (underground aquifers). To measure the benefit of water retention and flood hazard risk reduction from new green open spaces, the national FEMA value of $322 per acre (updated to 2017 dollars) was applied to new green open spaces that were previously impervious (FEMA, 2012) (AECOM,2017).

4. Environmental Value

The environmental values that were monetized within the BCA consist of air quality improvements, the value of pollination ecosystem services and nutrient pollution removal provided by the Project features. It is important to note that the Project features will provide many ecosystem service enhancements and benefits to the Meadowlands area. These benefits are described qualitatively within the BCA Appendix (AECOM, 2017). Because ecosystem services are so important to the project area, the benefits of wetland creation and enhancement are summarized below in qualitative terms. The APA narrative below focuses on those environmental values that were monetized and included within the benefit cost ratio (AECOM, 2017).

- **Air Quality Benefits -** The monetary values for the reduced emissions used in the benefits analysis are based on USDOT guidance (2016b) and adjusted into 2017 dollar terms. The GHG emission values are based on the Social Cost of Carbon (SCC) developed by the Federal Interagency Working Group on Social Cost of Carbon and suggested by TIGER guidance (USDOT, 2016b). SCC values were inflated to 2017 dollars. The GHG emissions value was calculated by multiplying the quantity in metric tons of carbon dioxide by the appropriate SCC value in that same year. Carbon sequestration of green infrastructure was monetized using the climate regulation annual values from FEMA of $15 per acre of new green open space (2012) (AECOM, 2017) (AECOM, 2017).
- **Pollination Services Benefits** - Creation of additional green space, including rain gardens and urban vegetation, provides opportunities for

native bees, butterflies, flies, and beetles to move pollen among flowers so that plants can form seeds and fruit. The pollination value applied was $319 per acre of new green open space per year as established by FEMA and updated to 2017 dollars (FEMA, 2012). The value of pollination services was calculated by multiplying this value per acre by the total acres associated with the select green infrastructure project features that would provide additional environment for the pollination supporting ecosystem services to be established (AECOM, 2017).

- **Reduced Nutrient Pollution / Nutrient Removal Benefits** - Common approaches for implementing permanent sustainable stormwater management features that have been included in the green infrastructure aspects of the Proposed Project emphasize nature-based methods and distributed source controls, such as permeable pavement, bioswales, rain gardens, green roofs, rain barrels, and cisterns. Managing stormwater to complement drainage improvements for more frequent rainfall events would improve the quantity and quality of runoff throughout the drainage areas of the Hackensack River and reduce nutrient pollution from excess nitrogen and phosphorus. Bioretention facilities are expected to reduce nutrient pollution from excess nitrogen and phosphorus. The factors used to determine the number of pounds of nitrogen and phosphorus reduced was obtained from the Watershed Protection Techniques Journal (Schueler, 1997). The monetized value per pound of the reduced nitrogen of $3.83 (Shaik, et. al. 2002 and Birch, 2011) and phosphorus of $40.20 (Ancev, et. al. 2006) come from multiple research journals (AECOM, 2017). The annual monetized value of the reduction in nitrogen and phosphorus was basedon multiplying the per pound values by the total pounds that would be removed given the relevant acreage hosting the green infrastructure projectfeatures with vegetation supporting this nutrient removal and uptake.
- **Wetland Enhancement and Creation** - Wetlands provide tangible and intangible ecosystem services including provisioning, regulating, cultural, and supporting services that generate economic value from their direct, indirect, and potential use. Provisioning services include the production of fish; storage and retention of water; creation of fiber, peat, fodder, and fuelwood; genetic materials for resistance to plant pathogens; and biochemical (extraction of medicines and other materials). Regulating services include climate regulation, water regulation, water purification and waste treatment, erosion regulation, flood control and storm protection, and habitat for pollinators. Cultural services include recreational activities, such as bird watching; educational opportunities; spiritual and religious values related to aspects of wetland ecosystems; and aesthetic value. Supporting services include soil formation and sediment retention and nutrient cycling. Biodiversity of plants and animals is supported by wetlands and help to maintain wetland processes (AECOM, 2017).
-

The Proposed Project would re-create and improve natural areas (and wetlands), which would be integrated throughout the Project Area. Re-created natural areas would generate ecosystem benefits including better water quality, reduced contaminated sediment, new habitat, and better fisheries production. Constructing, enhancing, and restoring wetlands can create new habitat and reduce fragmentation. Additionally, new wetland and riparian areas can contribute to nutrient cycling, biological control, erosion control, and support biodiversity (AECOM, 2017).

5. Economic Revitalization

The economic revitalization benefits that were monetized within the benefit cost analysis consist of a one-time enhancement in the value of adjacent properties, energy conservation benefits, and the present value of the residual value of land right-of-way hosting the Proposed Project (AECOM, 2017).

- **Enhanced Property Values** - Many studies have consistently shown that parks and open space have a positive impact on nearby residential property values (Crompton, 2005 and McConnell and Walls, 2005). The value of commercial properties near parks may also appreciate. The property value attributable to proximity to a park is separate from the direct recreational use value, meaning the property value appreciates even if the resident never visits the park. The magnitude of the increase in the property value is linked to the distance and the quality of the park and open space. While studies have shown increased property values up to 2,000 feet from a large park, most of the value is found within 500 feet of a park (Bolitzer and Netusil, 2000; Crompton, 2001; National Association of Realtors, 2009; Crompton, 2004; Crompton and Nicholls, 2005) (AECOM, 2017).

  A 2009 report from the National Association of Realtors found the premium for homes near parks can extend three blocks and start at 20% for those homes directly adjacent to these amenities (declining as distance from the park increases). An empirical review of 30 studies validated a 20% appreciation for properties abutting or fronting a passive park area and a 10% appreciation for properties 2 or 3 blocks away (Crompton, 2001). A 20 percent property value increase was applied to residential properties within 100 feet of new parks and a 10 percent property value increase was applied to residential properties between 100 and 500 feet of new parks (AECOM, 2017).

  In various studies, improved landscaping and new tree plantings have also been associated with overall increases in house values varying on average from 7 to 30% (Des Rosiers et. al., 2002; Donovan and Butry, 2010; EPA, 2016a; Kusnierz et. al., 2010; Wachter and Gillen, 2006). For purposes of this analysis, it is assumed that properties within 100 feet of new trees would appreciate in value by 7% (AECOM, 2017).

In 2015, median home value was higher in Bergen County ($441,400) in comparison to the five municipalities in the Project Area, which ranged from $269,500 in South Hackensack to $389,800 in Carlstadt (ACS, 2016). Improving the livability and aesthetics of the living environment and access to new recreational facilities can increase property values. The 2015 median values of housing units for each borough in the Project Area are displayed in Table 4-1 in the BCA Appendix C. The median housing value for each borough from the U.S. Census was used to help mitigate sensitivity to extremely high selling prices and the type of properties sold each year (e.g., condominiums versus single family homes) (AECOM,2017).

The full property value premium was calculated based on determining the number of residences that fell within a certain distance to the amenity and that would experience either a 20, 10, or 5% increase in value. As described above, the value base was the median home value. The onetime enhancement in property value was treated as a one-time stock benefit that would arise in 2023. This value was then discounted to present value in the benefit cost analysis (AECOM, 2017).

- **Energy Conservation** - The strategic planting of trees can provide shading and wind breaks, thereby saving and conserving on energy usage and fuel consumption. Natural gas and electricity savings were calculated based on applying the i-Tree Tool, a peer-reviewed software from the USDA Forest Service (itreetools.org). In addition to the kilowatt-hours of electricity savings, therms of natural gas savings, and monetized energy conservation benefit, the i-Tree Tool provides the number of gallons of reduced stormwater runoff, estimated stormwater savings benefit, and air emission reductions (in pounds), and the associated value (AECOM,2017).

  It was assumed that all trees planted would be Red Maples (a common tree in the study area) and would be 3 diameters when planted. The maturation period and the tree diameter growth was extrapolated to the end of the period of analysis. The average annual diameter growth was obtained from the USDA Forest Service Growth Model for the Northeastern United States (1991). When more specific values for the study area were available, these were used in place of the estimates from i-Tree. The i-Tree Tool was used to calculate the average annual electricity benefit of $6.36 per tree and average annual natural gas benefit of $26.04 per tree. The number of new trees planted was then applied per each area to the projected annual value per tree (for combined energy savings) per each project sub-area. The number of trees to be planted by area was sourced from the Build Plan (AECOM, 2017).

- **Residual Value of Land -** The value of the land (right of way, ROW) is included as a nominal residual value (in the year 2072) and then discounted to present value in the benefit cost analysis (AECOM, 2017).

## 5.7 Description of Risks to Ongoing Benefits from Overall Project

The Proposed Project is designed to provide resilience and community benefits to the residents, businesses, and stakeholders within the Project Area. The risks, as described above in Section 5.6, are events or issues that could influence the Proposed Project's projected benefits during the lifecycle of the Build Plan such that those benefits would not be realized or recognizable, or would not be realized to the level anticipated. These risks could arise from circumstances outside of the Proposed Project's footprint, boundary or resources, or for various other reasons, or unforeseen and unanticipated events (AECOM,2017).

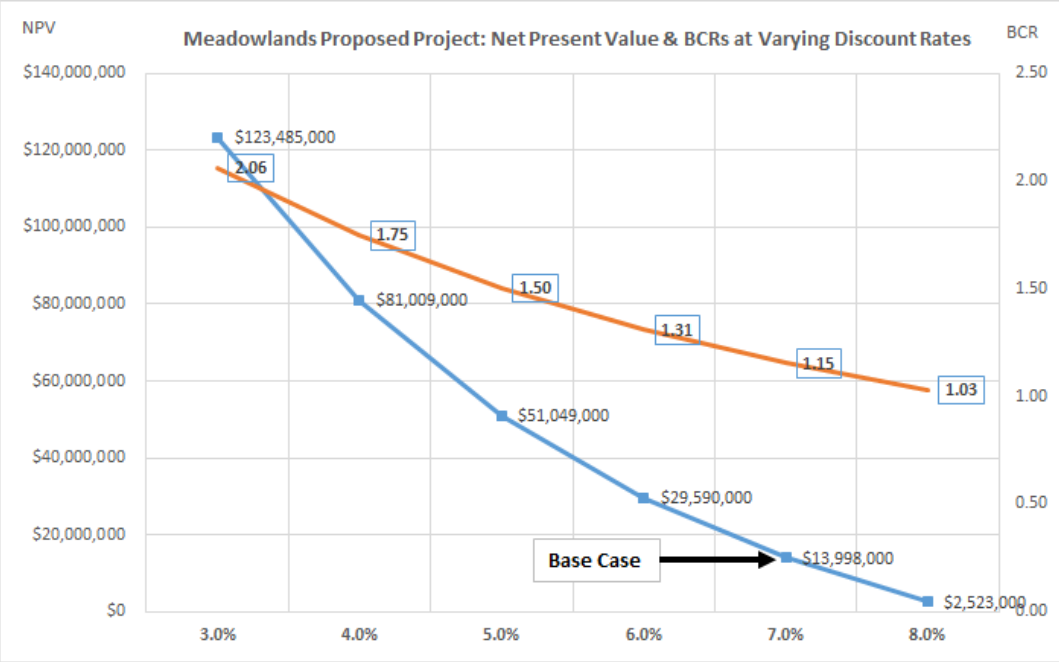
In addition, challenges described within Section 5.8 below could have potential impacts on the Proposed Project's costs (capital costs during construction and long-term annually recurring O&M costs) as well as lead to delays in project implementation.

A sensitivity analysis was conducted to gauge how responsive the Proposed Project's net present value and benefit cost ratio are to departures from the base discount rate of 7.0%. Table 11 and Figure 2 below shows that a slight lowering of the base discount rate, from 7% to 6% increases the net present value and BCR significantly.

**Table 11: Proposed Project Cumulative Net Present Value of Benefits & Benefit Cost Ratios at Varying Discount Rates**

| Discount Rate | Net Present Value: NPV | Benefit Cost Ratio: BCR |
|---|---|---|
| 3.0% | $123,485,000 | 2.06 |
| 4.0% | $81,009,000 | 1.75 |
| 5.0% | $51,049,000 | 1.50 |
| 6.0% | $29,590,000 | 1.31 |
| 7.0% | $13,998,000 | 1.15 |
| 8.0% | $2,523,000 | 1.03 |
| Source: Louis Berger | | |

**Figure 2: Proposed Project: NPVs and BCRs at Varying Discount Rates**




Lowering the base discount rate from 7% down to 3% shows that the net benefits and BCR are sensitive to the application of an alternative discount rate. As the Proposed Project is not meant to discourage privateinvestment or consumption, but is intended to create a resilient environment and community that is conducive to attracting future investment, it is unlikely that private investment will be displaced by the Project. The Project is an "enabling" infrastructure investment, a term used to describe infrastructure that facilitates economic growth and productivity. Therefore, thelower discount rate of 3% is provided to show that the BCR is higher with this lowerhurdle rate. At a discount rate of 3%, the cumulative present value of net benefits from the Build Alternative is $123.5 million and the BCR is 2.06.

## 5.8 Assessment of Project Challenges

A number of challenges can be encountered when implementing a project that covers a large, populated area and over a long period of time. Below is a discussion of some of the anticipated challenges that may arise during the Proposed Project (AECOM, 2017).

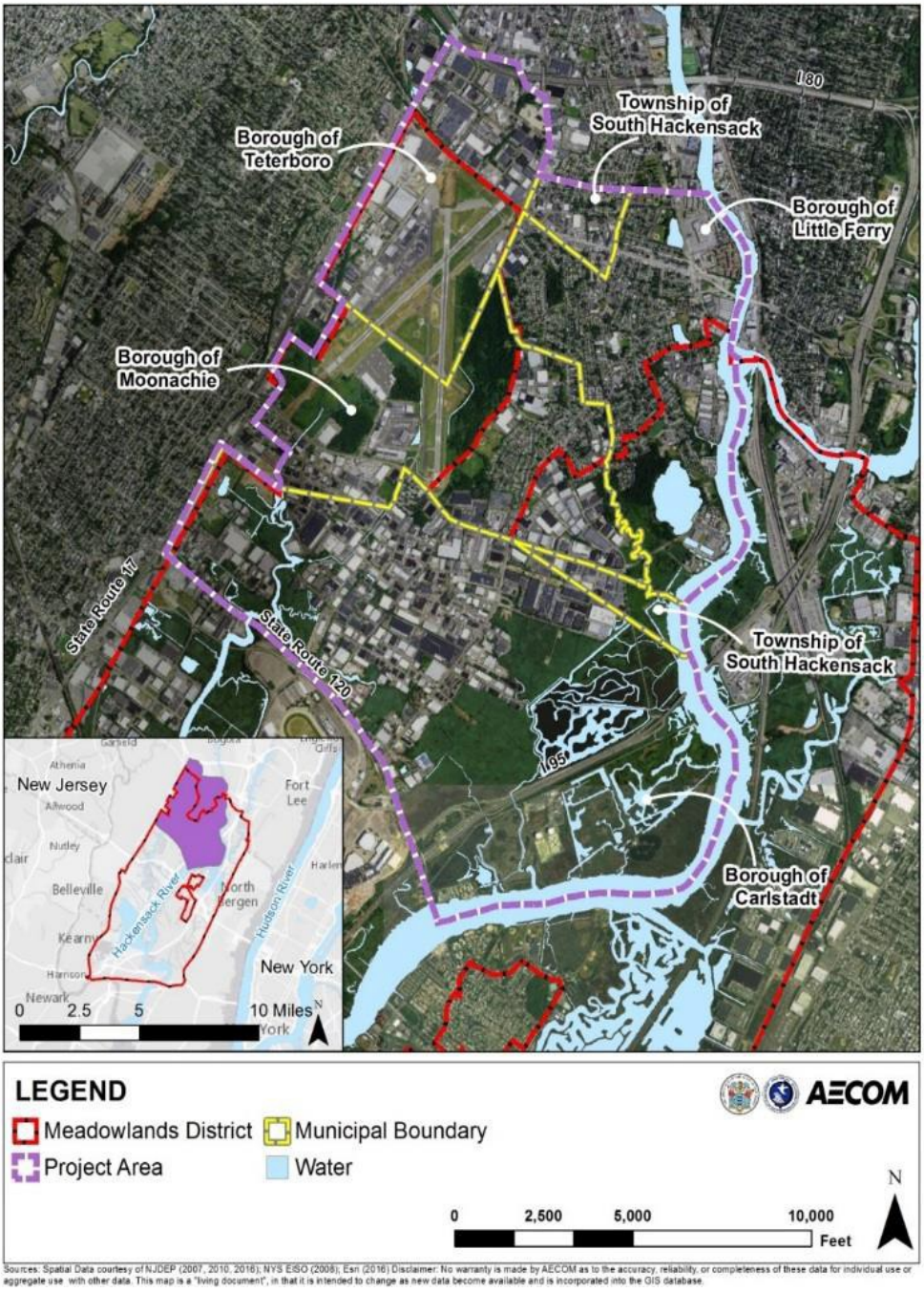
- Real estate acquisition, including both monetary costs and timedelays;
- Future O&M investments;
- Construction phasing challenges associated with urbanareas;
- Community Coordination and potential opposition including lawsuitsor legal challenges;
- Permitting or Regulatory Delays;
- Availability of the necessary mitigation credits for wetlands andriparian zones;

- Issues related to both known and unknown contaminated areas within the Project Area; and,
- Future development encroaching on green infrastructure.

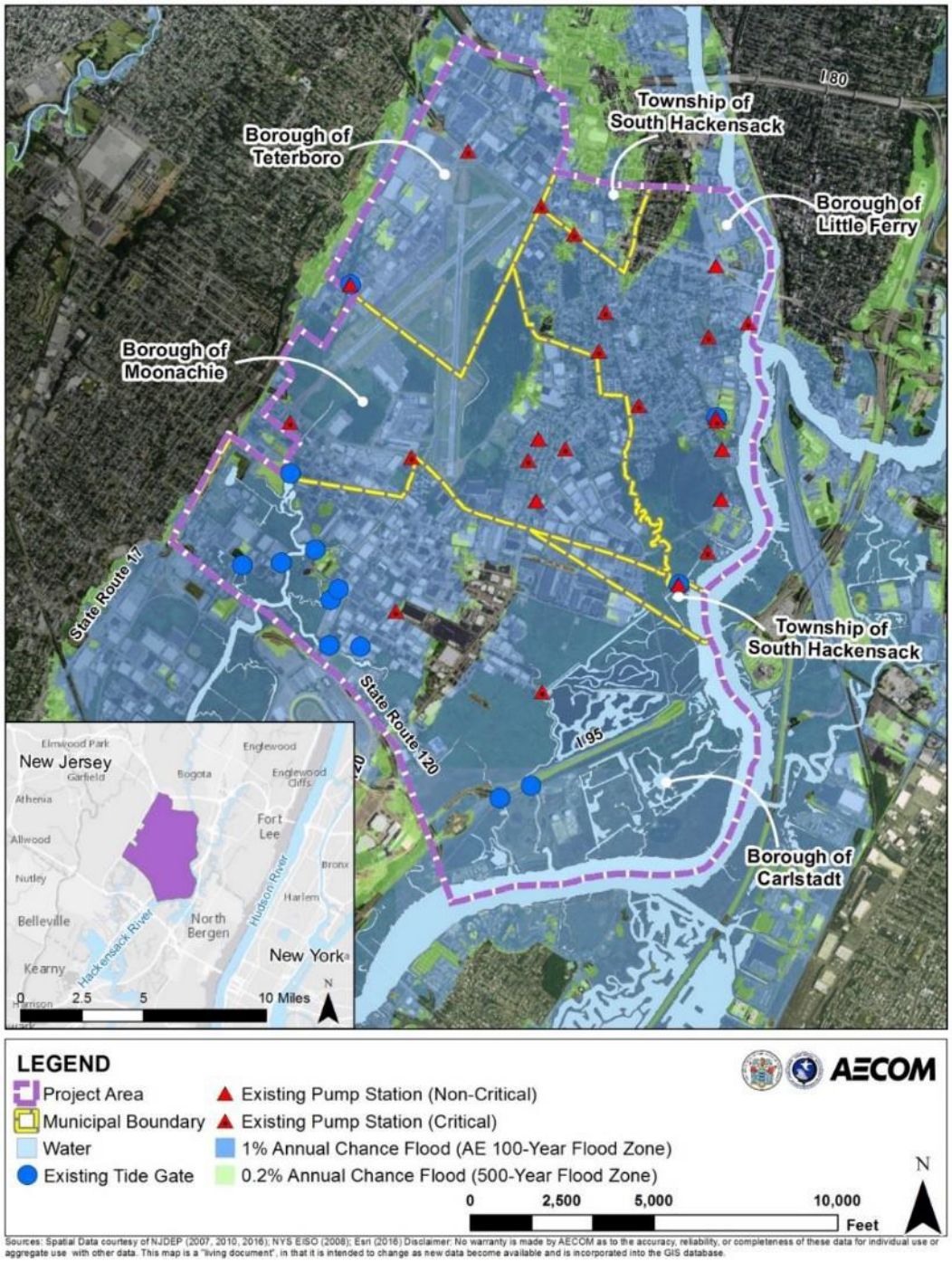
These issues may occur in various stages of a Project implementation: ongoing feasibility, design, construction, or O&M. The challenges can be centered on costs, logistics, or coordination.

# Appendix A: Alternative 3 Hybrid: Build and Future Plan

# Figure 1. RBD Meadowlands Project Area

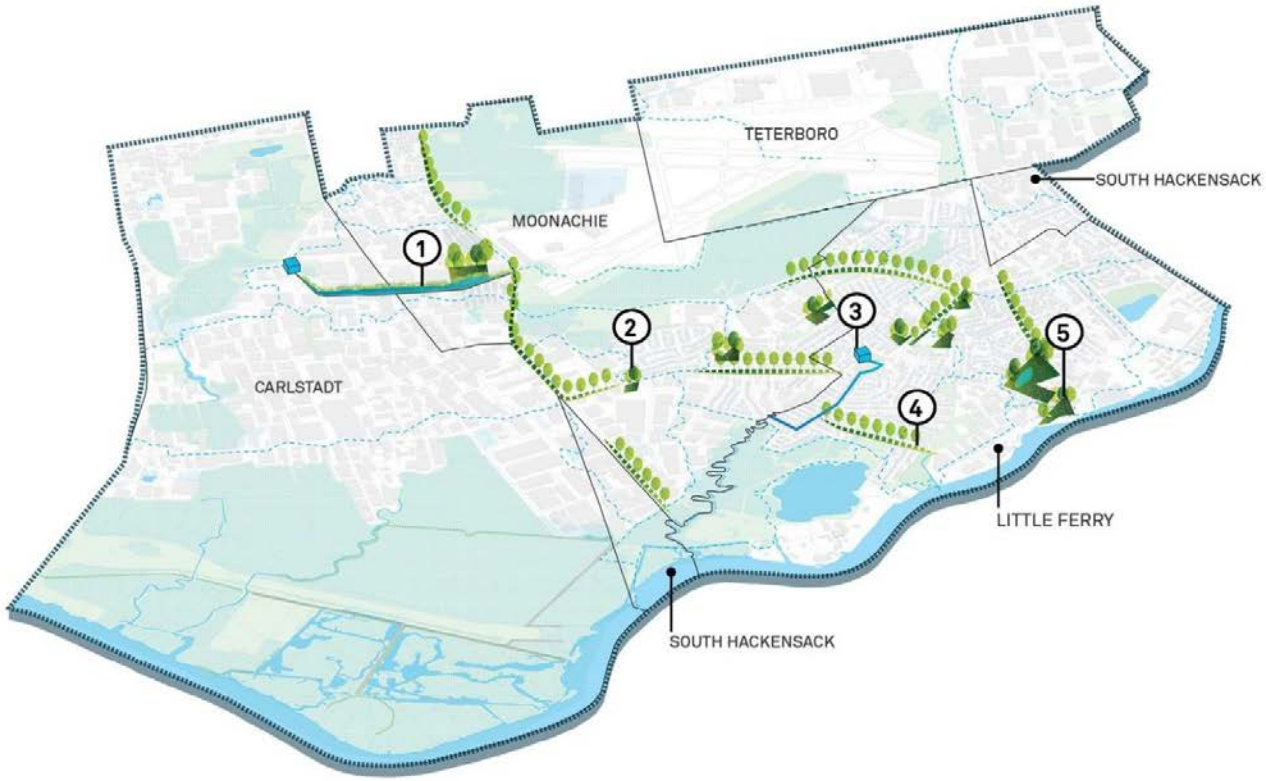


# Figure 2: Project Area within the 100-Year and 500-Year Floodplains



# Figure 3: Alternative 3 – The Hybrid

# Figure 4: Alternative 3 – Build Plan

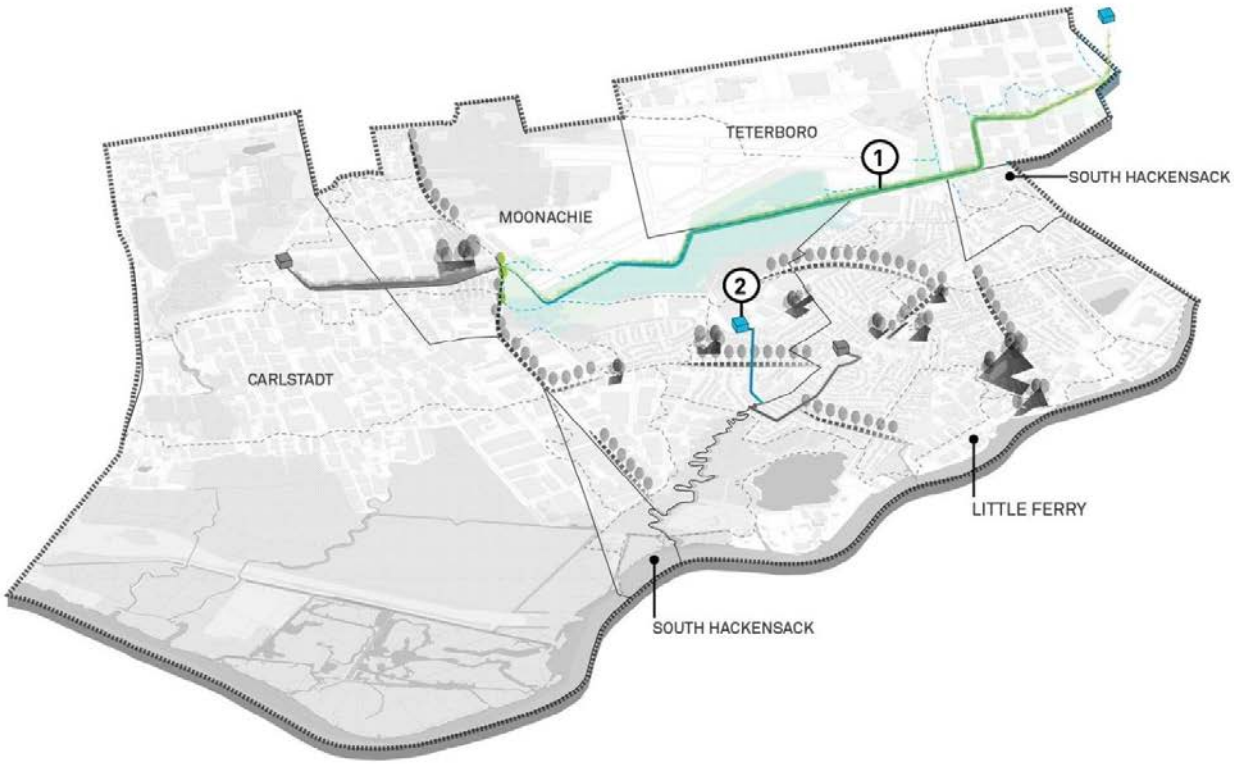



- The Build Plan can be constructed and functional by 2022
- The plan put forth will require less maintenance than that of the Alternative 1 system
- Benefit Cost Ratio greater than 1.0
- Plan can be constructed within Available Funds

**Stormwater Management Features**

1. East Riser: Channel Improvements + Enhanced Wetland Open Space
2. Avanti Park: Street Green Infrastructure + Enhanced Open Space
3. Losen Slote: Force Main + Public Facility Improvements
4. Green Infrastructure + Enhanced Wetland Open Space
5. GI Improvements to Willow Lake Park + 1 New Wetland / Open Space along

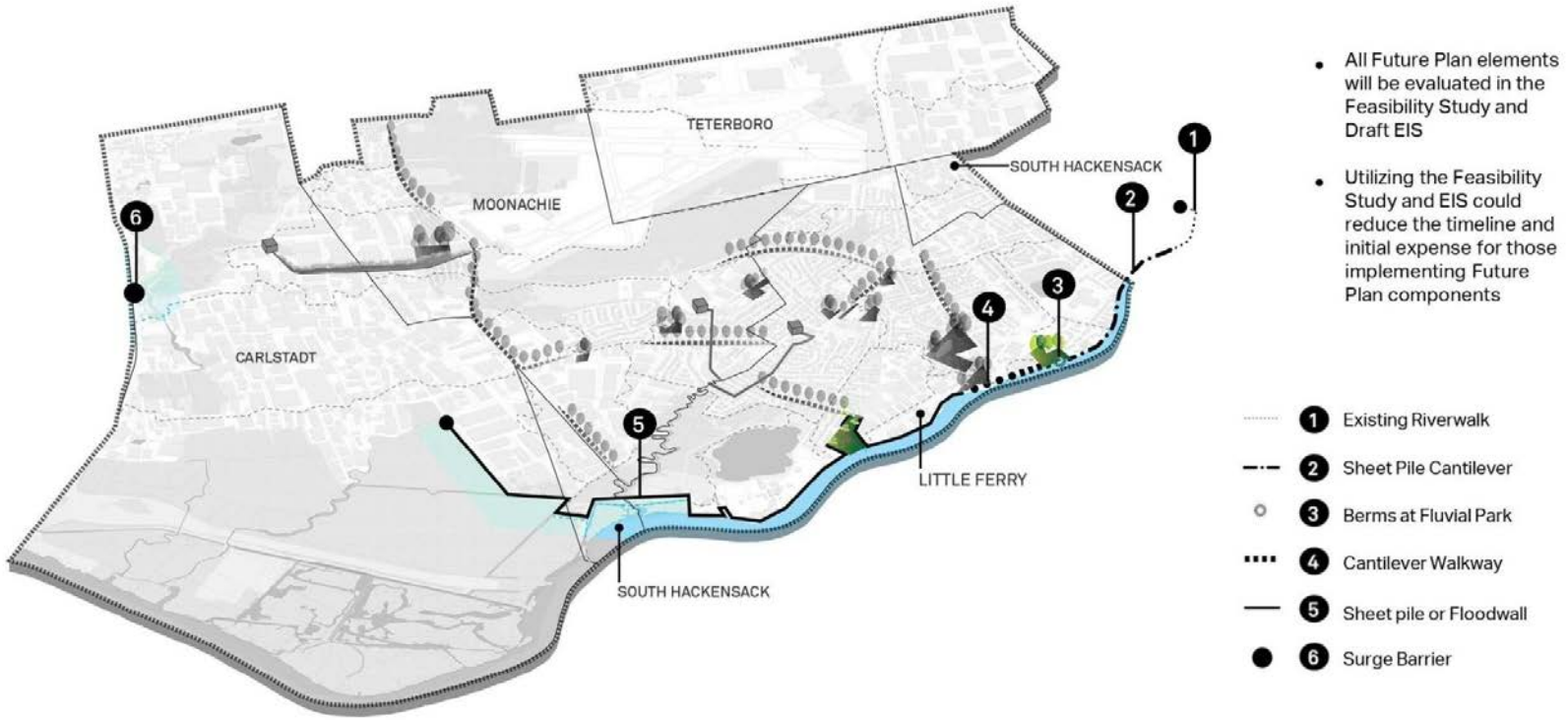
# Figure 5: Alternative 3 – Future Plan for Rain Flooding Reduction




1. East Riser Channel Improvements Extension toward South Hackensack
2. A second Losen Slote Pump Station & Force Main near Green Street to deliver water to Upper East Riser Ditch

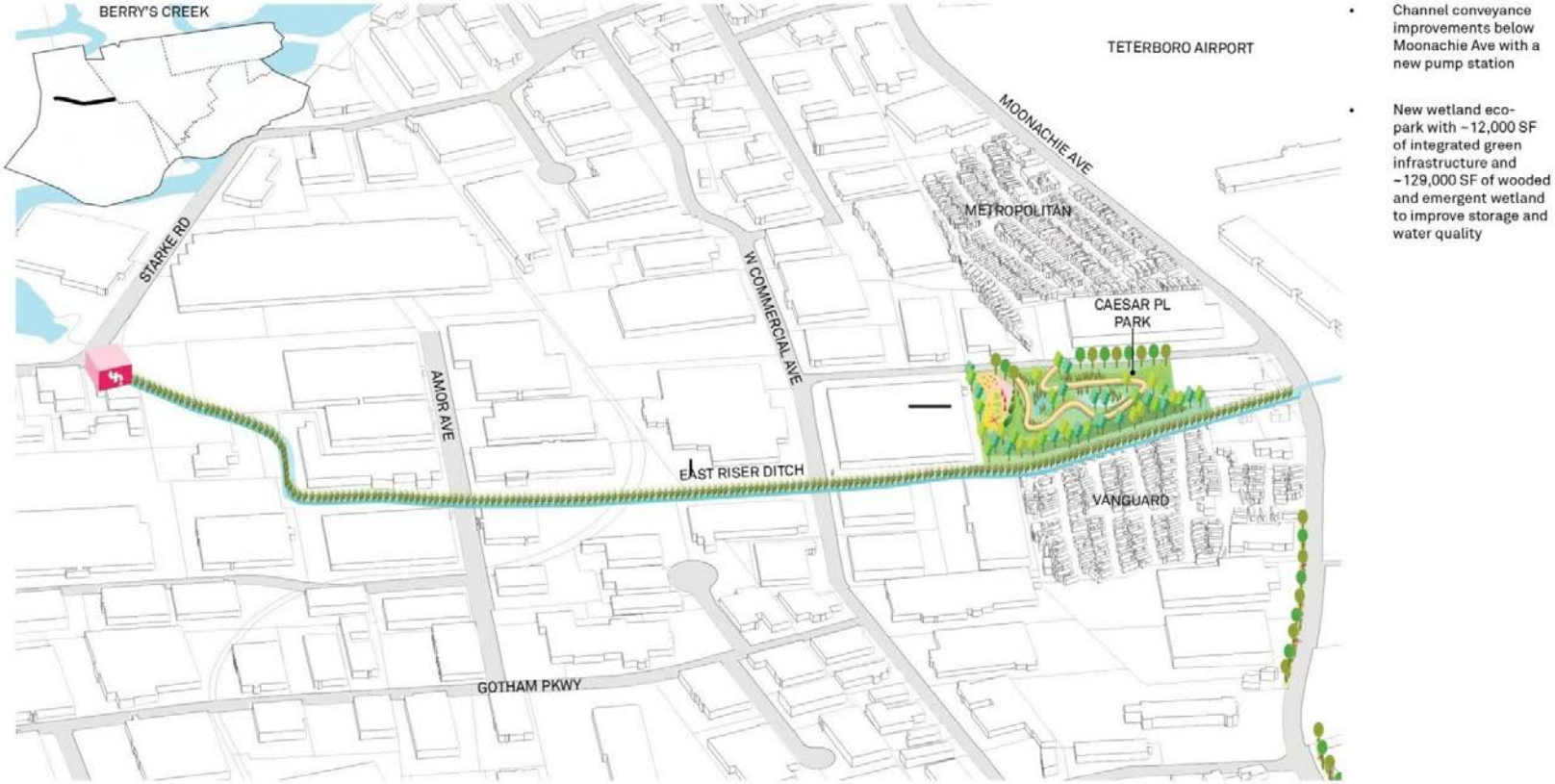
- All Future Plan elements will be evaluated in the Feasibility Study and Draft EIS
- Utilizing the Feasibility Study and EIS could reduce the timeline and initial expense for those implementing Future Plan components

# Figure 6: Alternative 3 – Future Plan for 50-Year Storm Surge Protection



# Figure 7: Alternative 3 – Build Plan for Frequent Flood Reduction

# Figure 8: Alternative 3 – Build Plan for East Riser Channel Improvements



# Figure 9: Alternative 3 – Build Plan for Losen Slote Drainage Improvements


- New pump station within the residential area of the stream
- Stormwater discharges via a 36" force main to the downstream Losen Slote marsh
- Energy dissipation structure limits erosion at discharge points
- Street green infrastructure collects water and filters total suspended solids

# Figure 10: Alternative 3 – Build Plan for Avanti Park

# Figure 11: Alternative 3 – Build Plan for Multiple CivicLocations


- Multiple improvements are made to the public facilities in Little Ferry such as bioswales and underground storage trenches
- Improvements are planned for the following facilities: Little Ferry Library, Little Ferry Municipal Building, Memorial Middle School, Washington Elementary, and Robert Craig Elementary
- Co-benefits to the municipal buildings include improvements near community buildings, such as opportunities for education, community outreach and involvement, and new habitat

# Figure 12: Alternative 3 – Build Plan for Willow Lake Park


- Reduce sedimentation into the drainage system & slows water movement
- Improvements to Willow Lake include approximately 65,000 SF of new native planting and low meadow and approximately 1,200 SF of rain gardens
- A new public open space on the Hackensack River includes approximately 5,700 SF of restored riparian wetland and approximately 30,000 SF of native planting and bioswales
- Co-benefits to the municipal buildings include improvements near community buildings, such as opportunities for education, community outreach and involvement, and new habitat

# Appendix B: Grey and Green Infrastructure Descriptions

Grey infrastructure elements included in the Preferred Alternative Build Plan may consist of the following components.

- **Force Mains** – A force main is a pressurized sewer pipe. Sewers most often operateusing the force of gravity to keep the stormwater flowing. However, in some cases, pipes must be installed when gravity is not sufficient to keep stormwater flowing, such as whenthe pipe must be installed at a nearly flat angle, or when the pipe must go uphill. Inthese situations, pumps or compressors are used to pressurize the sewer pipes to keepthe stormwater flowing.
- **Backflow Preventers** – Backflow preventers are flapgates, valves, or other devicesused to prevent water from flowing backwards through the stormwater drainage infrastructure. For example, it is possible that a spring tide or storm surge in the Project Area could increase the elevation of the Hackensack River above the elevation of some stormwater drainage outfalls. Without backflow preventers, this could result in river water traveling backwards through the stormwater drainage pipes and into the streets of the Project Area.
- **Channel Improvements** – Channel improvements can take several different forms depending on localized conditions. Channels can be widened or deepened to increase stormwater capacity. They can also be relocated or reshaped (e.g., straightened)as necessary to improve conveyance. Finally, they can be improved to prevent erosion and/or enhance ecological conditions and values, which benefit both water quality and biologicalresources.
- **Off-Channel Storage** – Off-channel storage refers to areas where stormwater can be diverted when the capacity of the drainage infrastructure is exceeded. This type of storage can take various forms, including retention/detention basins, underground vaults,parks, and parking lots (Guo 2011).
- **Settling Basins/Forebays** – Settling basins are generally earthen depressions that collect and retain stormwater long enough to allow suspended solids (i.e., sediment) to settle out of the water. Forebays serve a similar function, except are located immediately upstream of another waterbody. By removing pollutants, sediment, and excess nutrients, settling basins and forebays help to prevent water pollution and to increase waterquality.
- **Berms** – Berms may be installed along ditches or ponds in order to improvetheir stormwater storage and conveyance capacities. Berms consist of compacted earth. The core of these structures, generally composed of clay, is impermeable so as toprevent seepage and structural weakening (FEMA 2007). The outer layer is vegetated in order to prevent erosion. Berms can be implemented in a wider array of circumstances due to their smaller sizes. For example, berms are often

constructed along individual properties to prevent flooding, or along ditches or channels in order to prevent overflow duringstorms. Because berms consist of mounds of compacted earth, their width must be greater than their height in order to maintain structural integrity. As such, they require correspondingly large footprints of property in order to be constructed (FEMA2007).

Depending on size and location, berms can sometimes be fitted with pathways for pedestrian and bicycle transportation. The type of vegetation used for stabilization can also be chosen and maintained in a manner that creates specific ecological habitatsand improvements. Further, berms can be incorporated into public open space toenhance community recreation areas.

- **Pump Stations** – Pump stations may be installed in areas that are naturally slow to drain. Pump stations are constructed to move water from one location to another, and vary significantly in terms of the volume of water they are capable of moving reliably. Pump stations may be installed either in locations that regularly require water to be pumped, such as flat areas where drainage is naturally difficult, or in locations that accumulate large amounts of water during floods and need to be pumped on occasion. In theProject Area, pump stations are often located behind tide gates or along ditches, so that they can keep water flowing in locations where drainage is either naturally difficult or impeded by a closed tide gate.

Green infrastructure elements included in the Preferred Alternative Build Plan may consistofthe following components.

- **Bioswales** – Bioswales are essentially rain gardens in the form of a channel. Often found along streets or parking lots, bioswales collect stormwater and convey it toward an outlet. Like rain gardens, bioswales also help to filter out pollutants before stormwater reaches a receiving waterbody (USEPA2016).
- **Rain gardens** – Rain gardens are landscaped stormwater collection basins that are designed, based on the soil and vegetative composition, to absorb and filter stormwater. They allow collected stormwater to infiltrate the ground or be absorbed by vegetation, thereby reducing stormwater flow that could cause flooding and relieving stress on the overall stormwater drainage infrastructure. Additionally, rain gardens help to improve water quality. As stormwater travels through these systems, soil, pollutants, sediment, and excess nutrients settle out. By directing stormwater into the soil or vegetation, rain gardens help to filter out pollutants before they reach a receiving waterbody (USEPA2017).
- **Storage Trenches/ Tree Trenches** – Storage trenches are non-vegetated subsurface basins typically used where the ground surface needs to be repaved or reestablished as lawn due to the existing site use. Street runoff is diverted to storage trenches by stormwater inlets, where it either infiltrates to native soil, or, where infiltration is not feasible, the system underdrains back into the existing stormwater sewer system. Where existing site conditions allow for

- small unpaved areas like tree pits, trees may be added to a storage trench to enhance street landscapes, and these systems are typically referred to as Tree Trenches – Tree trenches do not capture runoff or provide surface runoff treatment like bioswales but do allow for stormwater uptake through the tree root systems, which reduces the volume of runoff reaching the existing storm sewersystem.
- **Permeable Pavement** –Permeable pavement provides a surface that is mostly paved, but that permits some infiltration of rainfall into the ground, thereby decreasing the amountof stormwater that must be conducted offsite by the stormwater drainage infrastructure. Permeable pavement can be created with a variety of materials, including porous asphalt, pervious concrete, or spaced paver stones (USEPA 2016).
- **Wetland Improvements** – Wetlands provide similar functions as rain gardens. However, wetlands remain saturated on a seasonal or year-round basis, while rain gardens are normally dry, except after storm events. Wetlands capture and store stormwater, and remove pollutants, sediment, and nutrients. Additionally, wetlands provide valuable habitat for a wide variety of plant and animal species.
- **Parks/Open Spaces** – New or improved parks or open spaces provide additional opportunities for water to be collected and absorbed by the land. These areas also provide additional recreational opportunities, such as playing fields. Within the Project Area, such areas would provide public access to the Hackensack River, as well as include targeted habitat improvements.

# Appendix C: RBD Meadowlands Benefit Cost Analysis

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# Rebuild by Design Meadowlands Project

# Benefit Cost Analysis
# Build Alternative - APA Full Narrative

**Draft**
March 8, 2018

Prepared for the State of New Jersey Department of Environmental Protection

**Rebuild by Design Meadowlands Project**
**Benefit Cost Analysis – APA Full Narrative**
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## I. Executive Summary

This benefit cost analysis (BCA) was prepared for the proposed Rebuild by Design Meadowlands Project (Alternative 3, Build Plan) on behalf of the State of New Jersey Department of Environmental Protection. The BCA was prepared by following the Guidance for Benefit-Cost Analysis included within the HUD Notice: CPD-16-06, and also adheres to the principles articulated within the document entitled *OMB Circular A-94 – Guidelines and Discount Rates for Benefit-Cost Analysis of Federal Programs*. The analyses presented herein are based on 2017 price levels and the application of a base 7% annual discount rate pursuant to OMB Circular A-94.

The Proposed Project is needed to address systemic inland flooding from high-intensity rainfall/runoff events and coastal flooding from storm surges, as the interplay between the two forces contributes to the reoccurring flooding conditions throughout the Project Area. In addition to flood reduction, the Proposed Project is needed to directly protect life, public health, and property. It is further needed to restore property values, improve community resilience, protect ecological resources, and improve civic, cultural, and recreational values in the Project Area. The purpose of the Proposed Project is to reduce flood risk and increase the resiliency of the communities and ecosystems in the Project Area, thereby protecting infrastructure, facilities, residences, businesses, and ecological resources from the more frequent and intense flood events anticipated to occur in the future. The ability of the Proposed Project to meet this purpose will be measured in terms of the following objectives.

**1)** Contribute to Community Resiliency.
**2)** Reduce Risks to Public Health.
**3)** Deliver Co-Benefits.
**4)** Enhance and Improve Use of Public Space.
**5)** Consider Impacts from Sea Level Change.
**6)** Protect Ecological Resources.
**7)** Improve Water Quality.

Alternative 3 was selected as the Recommended Plan because it addresses both coastal surge and systemic inland flooding. Alternative 3 was conceived to be implementable in two project stages: the initial stage as reflected in a Build Plan, which includes all features to be constructed as part of the Proposed Project, and a second stage as reflected in a Future Plan, which includes the remaining features of Alternative 3. This second stage could be constructed over time as funding and construction feasibility permit. Implementation of the Build Plan would remain, and would be implementable within both the budget and schedule associated with the RBD funding. The Build Plan is an integrated plan that primarily addresses systemic inland flooding that results from heavy or frequent precipitation in the Project Area. The Build Plan includes both grey and green stormwater management infrastructure features described under **Section IV.**

The Benefit Cost Analysis demonstrates that the Build Plan (Proposed Project) is economically feasible at a discount rate of 7%. The Proposed Project will generate net benefits (benefits exceed costs over its useful life).

**Table 1: Executive Summary**

| **Meadowlands Proposed Project: Benefit Cost Analysis Summary Cumulative Present Values (2018-2072**)-Constant 2018 Dollars | | |
|---|---|---|
| | **Cumulative Present Values** (Discount Rate = 7%) | **Cumulative Present Values** (Discount Rate = 3%) |
| **A-LIFECYCLE COSTS** | | |
| Project Investment Costs \a | $79,500,000 | $91,267,000 |
| Operations & Maintenance | $11,520,000 | $25,244,000 |
| Total Costs | **$91,020,000** | **$116,511,000** |
| **B- BENEFITS** | | |
| **B1) Resiliency Values** | **$84,771,000** | **$203,541,000** |
| Flood Damage Reduction Benefits | | |
| East Riser Ditch | $72,752,000 | $176,460,000 |
| West Riser Ditch | $7,834,000 | $16,501,000 |
| Losen Slote | $4,185,000 | $10,580,000 |
| **B2) Environmental Values** | **$180,000** | **$424,000** |
| Air Quality | $139,000 | $333,000 |
| Pollination | $37,000 | $82,000 |
| Nutrient Pollution | $4,000 | $9,000 |
| **B3) Social Values** | **$8,990,000** | **$20,134,000** |
| Recreation | $7,179,000 | $16,059,000 |
| Avoided Stormwater Treatment Costs | $1,559,000 | $3,511,000 |
| Aesthetic Value | $206,000 | $460,000 |
| Water retention/flood hazard risk reduction | $46,000 | $104,000 |
| **B4) Economic Revitalization Benefits** | **$11,077,000** | **$15,895,000** |
| Property value premium | $10,677,000 | $13,419,000 |
| Energy conservation | $151,000 | $449,000 |
| Residual value of land | $249,000 | $2,027,000 |
| | | |
| **Total Benefits = B1+B2+B3+B4** | **$105,018,000** | **$239,994,000** |
| **Benefits less Costs (Net Present Value, = B-A )** | $13,998,000 | $123,483,000 |
| **Benefit Cost Ratio (BCR, = B/A)** | **1.15** | **2.06** |

Note: \a Because design, predevelopment, site development, and construction are scheduled to occur over the period spanning from 2018 to 2022, and capital construction expenditures are phased in over these years, the cumulative present value calculation of costs (as of 2018) will appear to be lower than the nominal project investment costs shown in the total project cost (See Table 6 below) due to the application of the 7% discount rate. The nominal value of total project capital costs is $101,680,000 (Table 6 below), while the discounted cost is $79,500,000 (shown above in the Project Investment Costs row for the discount rate of 7%).
Source: AECOM, <<Meadowlands BCA Model_revised 2-27-18_ AB_review update RE cost.xlsx>>

**Table 1** shows the cumulative present value of the monetized benefits and costs for the Proposed Project. The largest group of benefits consists of resilience values related to flood risk protection. In summary, the lifecycle costs required to build and operate the Project (amounting to $91 million, in cumulative present value, 2018 dollars) will generate the following benefits:

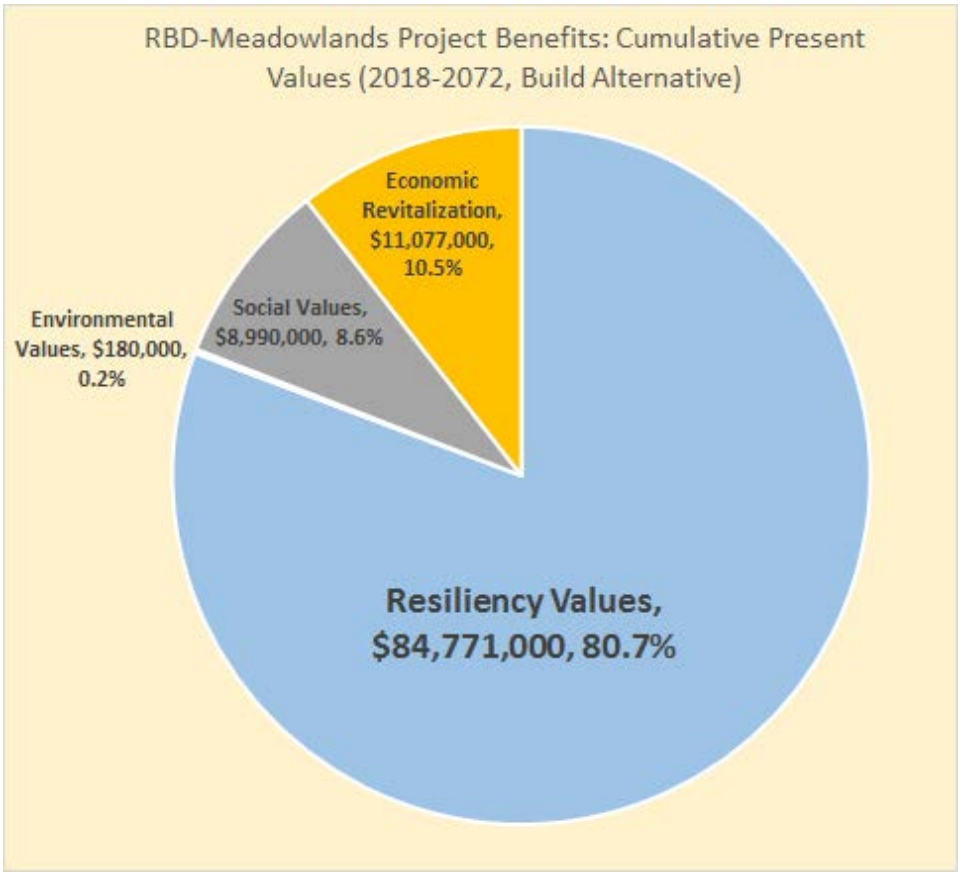
Total Benefits of $105 million, of which:

- Resiliency Values are: $84.8 million
- Environmental Values are: $0.2 million
- Social Values are: $9.0 million
- Economic Revitalization: $11.0 million

The Project's cumulative present value of net benefits (benefits minus costs) is $14.0 million, and the benefit cost ratio (BCR: Benefits divided by Costs) is 1.15. These net benefits demonstrate that the Project will add significant value to the community and Meadowlands region.

A sensitivity analysis was conducted on the Project discount rate. Lowering the base discount rate from 7% down to 3% shows that the net benefits and BCR are sensitive to the application of an alternative discount rate. As the Proposed Project is not meant to discourage private investment or consumption, but is intended to create a resilient environment and community that is conducive to attracting future investment, it is unlikely that private investment will be displaced by the Project. The Project is an "enabling" infrastructure investment, a term used to describe infrastructure that facilitates economic growth and productivity. Therefore, the lower discount rate of 3% is provided to show that the BCR is higher with this lower hurdle rate. At a discount rate of 3%, the cumulative present value of net benefits from the Build Alternative is $123.5 million and the BCR is 2.06.

**Figure 1: Breakdown of Proposed Project's Benefits (7% Discount Rate)**



## II. Introduction

Pursuant to Federal Register (FR)-5696-N-11, and its implementation guidance, the State of New Jersey is required to submit with its Substantial Action Plan Amendment (APA) a Benefit-Cost Analysis (BCA), as well as a clear and concise narrative description of the BCA. The narrative description below describes the Rebuild by Design (RBD) Meadowlands Flood Protection Project (Proposed Project) and expected costs and benefits, according to the categories outlined in the United States (US) Department of Housing and Urban Development (HUD) Notice CPD-16-06, issued on April 20, 2016.

Per CPD-16-06, HUD is requiring that Community Development Block Grant Disaster Recovery (CDBG-DR) grantees examine RBD projects through the lens of a BCA because it is a valuable tool to help inform decision-making regarding public infrastructure investments. The BCA will not serve as the sole determinant as to whether an RBD project plan may or may not be approved. The standard BCA criterion for projects is a net present value above zero (or equivalently, a benefit-to-cost ratio greater than one). The methodology employed must be consistent with the general principles outlined in Office of Management and Budget *(OMB) Circular A-94, Guidelines and Discount Rates for Benefit-Cost Analysis of Federal Programs.* To the degree that a methodology or approach deviates from the general principles in OMB Circular A-94, explanations and justifications must be provided (AECOM, 2017).

CPD-16-06 provides guidance regarding content and format of this BCA; this guidance was carefully followed during the crafting of this document. While it is recognized that the BCA is not the only measure of the effectiveness of a project, many project features and benefits can be quantified using methods developed by various Federal agencies and generally accepted economic and financial principles (AECOM, 2017).

## III. Process for Preparing the Benefit Cost Analysis (BCA)

The New Jersey Department of the Environment (NJDEP), as the recipient of HUD grant funds designated for the construction of the Proposed Project, contracted with AECOM Technical Services to complete the engineering designs, quantity and cost calculations, analysis of flood resiliency capabilities and benefits, and other benefit studies needed to quantify and monetize values for the BCA. NJDEP has provided consistent guidance and oversight throughout the BCA process.

Louis Berger was tasked to provide the BCA narrative write-up and Quality Assurance/Quality Control (QA/QC). The analysis incorporates BCA Quality Control / Quality Assurance independent third-party peer review provided by Louis Berger. The cost and benefit data was developed by AECOM and also incorporated QA/QC answers to comments from Louis Berger. Louis Berger did not separately estimate any lifecycle costs or benefit streams. Louis Berger did however provide BCA formatting and project evaluation advice, and a project resource statement tool for use by the entire team. The project resource statement tool was essential for independently checking the benefit cost analysis results: the measures of project merit (i.e., the net present value and the benefit cost ratio). The project resource statement tool also enables other reviewers to independently recreate the results of the BCA in a transparent manner. In addition, applying the tool, Louis Berger also provided a sensitivity analysis of the benefit cost

analysis results at varying discount rates. The project resource statement tool developed by Louis Berger addresses the HUD requirement that "The BCA must all include all pertinent data and quantifiable calculations for benefits and costs in single spreadsheet tab (or table). Benefits and costs must be estimated for each year after the project's start date and for the analysis period" (HUD, Notice: CPD-16-06, p. 4). After this report is provided, NJDEP will have custody of the project resource statement (and all work files listed in the References section below) for use in the future, should project elements change after the submission of this report.

As noted above, the BCA was prepared by following the Guidance for Benefit-Cost Analysis included within the HUD Notice: CPD-16-06, and also adheres to the principles articulated within the document entitled *OMB Circular A-94 – Guidelines and Discount Rates for Benefit-Cost Analysis of Federal Programs*. The analyses presented herein are based on 2017 price levels and the application of a base 7% annual discount rate pursuant to OMB Circular A-94.

Many of the major Proposed Project features, such as pump stations, and drainage pipes/channels have the potential to be effective for a period well beyond 50 years. To account for the additional benefits expected to persist beyond the 50 year project planning horizon, only the residual value of property right of way (ROW) is included within the BCA as a present value amount. For analytical purposes, costs and benefits have been evaluated over a 50-year period. The present value of future replacement costs for features with less than a 50-year life is evaluated as part of the operations and maintenance (O&M) costs (AECOM, 2017).

The Proposed Project incorporates a wide range of technologies to provide increased resiliency, environmental, social and economic revitalization values. Given the Project Area's high vulnerability to flooding, the majority of Proposed Project benefits (81%) are associated with increased resiliency. A number of flood risk evaluation models were considered for use in the resiliency analysis and were assessed for their potential application in this BCA exercise. The BCA Appendix discusses the pros and cons of these tools (AECOM, 2017).

The flood risk modelling approach selected for the Proposed Project's resiliency analysis and benefits monetization was the Hydrologic Engineering Center - Flood Damage Analysis (HEC-FDA) model developed by the Hydrologic Engineering Center of the United States Army Corps of Engineers (USACE). The HEC-FDA model was developed to perform integrated hydrologic engineering and economic analysis of flood risk.[1] The economic module of the HEC-FDA analysis includes information regarding the location, value, and vulnerability of every building falling within the modeled study area (Project Area) floodplain. The economic consequence of flooding has been calculated using guidance developed by both the USACE and the Federal Emergency Management Act (FEMA). Generally, physical flood damage assessments are based on relationships developed and published by the USACE. Other aspects of vulnerability, such as the potential for injury or mortality, treatments for flood-related mental health impacts, and lost productivity, are generally based on procedures developed by FEMA, supplemented by guidance contained in HUD Notice CPD-16-06. Appropriate FEMA and USACE guidance and references are cited as appropriate throughout this document (AECOM, 2017).

[1] Additional documentation of the HEC-FDA model's capabilities is available at: http://www.hec.usace.army.mil/software/hec-fda/

Finally, economic revitalization, social values and environmental value benefits generated under the Proposed Project were quantified and where possible monetized. Where these benefits were not monetized, they were assigned qualitative point factors (e.g. ++) per HUD's qualitative rating criteria guidance provided in HUD Notice: CPD-16-06 (See BCA Appendix). The benefits analysis was conducted using the Phase 2 Instructions for Community Development Block Grant National Disaster Resilience (CDBG-NDR) Applicants (Appendix H) as a guide for preferred methods and monetized values. The parameters of the benefits analysis follow the protocols set by OMB Circular A-94 as well as the recommended benefit quantification methods by the U.S. Department of Transportation, USACE, and FEMA except in cases where more Project-specific values or prices were available. In all such cases, modifications are noted and references are provided for data sources. The analysis follows a conservative estimation of the benefits and assesses some of the benefits qualitatively. By adhering to a strict standard of what could be included in the benefits analysis, actual total benefits may be greater than depicted within the monetized benefits analysis (AECOM, 2017).

A custom model was developed by AECOM to estimate the future benefits for each alternative and for the Proposed Project (Build Plan). Benefits were estimated over a 50-year period beginning in 2023 and spanning until 2072. The base year is 2018 and all values (costs and benefits) were discounted to the base year. While it was assumed that 2023 would be the first year that the project would be fully complete and benefits would begin accruing at the beginning of the year, some benefits are included that would start in late 2022. These annual benefits were therefore prorated and included within that year. All benefits are expressed in constant 2018 dollars (AECOM, 2017).

## IV. Proposed Funded Project

The purpose of the Proposed Project is to reduce flood risk and increase the resiliency of the communities and ecosystems in the Project Area, thereby protecting infrastructure, facilities, residences, businesses, and ecological resources from the more frequent and intense flood events anticipated to occur in the future. The ability of the Proposed Project to meet this purpose will be measured in terms of the following objectives:

**1) Contribute to Community Resiliency**. The Proposed Project would integrate a flood hazard risk reduction strategy with existing and proposed land uses and assets. It would reduce flood risks within the Project Area, leading to improved resiliency and the protection of accessibility and on-going operations of services, allowing these services to support emergency preparedness and community resiliency during and after flood events.

**2) Reduce Risks to Public Health**. The flood risk reduction strategy would additionally reduce the adverse health impacts associated with large flood events, such as the spread of infectious diseases, compromised personal hygiene, mental health impacts, and contaminated water sources.

**3) Deliver Co-Benefits.** Where possible, the Proposed Project would integrate the flood hazard risk reduction strategy with civic, cultural, ecological, and recreational values. It would strive to incorporate active and passive recreational uses, multi-use facilities, and other design elements that would allow the Proposed Project to become part of the fabric of the community.

**4) Enhance and Improve Use of Public Space**. The Proposed Project would strive to include concepts and alternatives that reduce risks to private and public property from flood impacts, while also incorporating design elements that improve public and recreational spaces.

**5) Consider Impacts from Sea Level Change**. The Proposed Project would consider the projected impacts from sea level change, including impacts on the frequency and degree of flooding.

**6) Protect Ecological Resources**. The Proposed Project would work to protect and enhance ecological resources by protecting wetlands and other habitats that contribute to regional biodiversity and ecosystem resiliency.

**7) Improve Water Quality.** The Proposed Project would include green infrastructure solutions as a part of the design and construction of the proposed flood risk reduction measures to manage stormwater runoff, reduce stormwater pollution, and improve water quality.

The Proposed Project is needed to address systemic inland flooding from high-intensity rainfall/runoff events and coastal flooding from storm surges and spring high tides, as the interplay between the two forces contributes to the reoccurring flooding conditions throughout the Project Area. In addition to flood reduction, the Proposed Project is needed to directly protect life, public health, and property. It is further needed to restore property values, improve community resilience, protect ecological resources, and improve civic, cultural, and recreational values in the Project Area (AECOM, 2017).

a. Proposed Project

Alternative 3 was selected as the Recommended Plan because it addresses both coastal surge and systemic inland flooding. However, due to the Proposed Project's funding and schedule constraints, Alternative 3 would exceed the Proposed Project's available funding and mandated schedule (i.e., to be implemented by September 2022). To address these constraints, Alternative 3 was conceived to be implementable in two project stages: the initial stage as reflected in a Build Plan, which includes all features to be constructed as part of the Proposed Project, and a second stage as reflected in a Future Plan, which includes the remaining features of Alternative 3. This second stage could be constructed over time as funding and construction feasibility permit. Implementation of the Build Plan would remain, and would be implementable within both the budget and schedule associated with the RBD funding (AECOM, 2017).

The Build Plan is an integrated plan that primarily addresses the systemic inland flooding that results from heavy or frequent precipitation in the Project Area. The Build Plan includes both grey and green stormwater management infrastructure features. The grey stormwater management infrastructure features will be designed to reduce flooding damages by capturing and more rapidly evacuating stormwater in the Project Area.

The green stormwater management infrastructure features, will be designed to capture stormwater runoff from streets and sidewalks to reduce local flooding, treat water quality, and enhance the streetscapes with permanent vegetation or new porous paving. Specific features and practices include bioswales, rain gardens, storage trenches, permeable pavement, new improved parks/open spaces, and wetland improvements, designed to capture stormwater runoff from streets and sidewalks to reduce local flooding, treat water quality, and enhance the streetscapes with permanent vegetation or new porous paving. Green infrastructure features can be found in streets and parks. The Build Plan also incorporates community co-benefits through the enhancement and improvement of public spaces in the Project Area (AECOM, 2017).

### i. Build Plan Grey Stormwater Management Infrastructure

The grey infrastructure improvements could include new pump stations, force mains, channel modifications, culvert and bridge improvements, operations and maintenance access ways and other associated structures and easements. Grey infrastructure elements included in the Build Plan consist of the following components.

- **East Riser Components**: A new pump station would be installed upstream of the existing East Riser Ditch tide gate and Starke Road. Based on the Feasibility level design it is anticipated that the station could include a screened intake bay, Archimedean screw pumps (or other pumps as to be determined in design), a discharge channel, a modified forebay inlet to the existing tide gate, and an energy dissipation structure on the downstream side of the tide gate. Flow discharged from the pump station would be conveyed through the existing culverts under Starke Road. An access road, facility access, and parking area would be provided for facility access and egress from the building, parking, and maintenance and operation.

  A forebay inlet to the existing tide gate would be installed upstream of Starke Road to receive discharge from the pump station and convey it to the existing culverts under Starke Road and out the existing tide gate. The forebay would tie into the existing culvert headwall on the upstream side of the Starke Road culverts. Four flap gates would be installed inside the forebay on the upstream side to allow low flow stream passage through the forebay when the pump is not operational.

  The East Riser Ditch channel would be dredged from the tide gate location to Moonachie Avenue to not just restore but increase flow conveyance capacity. Approximately 20,000 in-place cubic yards (CY) would be removed from the ditch and disposed of off-site at a facility licensed to receive

the dredged material. Channel boundaries and adjacent areas falling within the riparian zone would be re-vegetated with native plant species consistent with that habitat type in the Project Area. The Project Area associated with this improvement is estimated to be 9.5 acres. An O&M access way would be provided on one side of the channel throughout the improved reach. Access would be tied into local residential roads where feasible, but in some cases, it would tie into parking areas on private property. Easements would be acquired to establish access where needed. Gates and adjacent hurricane fencing would be installed at access points to the O&M corridors to limit access to authorized personnel.

To improve water conveyance in East Riser Ditch, three existing culvert and bridge structures would be removed and replaced with appropriately sized replacement culverts or bridges. The removed structures would be disposed at a facility licensed to receive that material.

- **Losen Slote Components**: In the Losen Slote drainage basin, a new stormwater pump station (Losen Slote pump station A) and associated force main are proposed. Pump station A would be located in the vicinity of 15 Liberty Street in Little Ferry, immediately east of the Liberty Bell Village. This pump station would have one 50 cfs (cubic feet/second) or similar sized pump, and would discharge stormwater through a force main in the vicinity of Lorena Street, Liberty Street, Eckel Road, and Birch Street rights-of-way. This force main would be approximately 3,300 feet long, and would consist of a ductile iron pipe with manholes installed along the pipe for maintenance. It would discharge into Losen Slote at the western terminus of Birch Street. Additionally, a remnant concrete headwall, once part of a tide gate in the Losen Slote channel in the vicinity of Joseph Street, would be removed to improve natural channel flow.

  The Losen Slote pump station would additionally have a backup pump and a backup generator installed in case of pump malfunction or electricity outages. Energy dissipation structures would also be constructed at the discharge point for Force Main A to prevent erosion of the Losen Slote channel.

ii. Build Plan Green Stormwater Management Infrastructure and Open Space

The Build Plan includes approximately 41 green infrastructure retrofit systems (approximately 37,000 SF) within the public right-of-way that are designed to reduce damages from flooding by capturing stormwater runoff from streets and sidewalks, treat water quality, and enhance the streetscapes with permanent vegetation or new porous paving. Additionally, approximately 18 green infrastructure systems (approximately 26,000 SF) are also included in the open space and park concepts. The green infrastructure features could include bioswales, rain gardens, storage trenches/ tree trenches, permeable pavement, wetland improvements, and parks/open spaces and other associated structures and easements. These features are described in more detail in Appendix B of the APA. The locations associated with green infrastructure features in the Build Plan are as follows:

- **DePeyster Creek Area right-of-way** would be located primarily within the sidewalk of Monroe Street and Dietrich Street between Eckel Road and Industrial Avenue. Subsurface stone trenches

would expand the storage footprint to manage runoff from roughly 0.5 acres of impervious roadway.

- **Carol Place Area right-of-way** would be located primarily within the sidewalk of Moonachie Avenue and Empire Boulevard between Caesar Place and State Street. The vegetated portion of these bioswales would be located within the lawn space between sidewalk and curb. Subsurface stone trenches would expand the storage footprint to manage runoff from approximately 1.4 acres of impervious roadway.

- **West Riser Ditch Area right-of-way** would incorporate rain garden median plantings to capture and treat adjacent roadway runoff from roughly 0.5 acres of impervious roadway.

- **Park Street Area right-of-way** would incorporate storage trenches along Moonachie Road, storage trenches along Liberty Street, and bioswales with internal check dams along Redneck Avenue to manage runoff from approximately 1.4 acres of impervious roadway.

- **Main Street Area** would incorporate several bioswales and storage trenches on sidestreets intersecting Main Street with rain gardens within medians at the intersection of Bergen Turnpike and Sylvan Avenue (US Route 46). In total, the Main Street area is expected to manage runoff from roughly 2.8 acres of impervious roadway.

The Build Plan also includes additional flood management measures integrated with new open space and improvements to existing open space, which also provide additional water quality benefits. The improvements include the following:

- **Riverside Park Area** open space acquisition of 2.59-acres. This riverfront park transforms an existing boat dock area and impervious parking lot into approximately 600 linear feet (LF) of pervious area including bioswales providing flood management and water quality improvement by allowing for stormwater infiltration and filtration. This area would also provide public recreational access to the riverfront open space and include a restored riparian wetland that would provide new intertidal wetland habitat. River access would be maintained through improved boat docks and boat launch to create recreational opportunities.

- **Caesar Place Park** open space acquisition of approximately 4.03 acres that would provide stormwater storage through creation of approximately 1.50 acres of wooded wetland and 1.39 acres of emergent wetland. This would improve and expand the existing wetland located on site. Passive recreation could include elevated boardwalks that would maintain public access. Rain gardens would help infiltrate runoff and filter stormwater from Caesar Place Road. Open lawn and nature play areas may be included in an existing upland area to provide active recreation and play while minimizing environmental impacts.

- **Avanti Park** open space acquisition of 0.97 acre on an existing open lot along Moonachie Road that would improve drainage through creation of a 0.29-acre wetland and collect and infiltrate stormwater from the site and the adjacent lot. The park would feature expanded wetlands, open

space, passive and active recreation and native habitat. An elevated walkway could traverse this wetland, maintain public access, and connect back an area of permeable pavement at grade along Moonachie Road. Active recreation opportunities include a permeable play surface and play structure. Remaining elements could include woodland to screen adjacent warehouses and native plantings.

- **Willow Lake Park** improvement of an existing 7.02-acre public park. Proposed improvements include rain gardens to store and filter stormwater from Pickens Street, thereby reducing flood damage risk and improving water quality. Native planting and low meadows with scattered trees would increase infiltration and provide habitat for pollinators and birds. Approximately an acre of woodland areas frame the park and provide additional habitat. The permeable area will be expanded, thereby increasing flood management through improved drainage. This will be achieved by adding a new play area with a permeable surface to expand the existing playground permeable play surface. Other proposed improvements include pedestrian circulation, recreation, and ecological benefits. Existing pedestrian trails would be expanded to connect the northern and southern portions of the park, active recreation, expanded playground with impervious pavement, and ecological benefits. Approximately 1.6 acres of plazas and circulation walkways frame the park and draw in people from Main Street, Pickens Street, and Washington Avenue, with a centralized plaza near Willow Lake.

- **Little Ferry Municipal Improvements** for both Little Ferry Library and the Little Ferry Municipal Building including approximately 0.27 acre of native plantings and rain gardens, as well as the addition of native plants and replacement of existing asphalt parking with permeable paving. The improvements would increase stormwater infiltration to reduce runoff and thereby potential for flooding and improve stormwater quality.

- **Little Ferry Public Schools** campus improvements at Washington Elementary and Little Ferry Public Schools could include rain gardens along Liberty Avenue, approximately 0.83 acre of impervious pavement converted to permeable pavement at Washington Elementary, and approximately 0.96 acre of existing turf converted to native vegetation (with trees). This would increase stormwater infiltration and thereby flood risk, while also improving biodiversity. Approximately 0.39 acre of an existing sports field could be improved, with the existing active programming areas remaining.

- **Robert Craig Elementary School** campus could include improvements of approximately 1.74 acres including 0.30 acre of permeable play surface at an existing impermeable play surface, a rain garden at an existing open lawn, and approximately 1.36 acres of new sports field at an existing baseball diamond and open lawn to improve stormwater filtration and conveyance on site.

- **St. Joseph Park** improvements of an existing public park. Bioswales are proposed to improve stormwater filtration. An existing parking lot would receive treatment to improve its permeability and ability to infiltrate and filter stormwater. Landscape improvements would be made to 0.87 acre of the park through the planting of native vegetation. Active recreational opportunities that

could also be incorporated into the park landscape include amenities such as basketball, sports courts, lawn, soccer, tennis, and a gazebo.

In summary, under the Preferred Alternative Build Plan, the total acreage of new parks created would be approximately 7.6 acres. The Preferred Alternative Build Plan would reduce the depths and spatial extent of inland flooding in the East Riser Ditch and Losen Slote watersheds. Stormwater conveyance in East Riser Ditch would primarily be improved between the East Riser Ditch tide gate and US Route 46, while Losen Slote would experience reduced flooding between Bertollow Avenue and Niehaus Avenue. If additional funding becomes available, implementation of the Future Plan would further reduce inland flooding in the Losen Slote watershed along the Park Street Reach between the Main Reach and Union Avenue. Additionally, the Future Plan would protect against coastal storm surges and spring high tides. By implementing a hybrid solution of both coastal and inland flooding reduction, the Preferred Alternative provides the greatest overall flood reduction among the three Build Alternatives considered, while adhering to the feasibility constraints (i.e., budget and schedule) of the Proposed Project.

## V. Full Project Cost

**Table 2** shows the elements of the capital construction costs for the Proposed Project (Build Plan) as well as the full program costs including NJDEP program administration and the Feasibility Study/EIS. More detailed capital cost tables are included within the BCA Appendix. The summary below includes adjustments for inflation and contingencies embedded within the totals shown.

It should be noted that the total costs shown in **Table 2** are treated as expenditures that will be phased in, in annual increments over the construction period spanning from 2018 to 2022. Therefore, within the BCA, these future year amounts are discounted to present value by applying the project discount rate of 7%. Consequently, the cumulative present value costs shown in the BCA summary tables will appear lower than the nominal (undiscounted) costs shown in **Table 2**.

In addition, HUD Benefit Cost Guidance specifies that the price level be held constant (at 2018 constant prices) throughout the project evaluation period, 2018-2072. (HUD CPD 16-06, p.8). Because of this convention, the capital cost price escalation contingency to the year 2021 was removed within the BCA. Explanatory tables showing the adjustments made to all costs, and the reconciliation to nominal budgeted amounts are provided below in **tables 3 and 4**.

**Table 2: Build Plan Total Project Capital Costs**

| Project Features | ESTIMATED TOTAL WITH CONTINGENCY & ESCALATION (2017$) |
|---|---|
| **Construction** | |
| Grey Infrastructure Features | $65,153,000 |
| Green and Open Space Features | $14,385,000 |
| Allowances | $5,749,000 |
| General Requirements | $5,637,000 |
| **Construction Costs** | **$90,924,000** |
| **Additional Capital** | |
| Real Estate | $10,300,000 |
| Engineering and Design | $9,270,000 |
| Construction Administration | $4,006,000 |
| **Total Project Capital Costs** | **$114,500,000** |
| **Feasibility Study/EIS** | **$20,500,000** |
| **NJDEP Program Delivery** | **$13,100,000** |
| **NJDEP Administration** | **$1,900,000** |
| **Total Program Costs:** | **$150,000,000** |

Notes:

1- Estimate includes 25% contingency on Construction Costs.
2- Estimate includes escalation to a construction mid-point of 2021, at 3.5% per year compounded.
3- Estimate assumes all excess soils generated by construction will be classified as non-hazardous ID27 solid waste. These excess soils are assumed to be transported/Disposed from the site at a cost of $85 per ton. The weight of excavated material was conservatively estimated to be 2 tons per cubic yard, resulting in a disposal cost of $170 per CY.
4- Estimate EXCLUDES costs for HTRW mitigation.
5- Estimate includes allowances for utility relocations/protection.
6- Wetland mitigation costs are addressed with an allowance.
7- Estimate assumes force mains, storm water piping & box culverts will require deep foundation support.
8- GENERAL REQUIREMENTS - 6.5% of construction cost that covers contractor PM and Supervision (3%), Mob/Demob (1%), Traffic Maintenance (2 %), and Erosion-sedimentation controls (0.5%)

Source: AECOM; <<Meadowlands BCA Model_revised 2-27-18_ AB_review update RE cost.xlsx>>

**Table 3** below removes the 2021 price escalation adjustment to express all costs in 2018 constant dollars, per HUD BCA Guidelines.

**Table 3: Build Plan Total Project Capital Costs Modelled in Benefit Cost Analysis**

| Project Features | Estimated Cost Before Physical Contingency | Physical Contingency | Total with Contingency |
|---|---|---|---|
| **Construction** | | | |
| Grey Infrastructure Features | $45,422,000 | $11,355,000 | $56,777,000 |
| Green and Open Space Features | $10,029,000 | $2,507,000 | $12,536,000 |
| Allowances | $5,010,000 | $0 | $5,010,000 |
| General Requirements | $3,930,000 | $982,000 | $4,912,000 |
| **Total Construction Costs** | $64,391,000 | $14,844,000 | $79,235,000 |
| Real Estate | $10,300,000 | $0 | $10,300,000 |
| Engineering and Design | $7,727,000 | $927,000 | $8,654,000 |

| Project Features | Estimated Cost Before Physical Contingency | Physical Contingency | Total with Contingency |
|---|---|---|---|
| Construction Administration | $2,791,000 | $700,000 | $3,491,000 |
| **TOTAL PROJECT COSTS** | $85,209,000 | $16,471,000 | $101,680,000 |
| | | | |
| Total Price Contingency (removed from BCA) | $12,820,000 | Total Price Contingency (removed from BCA) | $12,820,000 |
| Feasibility Study/EIS | $20,500,000 | Feasibility Study/EIS | $20,500,000 |
| NJDEP Program Delivery | $13,100,000 | NJDEP Program Delivery | $13,100,000 |
| NJDEP Administration | $1,900,000 | NJDEP Administration | $1,900,000 |
| Total Program Costs | | | $150,000,000 |

**Table 4** shows the results of the process of discounting the future nominal Total Project Cost expenditures by construction phase year (in 2018 to 2022) to the present value basis of 2018, to account for the time value of money.

**Table 4: Build Plan: Nominal and Discounted Total Project Costs by Construction Year**

| | Total / Cumulative Present Value-2018: (Sum of 2018-2022) | 2018 | 2019 | 2020 | 2021 | 2022 |
|---|---|---|---|---|---|---|
| Capital Cost Phase-in Shares, % | 100.0% | 2% | 6% | 36% | 33% | 22% |
| Total Project Costs: Nominal Capital Costs ($) | $101,680,000 | $2,466,403 | $6,429,055 | $36,195,120 | $33,783,678 | $22,805,745 |
| Discount Factor (I = 7.0%) | | 0.9346 | 0.8734 | 0.8163 | 0.7629 | 0.7130 |
| Discounted Capital Costs \a | $79,500,377 | $2,305,100 | $5,615,136 | $29,546,076 | $25,773,568 | $16,260,496 |
| Source: AECOM, 2018 and BCA calculations applying 7% discount rate<br>\a rounded total value is $79,500,000 | | | | | | |

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## VI. Current Situation and Problem to be Solved

As demonstrated by Superstorm Sandy, the Project Area is subject to periodic, devastating flooding that wreaks havoc on the area during large storm surges. In addition, repetitive flooding occurs throughout the Project Area due to both intense rainfall events and from smaller storm surges that block the existing tide gates. In general, there are three distinct sources of flooding in the Project Area:

- Storm surge overwhelming the existing Line of Protection (LOP)
- Rainfall trapped behind the existing gates and levees at high tide

- Limits in the capacity of the existing drainage structures, resulting in flooding during rainfall-only events.

The BCA Appendix describes how flooding is currently affecting the Project Area. The Project Area is not specifically or particularly susceptible to wind, fire, or earthquake damage; as such, the Build Plan focuses on reducing flood risk. Climate change and associated sea level change would exacerbate the flooding risks associated with the Project Area, as discussed in detail within the BCA Appendix (AECOM, 2017).

## VII. Risks Facing Project Area Community

In accordance with the guidance provided in CPD-16-06, this section provides a description of the risks to achieving the anticipated benefits of the Proposed Project. This section identifies the key risks and uncertainties that may affect the Proposed Project, either in a positive or adverse way. In addition, the Proposed Project's ability to adapt to, or to accommodate any of these risks is discussed, as applicable.

The Proposed Project is designed to provide resilience and community benefits to the residents and businesses in the Project Area. The risks, as described in this section, are events or issues that would influence the Proposed Project's projected benefits during the project lifecycle such that those benefits would not be realized or recognizable, or would not be realized to the level anticipated. These risks could arise either from within the Proposed Project' marshalling of resources, or from various external reasons or unpredictable events. Below is a description of potential risks that may occur and how they may impact the Proposed Project's realization of benefits (AECOM, 2017).

- **Rapid Sea Level Change**

A rapid sea level change that increases at rates substantially higher than the estimates used for this BCA analysis could impact the Project Area to an extent that the benefits from the Proposed Project are not realized to the level anticipated. Overall, this would result in a reduction in resiliency benefits. If sea level change were to increase at historic rates for the Project Area (which is lower than the predictions used in this analysis), predicted damages would be lower than analyzed and the Proposed Project would likely still be effective.

However, if the sea level rises at a rate higher than the predicted rates used in this analysis, the Proposed Project could still provide greater benefits for the first few decades, but would ultimately have a shorter effective project life. This could mean that the future flood levels are so high that waters would flow over existing flood protection structures, rather than being stopped or blocked by them. Drainage improvements that would be built under the Proposed Project would likely be overloaded and potentially destroyed, causing their drainage benefits to be negligible, and generating unplanned costs and repairs to maintain them, reconstruct them, or increase their capacity.

The O&M Plan for the Proposed Project assumes that the pumps at pump stations would need to be replaced after 25 years, providing an opportunity to increase the pump capacity in response to rapid sea level rise. The Proposed Project has also identified opportunities in the design for green infrastructure

strategies. Implementation of such strategies would help to mitigate the impact of increased flood intensity from increased rates of rainfall (AECOM, 2017).

- **Relocation or Closure of Industrial/Commercial Establishments**

If a significant number of business or warehouses in the Project Area were to leave the Project Area or close-down for various reasons (e.g., increased maintenance or insurance costs, changes in management, down-sizing, etc.), the benefits associated with reduced flood risk would not be realized to the extent projected in the BCA. While the Proposed Project would still reduce flood risk for the small number of business that may still be operating within the Project Area, the flood risk reduction benefits assume the retention of establishments and their maintenance, or a growing business environment over time. These assumptions are required for all associated benefits of the Proposed Project to be fully realized over the evaluation time horizon (AECOM, 2017).

- **Decline in Population**

If there were a significant decrease in the population within the Project Area for unforeseen or unanticipated reasons (e.g., natural disaster, large emigration from the Project Area, significant decrease in birth rates, etc.), the expected benefits of the Proposed Project would not be fully realized. With a significant decrease in population, the Project Area could also experience a decrease in business employment and maintenance, the use and maintenance of open spaces and public areas, and the number of residents that need protection from future flood events.

An increase in flood insurance rates could make the cost of home or business ownership in the Project Area floodplain more expensive over time, which could indirectly cause a decline in the resident population. Currently, purchasing Federal flood insurance for insurable structures is a requirement in high-risk areas to protect Federal financial investments, such as federally backed mortgages. As identified on FEMA flood-maps, and as shown on Figure 7.4 1 (in the BCA Appendix), over 90% of the Project Area is within the 100-year flood zone and is considered high-risk (Zone AE, 1% annual chance of flooding) (FEMA 2017). An increase in the required cost of living in the Project Area may indirectly encourage the residents currently living in the Project Area to move away, or could discourage new residents from moving into the Project Area.

While the Proposed Project would still provide risk reduction benefits and enhancements for the smaller number of persons who still resided in the Project Area after a hypothetical significant decline in the population, a maintained or growing population is needed for all anticipated benefits of the Proposed Project to be fully realized over time. Some of the aspects of the Proposed Project that may not be realized with a significant decrease in the population are identified below:

- Emergency Response and Preparedness. Aspects of the Proposed Project that aim to assist with medical and emergency preparedness and response times would likely not be realized with a significantly decreased population. With fewer residents to attend to, emergency and medical responders and those services would likely also decrease in size and capabilities. It is likely that any residents who still resided in the area would have to travel outside of the Project Area, or responders responding to the Project Area would have to travel from the outside, to receive and provide emergency services.

- Open space and recreational demand. Improvements and enhancements to open space, recreational land, and commercial areas would not be fully realized with a significant decrease in the population. With fewer people to enjoy and utilize these spaces, there would be a decreased need to maintain the aesthetics and advancement of these locations.

- Public Health Risks. Risks to public health associated with residing near, or being proximate to a crowded urban area (such as the spread of infectious diseases) would subsequently decrease with a decrease in the population. Efforts of the Proposed Project to decrease public health risks would not be fully realized when it is not associated with an urban and densely populated environment (AECOM, 2017).

## VIII. Benefits and Costs

This section summarizes the lifecycle costs and benefit / values that are included within the benefit cost analysis. For a more detailed description of these costs and benefits refer to the BCA Appendix.

### a. Lifecycle Costs

The lifecycle costs of the Proposed Project consist of the both the full project investment capital construction costs and the long-term annually recurring operational and maintenance costs (O&M). Within the BCA the annually recurring O&M costs are modelled as being incurred when the construction period is complete (estimated at year: 2022) and operations commence (estimated at year: 2023). **Table 5** below shows the summary of the main O&M groupings for the Proposed Project. The Project Capital Construction Costs and shown above in **Table 4**.

**Table 5: Proposed Project-Annual Operational and Maintenance Costs (O&M)**

| O&M Cost Category: | East Riser Ditch \a | Losen Slote \b | Total |
|---|---|---|---|
| Grey Features | $446,300 | $87,400 | $533,700 |
| | | | |
| Green Features -Open Space (not including equipment and replacement of park features) | | | $520,700 |
| Green Features – Streetside Green Infrastructure | | | $21,300 |
| Total Annual O&M Costs: | | | $1,075,700 |
| **Total Annual O&M Costs rounded: ≈** | | | **$1,100,000** |

Notes:
a\ 500 cfs pump station, discharge channel, modified forebay inlet to existing tide gate, culvert upgrades, ditch dredging)
b\ 50 cfs pump stations, force mains

Source: AECOM, <<20171116_RBDM_Build Plan- O&M_Cost_Estimate.xlsx>>

**Table 5** shows the annual O&M costs broken out by the Proposed Project's grey and green features. Slightly over one half of the annual O&M will be required to sustain the 500 cfs pump station, discharge channel, modified forebay inlet to the existing tide gate, culvert upgrades and ditch dredging for the East

Riser Ditch, and the Losen Slote project elements. The remaining half of annual O&M will be required to sustain the green infrastructure stormwater management features relating to open spaces but not including equipment and replacement of park features.

b. Resiliency Value

The benefits calculated for the Proposed Project are based on a comparison of future conditions with and without implementation of the Proposed Project. The benefit analysis assumed that certain conditions would exist in the future. These conditions are fully described in the BCA Appendix and summarized in **Section VI** of this document. Changes in the future condition assumptions from those anticipated in the BCA calculations could result in higher or lower benefits than currently estimated.

The main resiliency benefits consist of avoided flood damages. The Proposed Project will provide direct resiliency benefits by reducing flood damages to structures and their contents. These structures consist of residences, apartments, commercial, industrial, municipal and utility buildings. In addition, resiliency benefits consist of avoided flood damages to motor vehicles, avoided debris/disposal costs, avoided mortality and injuries to the population, avoided public emergency costs, and avoided critical facility disruptions. Flood damage reduction benefits were calculated using the HEC-FDA model. About 69% of the annual resiliency benefits were derived from damage reductions to structures (i.e., residential, commercial, municipal, and utilities), and the remaining 31% are associated with reductions in death/injury/mental/health, emergency response, motor vehicles, debris disposal, and critical facility disruption (BCA Appendix). **Table 6** shows a breakout of expected annual values, anticipated in 2023, and in 2073, by flood damage reduction benefit category (AECOM, 2018).

**Table 6: Resiliency Values: Expected Annual Benefits under the Proposed Project- Build Alternative 3**

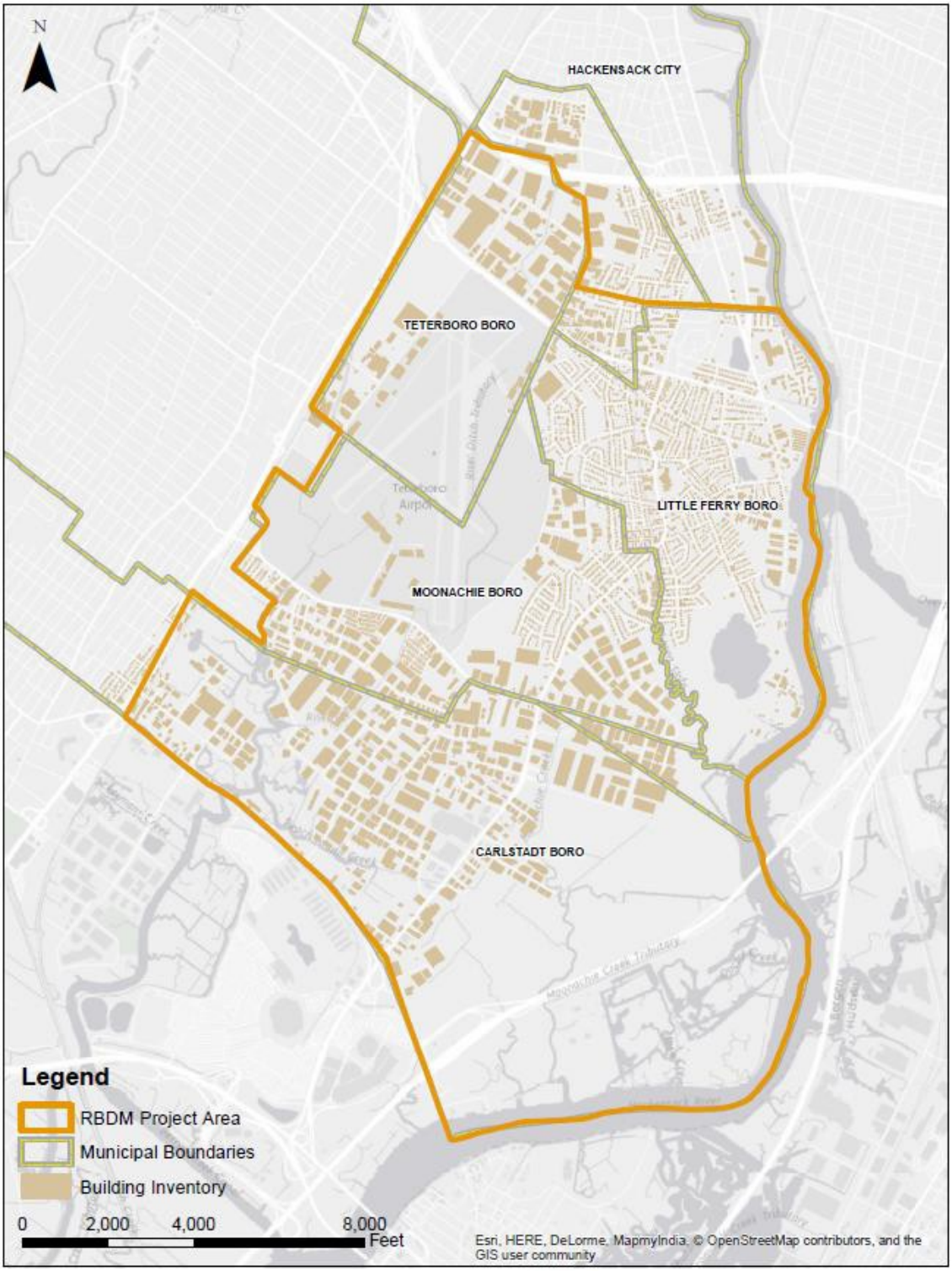
[1.2 Feet Sea Level Rise at the Battery, 0.8 Feet Assumed for Project Area]

| Flood Damage Reduction Benefit Category | Expected Annual Damage Reduction Value 2023 | Expected Annual Damage Reduction Value 2073 |
|---|---|---|
| **Structures:** | | |
| Residential | $54,520 | $131,670 |
| Apartment | $2,540 | $4,820 |
| Commercial | $1,946,670 | $3,600,400 |
| Industrial | $2,157,610 | $4,600,060 |
| Municipal | $92,750 | $149,000 |
| Utility | $100 | $20 |
| **Other:** | | |
| Motor Vehicles | $98,320 | $177,060 |
| Debris Disposal | $5,550 | $8,300 |
| Death/Injury | $1,807,210 | $4,168,190 |
| Public Emergency | $40 | $30 |
| Critical Facility Disruption | $30 | $90 |
| **Project Total:** | **$6,165,340** | **$12,839,640** |

Source: AECOM, 2018
<<Meadowlands BCA Model_revised 2-27-18_ AB_review update RE cost.xlsx: Alt 3 Build Resiliency>>

**Figure 2** shows a map of the area and the assets at risk from which flood reduction damages were calculated based on the projected sea level rise scenario for the Project Area.

**Figure 2: Map of Project Area and Assets at Risk**




Source: AECOM <<RBDM_Feasibility_FDA_Vulnerable Areas Map.pdf>>

c. Social Value

The BCR reflects the cumulative present value of the combined annual value of monetized social benefits, consisting of the following categories:

- Recreation
- Avoided Stormwater Treatment Costs
- Aesthetic Values, and
- Water retention related/flood hazard risk reduction benefits

Recreation

The recreational values associated with the Project Area are based on the value that visitors place on the open space and new park amenities. The annual value of recreation benefits is based on the estimated number of annual visits for populations residing within one-quarter mile from the new parks. From a former study, it was observed that 43% of park users lived within ¼ mile of the park, 21% lived between ¼ and ½ mile of the park, and 23% lived between ½ and 1 mile of the park surveyed (Cohen, 2007). Since some of the new parks are located near each other, only the estimated number of users within ¼ mile of the park was used for the analysis as a conservative estimate (AECOM, 2017).

The estimated number of users for the new parks was based on a study conducted by Active Living Research (2011). It was assumed that 10% of the population living within ¼ mile of a proposed park would be daily users, 40% would use the park once a week, 20% would use the park once a month, 10% would use the park less than once a month, 10% would use the park once, and 10% would never use the park (AECOM 2017).

The recreation benefits were monetized using the USACE recreational day use value for fiscal year 2017 of $5.94 based on the expected characteristics of the new parks (2016). The seasonal usage of the new parks is assumed to span the period from mid-April to mid-October (26 weeks) and because of inclement weather, it is conservatively assumed that daily users would only use the park 122 days per year. Using these assumptions, it is calculated that for every person living within ¼ mile of a new park, there would be 24 days of park use per year for an estimated annual use-value of about $144 (AECOM 2017).

The projected number of annual visits (concentrated within Little Ferry, Moonachie and the Outer Boroughs) was multiplied by the USACE 2017 unit day value for recreation to arrive at the annual monetized value of recreation associated with the incremental recreational use within the Project Area arising under the Build Alternative. **Table 7** shows the distribution of the annual recreational benefits across the Project Area (AECOM, 2017).

**Table 7: Annual Recreational Benefits from New Parks – Proposed Project**

| Area | Number of Annual Visits | Annual Value |
|---|---|---|
| Carlstadt | - | $0 |
| South Hackensack | - | $0 |
| Little Ferry | 71,823 | $426,631 |
| Teterboro | - | $0 |
| Moonachie | 43,162 | $256,380 |
| Other Boroughs | 5,655 | $33,591 |
| Total | 120,640 | $716,602 |

Source: AECOM, << Meadowlands GI Model_13Nov17.xlsx>>

Avoided Stormwater Treatment Costs

To estimate the value of rainfall intercepted on-site and potential cost reductions in stormwater-management control, a value that includes the avoided cost of collection, conveyance, and treatment was applied. The average price of stormwater runoff reduction ($0.089 per gal) (USDA, 2014) was applied to the estimated gallons of stormwater that would be intercepted by the Build Alternative's Green Infrastructure stormwater management project elements (i.e., Rain Gardens, Urban Vegetation, Bioretention/bioswales, New Green Space, Permeable Paving, as well as tree plantings).

Green infrastructure measures can vary in the level of effectiveness. This variability is accounted for in the model using minimum and maximum values for the number of gallons of stormwater that can be reduced. The average value of the low and high estimates was used to estimate the number of gallons of stormwater runoff that would be captured by the green infrastructure stormwater management measures and tree plantings. The factors used to calculate the minimum and maximum volume of stormwater that would be reduced by each green infrastructure measure (in gallons) were obtained from the Center of Neighborhood Technology (2010) and the formula was adapted to the local Meadowlands climatic conditions by applying the average annual rainfall in Teterboro (U.S. Climate Data, 2017). The stormwater benefits associated with the newly planted trees were calculated using the i-Tree Tool. The value of reduced stormwater was monetized as the product of the gallons of stormwater runoff that would be reduced annually and the avoided treatment cost (associated with traditional stormwater management control) (AECOM, 2017).

Aesthetic Value

Green infrastructure interventions can help to not only prevent debris from being carried away with runoff throughout the streets in higher-volume storms, but can also include plantings that create pockets of color and texture throughout the landscape. In addition to new green infrastructure features, the Build Alternative will also improve existing elements of the area's storm drainage networks. Existing ditches that undergo day-lighting are cleaned and re-landscaped to function more efficiently in conveying stormwater can also become a unique and attractive feature in the local landscape.

Redesigned parks, an activated waterfront, and other landscape-based interventions create a more visually appealing system of open spaces throughout the Project Area. Green infrastructure implementations within streetscapes establish more attractive conditions along transportation corridors. A literature derived or benefits transfer aesthetic value per acre was applied in the BCA. The aesthetic value from green open space applied is $1,787 per acre of new green open space per year as established by FEMA and updated to 2017 dollars (FEMA, 2012) (AECOM, 2017).

The per-acre value reflects a cultural/aesthetic related benefit, not captured elsewhere in the benefit cost analysis. The annual monetized aesthetic benefit was calculated based on multiplying this per acre value times the number of acres for project features that would provide this aesthetic value within the Project Area.

Water retention/flood hazard risk reduction

The value of water retention was calculated by converting the total square feet of all green infrastructure features combined, converting this SF value to acres and then applying a FEMA sustainability value per acre (updated to 2017 US$) that is a national average value that captures the benefits for this feature (See BCA Appendix). Green open space is a provisioning area for stormwater retention and floodwater storage and conveyance and contributes to replenishing groundwater (underground aquifers). To measure the benefit of water retention and flood hazard risk reduction from new green open spaces, the national FEMA value from $322 per acre (updated to 2017 dollars) was applied to new green open spaces that were previously impervious (FEMA, 2012) (AECOM, 2017).

d. Environmental Value

The environmental values that were monetized within the benefit cost analysis consist of air quality improvements, the value of pollination ecosystem services and nutrient pollution removal provided by the Project features. It is important to note that the Project features will provide many ecosystem service enhancements and benefits to the Meadowlands area. These benefits are described qualitatively within the BCA Appendix (AECOM, 2017). Because ecosystem services are so important to the project area, the benefits of wetland creation and enhancement are summarized below in qualitative terms. The APA narrative below focuses on those environmental values that were monetized and included within the benefit cost ratio (AECOM, 2017).

Air Quality Benefits

The monetary values for the reduced emissions used in the benefits analysis are based on USDOT guidance (2016b) and adjusted into 2017 dollar terms. The GHG emission values are based on the Social Cost of Carbon (SCC) developed by the Federal Interagency Working Group on Social Cost of Carbon and suggested by TIGER guidance (USDOT, 2016b). SCC values were inflated to 2017 dollars. The GHG emissions value was calculated by multiplying the quantity in metric tons of carbon dioxide by the appropriate SCC value in that same year. Carbon sequestration of green infrastructure was monetized using the climate regulation annual values from FEMA of $15 per acre of new green open space (2012) (AECOM, 2017) (AECOM, 2017).

Pollination Services Benefits

Creation of additional green space, including rain gardens and urban vegetation, provides opportunities for native bees, butterflies, flies, and beetles to move pollen among flowers so that plants can form seeds and fruit. The pollination value applied was $319 per acre of new green open space per year as established by FEMA and updated to 2017 dollars (FEMA, 2012). The value of pollination services was calculated by multiplying this value per acre by the total acres associated with the select green infrastructure project features that would provide additional environment for the pollination supporting ecosystem services to be established (AECOM, 2017).

Reduced Nutrient Pollution / Nutrient Removal Benefits

Common approaches for implementing permanent sustainable stormwater management features that have been included in the green infrastructure aspects of the Proposed Project emphasize nature-based methods and distributed source controls, such as permeable pavement, bioswales, rain gardens, green roofs, rain barrels, and cisterns. Managing stormwater to complement drainage improvements for more frequent rainfall events would improve the quantity and quality of runoff throughout the drainage areas of the Hackensack River and reduce nutrient pollution from excess nitrogen and phosphorus. Bioretention facilities are expected to reduce nutrient pollution from excess nitrogen and phosphorus. The factors used to determine the number of pounds of nitrogen and phosphorus reduced was obtained from the Watershed Protection Techniques Journal (Schueler, 1997). The monetized value per pound of the reduced nitrogen of $3.83 (Shaik, et. al. 2002 and Birch, 2011) and phosphorus of $40.20 (Ancev, et. al. 2006) come from multiple research journals (AECOM, 2017). The annual monetized value of the reduction in nitrogen and phosphorus was based on multiplying the per pound values by the total pounds that would be removed given the relevant acreage hosting the green infrastructure project features with vegetation supporting this nutrient removal and uptake.

Wetland Enhancement and Creation

Wetlands provide tangible and intangible ecosystem services including provisioning, regulating, cultural, and supporting services that generate economic value from their direct, indirect, and potential use. Provisioning services include the production of fish; storage and retention of water; creation of fiber, peat, fodder, and fuelwood; genetic materials for resistance to plant pathogens; and biochemical (extraction of medicines and other materials). Regulating services include climate regulation, water regulation, water purification and waste treatment, erosion regulation, flood control and storm protection, and habitat for pollinators. Cultural services include recreational activities, such as bird watching; educational opportunities; spiritual and religious values related to aspects of wetland ecosystems; and aesthetic value. Supporting services include soil formation and sediment retention and nutrient cycling. Biodiversity of plants and animals is supported by wetlands and help to maintain wetland processes (AECOM, 2017).

The Proposed Project would re-create and improve natural areas (and wetlands), which would be integrated throughout the Project Area. Re-created natural areas would generate ecosystem benefits including better water quality, reduced contaminated sediment, new habitat, and better fisheries production. Constructing, enhancing, and restoring wetlands can create new habitat and reduce fragmentation. Additionally, new wetland and riparian areas can contribute to nutrient cycling, biological control, erosion control, and support biodiversity (AECOM, 2017).

e. Economic Revitalization

The economic revitalization benefits that were monetized within the benefit cost analysis consist of a one-time enhancement in the value of adjacent properties, energy conservation benefits, and the present value of the residual value of land right-of-way hosting the Proposed Project (AECOM, 2017).

Enhanced Property Values

Many studies have consistently shown that parks and open space have a positive impact on nearby residential property values (Crompton, 2005 and McConnell and Walls, 2005). The value of commercial properties near parks may also appreciate. The property value attributable to proximity to a park is separate from the direct recreational use value, meaning the property value appreciates even if the resident never visits the park. The magnitude of the increase in the property value is linked to the distance and the quality of the park and open space. While studies have shown increased property values up to 2,000 feet from a large park, most of the value is found within 500 feet of a park (Bolitzer and Netusil, 2000; Crompton, 2001; National Association of Realtors, 2009; Crompton, 2004; Crompton and Nicholls, 2005) (AECOM, 2017).

A 2009 report from the National Association of Realtors found the premium for homes near parks can extend three blocks and start at 20% for those homes directly adjacent to these amenities (declining as distance from the park increases). An empirical review of 30 studies validated a 20% appreciation for properties abutting or fronting a passive park area and a 10% appreciation for properties 2 or 3 blocks away (Crompton, 2001). A 20 percent property value increase was applied to residential properties within 100 feet of new parks and a 10 percent property value increase was applied to residential properties between 100 and 500 feet of new parks (AECOM, 2017).

In various studies, improved landscaping and new tree plantings have also been associated with overall increases in house values varying on average from 7 to 30% (Des Rosiers et. al., 2002; Donovan and Butry, 2010; EPA, 2016a; Kusnierz et. al., 2010; Wachter and Gillen, 2006). For purposes of this analysis, it is assumed that properties within 100 feet of new trees would appreciate in value by 7% (AECOM, 2017).

In 2015, median home value was higher in Bergen County ($441,400) in comparison to the five municipalities, which ranged from $269,500 in South Hackensack to $389,800 in Carlstadt (ACS, 2016). Improving the livability and aesthetics of the living environment and access to new recreational facilities can increase property values. The 2015 median values of housing units for each borough are displayed in Table 4-1 in the BCA Appendix. The median housing value for each borough from the U.S. Census was used to help mitigate sensitivity to extremely high selling prices and the type of properties sold each year (e.g., condominiums versus single family homes) (AECOM, 2017).

The full property value premium was calculated based on determining the number of residences that fell within a certain distance to the amenity and that would experience either a 20, 10, or 5% increase in value. As described above the value base was the median home value. The one time enhancement in property

value was treated as a one-time stock benefit that would arise in 2023. This value was then discounted to present value in the benefit cost analysis (AECOM, 2017).

Energy Conservation

The strategic planting of trees can provide shading and wind breaks, thereby saving and conserving on energy usage and fuel consumption. Natural gas and electricity savings were calculated based on applying the i-Tree Tool, a peer-reviewed software from the USDA Forest Service (itreetools.org). In addition to the kilowatt-hours of electricity savings, therms of natural gas savings, and monetized energy conservation benefit, the i-Tree Tool provides the number of gallons of reduced stormwater runoff, estimated stormwater savings benefit, and air emission reductions (in pounds), and the associated value (AECOM, 2017).

It was assumed that all trees planted would be Red Maples (a common tree in the study area) and would be 3 diameters when planted. The maturation period and the tree diameter growth was extrapolated to the end of the period of analysis. The average annual diameter growth was obtained from the USDA Forest Service Growth Model for the Northeastern United States (1991). When more specific values for the study area were available, these were used in place of the estimates from i-Tree. The i-Tree Tool was used to calculate the average annual electricity benefit of $6.36 per tree and average annual natural gas benefit of $26.04 per tree. The number of new trees planted was then applied per each area to the projected annual value per tree (for combined energy savings) per each project sub-area. The number of trees to be planted by area was sourced from the Build Plan (AECOM, 2017).

Residual Value of Land

The value of the land (right of way, ROW) is included as a nominal residual value (in the year 2072) and then discounted to present value in the benefit cost analysis (AECOM, 2017).

## IX. Project Risks

The Proposed Project is designed to provide resilience and community benefits to the residents, businesses, and stakeholders within the Project Area. The risks, as described above in **Section VII**, are events or issues that could influence the Proposed Project's projected benefits during the lifecycle of the Build Alternative such that those benefits would not be realized or recognizable, or would not be realized to the level anticipated. These risks could arise from circumstances outside of the Proposed Project's footprint, boundary or resources, or for various other reasons, or unforeseen and unanticipated events (AECOM, 2017).

In addition, challenges described within **Section X** below could have potential impacts on the Proposed Project's costs (capital costs during construction and long-term annually recurring O&M costs) as well as lead to delays in project implementation.

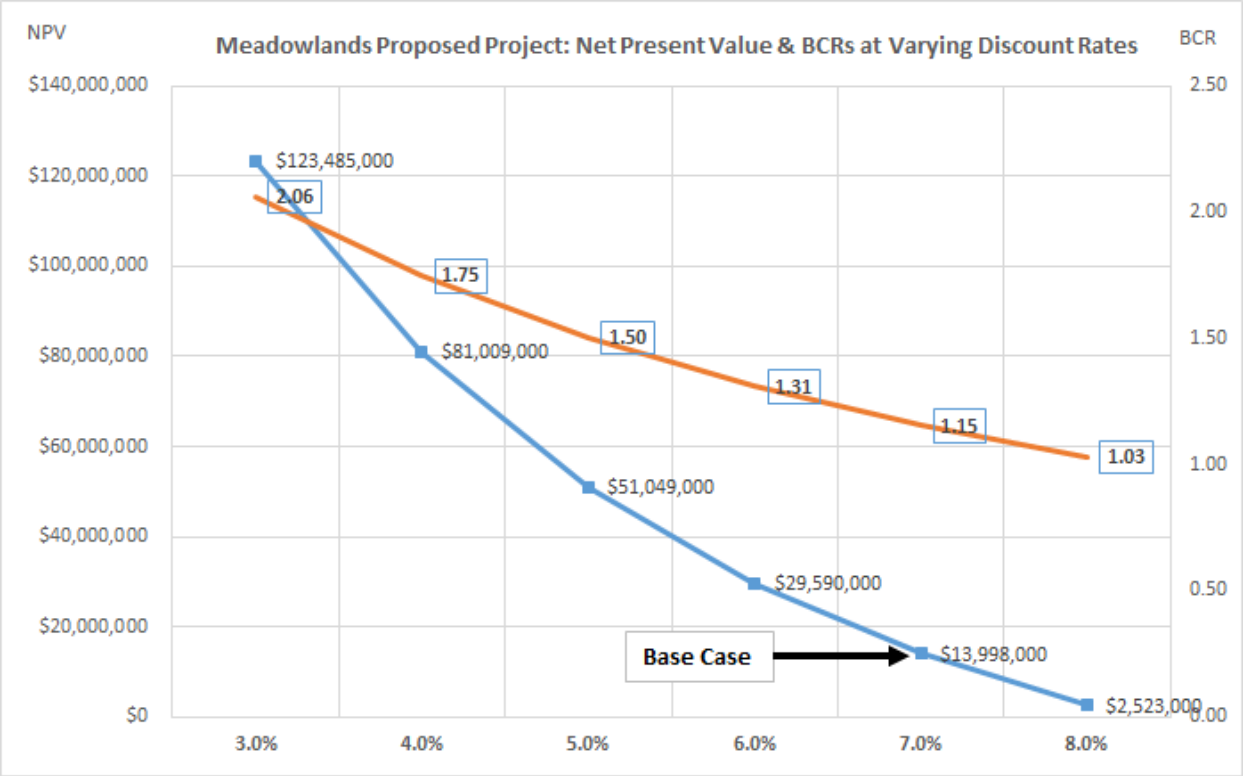
a. Sensitivity Analysis

A sensitivity analysis was conducted to gauge how responsive the Proposed Project's net present value and benefit cost ratio are to departures from the base discount rate of 7.0%. **Table 8** and **Figure 3** below shows that a slight lowering of the base discount rate, from 7% to 6% increases the net present value and BCR significantly.

**Table 8: Proposed Project Cumulative Net Present Value of Benefits & Benefit Cost Ratios at Varying Discount Rates**

| Discount Rate | Net Present Value: NPV | Benefit Cost Ratio: BCR |
|---|---|---|
| 3.0% | $123,485,000 | 2.06 |
| 4.0% | $81,009,000 | 1.75 |
| 5.0% | $51,049,000 | 1.50 |
| 6.0% | $29,590,000 | 1.31 |
| 7.0% | $13,998,000 | 1.15 |
| 8.0% | $2,523,000 | 1.03 |
| Source: Louis Berger | | |

**Figure 3: Proposed Project: NPVs and BCRs at Varying Discount Rates**




Lowering the base discount rate from 7% down to 3% shows that the net benefits and BCR are sensitive to the application of an alternative discount rate. As the Proposed Project is not meant to discourage private investment or consumption, but is intended to create a resilient environment and community that

is conducive to attracting future investment, it is unlikely that private investment will be displaced by the Project. The Project is an "enabling" infrastructure investment, a term used to describe infrastructure that facilitates economic growth and productivity. Therefore, the lower discount rate of 3% is provided to show that the BCR is higher with this lower hurdle rate. At a discount rate of 3%, the cumulative present value of net benefits from the Build Alternative is $123.5 million and the BCR is 2.06.

## X. Assessment of Implementation Challenges

A number of challenges can potentially be encountered when implementing a project that covers a large, populated area, and requires ongoing sustainment spanning a long time period. Challenges can arise throughout all of the various stages of the Proposed Project's implementation: design, construction, or O&M. The challenges may be centered on costs, logistics, or coordination. Below is a discussion of some of the anticipated challenges that may arise during the Proposed Project (AECOM, 2017).

### 1) Real Estate Acquisition

The Proposed Project may require the acquisition of real estate in select locations relating to implementing Proposed Project components. Acquiring real estate could be met with resistance from the community, real estate owner(s), or a property manager(s). Real estate acquisition can be a lengthy and complex logistical process, which could potentially slow or delay the implementation of the Proposed Project. This challenge would likely arise during the design and construction stages of the Proposed Project (AECOM, 2017).

### 2) Lack of Adequate Operations and Maintenance Funding to Sustain Project

The ongoing effectiveness of the Proposed Project to reduce flooding in the Project Area over the long-term will be dependent upon the application of proper maintenance. Without proper maintenance of the stormwater infrastructure, the Proposed Project could fail. Lack of proper O&M investments include, but are not limited to:

- drainage ditches filling with sediment,
- pump stations or tide gates clogging with trash,
- berms or floodwalls beginning to leak.

These challenges could arise during the operations stage of the Proposed Project.

The Proposed Project cannot fund O&M activities. As such, the NJDEP is required to develop an O&M plan for the Proposed Project to address long-term maintenance requirements and responsibilities. This O&M plan must identify funding sources, the responsible entity or entities for ensuring that long-term maintenance is implemented, and any necessary training and monitoring requirements over the life cycle of the Proposed Project. Given the O&M of existing flood control structures and ditches is an ongoing issue for the five municipalities within the Project Area, O&M associated with the implementation of the Proposed Project could also be a long-term challenge (AECOM, 2017).

Furthermore, the Proposed Project could require O&M costs greater than anticipated for a number of reasons, such as, but not limited to: improperly retrofitted or installed drainage improvements that

require additional maintenance or re-installation; increased flow or flooding events that cause additional unplanned post-disaster maintenance; or the vandalizing of Proposed Project components requiring extensive repairs or replacements. This challenge would likely arise during the operations stage of the Proposed Project (AECOM, 2017).

**3) Construction Phase Challenges**

A number of unpredictable challenges can arise during construction. These challenges could involve traffic management, finding an appropriate location to stage and store equipment, increased materials costs, or a decrease in available resources and workers due to increased market demands. These kinds of challenges would likely arise during the construction stage of the Proposed Project (AECOM, 2017).

**4) Community Coordination and Opposition**

As with any large project with a large number of stakeholders and interested parties (both public and private), there may be some challenges with coordinating and communicating with all of those involved. Attempting to time and schedule events to coordinate with all parties' schedules could prove to be a challenge. With increased or prevalent opposition from community members, this may require additional event scheduling and/or project planning in order to respond to and consider all concerns. This challenge could arise during the design, construction, or operations stages of the Proposed Project (AECOM, 2017).

NJDEP does not anticipate public controversy with the Proposed Project. Pursuant to 40 Code of Federal Regulations (CFR) § 1506.6, NJDEP has worked diligently to involve and inform the public about the Proposed Project and the ongoing NEPA process. Early in the Proposed Project's planning process and prior to publication of the Notice of Intent (NOI), the NJDEP authored two public outreach documents: the Citizen Outreach Plan (COP) and Guidance for Public Involvement (GPI); both documents are available for review at www.rbd-meadowlands.nj.gov. In order to make public outreach efforts most efficient, several committees were created early in the planning process. The Executive Steering Committee (ESC), which serves as an information exchange forum for leaders of the Proposed Project, reserves seats for the mayors (or their designees) of the five affected municipalities, thereby encouraging the participation of local elected leadership in critical decisions. This committee was tasked with identifying stakeholders that represent vulnerable and underserved populations in the Project Area and developing a comprehensive communication plan for engaging stakeholders in the development of the Proposed Project. The stakeholders identified by the ESC were invited to the Citizen Advisory Group (CAG), along with stakeholders identified by the NJDEP. As of October 2017, 11 CAG meetings have been held (AECOM, 2017).

The NJDEP is also working closely with the Meadowlands Interagency Mitigation Advisory Committee (MIMAC), which is an interagency review team for mitigation banks and other mitigation projects in the Meadowlands District. The MIMAC consists of representatives from the National Marine Fisheries Service (NMFS), United States Fish and Wildlife Service (USFWS), USACE, NJSEA, and NJDEP Mitigation Unit. Additionally, the Technical Coordination Team (TCT), which is also composed of regulatory agencies having potential purview over the Proposed Project, was created to establish clear communication channels with affected Federal, State, and local agencies (AECOM, 2017).

Besides agency involvement and consultations, pursuant to 40 CFR § 1501.7(a)(1), the National Historic Preservation Act (NHPA), and the Native American Graves Protection and Repatriation Act, NJDEP is also consulting with federally recognized Native American Tribes potentially having ancestral ties to the Project Area. The NJDEP sent consultation letters to the following Native American tribes:

- Absentee-Shawnee Tribe of Indians of Oklahoma
- Delaware Nation, Oklahoma
- Delaware Tribe of Indians
- Eastern Shawnee Tribe of Oklahoma
- Shawnee Tribe
- Stockbridge-Munsee Community Band of Mohicans

As of October 2017, the only response received was from the Stockbridge-Munsee Mohican Tribe; they declined to participate in the Proposed Project because it is outside of their cultural area of interest (AECOM< 2017).

**5) Permitting and Regulatory Delays**

The Proposed Project is likely to require permits from, and/or coordination with, multiple Federal and State agencies. These may include, but are not limited to, Section 7 consultation under the Endangered Species Act, Section 401/404 permits under the Clean Water Act, Section 10 under the Rivers and Harbors Act, a Coastal Zone Consistency Statement under the Coastal Zone Management Act, and consultation with the State Historic Preservation Officer under the National Historic Preservation Act. Each of these efforts would rely on agencies that are not directly involved on the Proposed Project team. Additionally, changes to Federal and/or State agencies (i.e., from potential budget cuts or shifts in priorities) resulting from transitions in political administrations could further impact the Proposed Project's approval process and the overall schedule. These challenges could arise during the design and construction stages of the Proposed Project (AECOM, 2017).

**Table 9** shows a list of the identified permits that will be required for the Build Alternative Proposed Project.

**Table 9: List of Permits – Build Plan**

| Law &/or Regulation | Type of Permit | Issuing agency |
|---|---|---|
| Federal Clean Water Act | Individual Section 404 permit | USACE-NYD |
| Federal Clean Water Act | Individual Section 401 Water Quality Certification | NJDEP DLUR |
| Federal Coastal Zone Management Act | Federal Consistency (issued through WFD permit) | NJDEP DLUR |
| NJ Waterfront Development Law/ NJ Coastal Zone Management Rules | Individual Upland and In-Water Waterfront Development Permits (jurisdiction waterward of Mean High Water in NJ Meadowlands District; in-water and upland jurisdiction outside of NJM District) | NJDEP DLUR |
| NJ Freshwater Wetlands Protection Act/ NJ FWWPA Rules | Individual Freshwater Wetland Permit (tidal and non-tidal wetlands outside NJ Meadowlands) | NJDEP DLUR |
| NJ Flood Hazard Area Control Act/ NJ FHCA Rules | Individual Flood Hazard Permit | NJDEP DLUR |
| NJ Tidelands Law | Tidelands License (for short term/construction) | NJDEP DLUR – Bureau of Tidelands |

| Law &/or Regulation | Type of Permit | Issuing agency |
|---|---|---|
| | Tidelands Lease (for long term/life of project) | |
| NJ Soil Erosion and Sediment Control Act /NJ SESC Standards | Soil Erosion / Sediment Control Plan Certification | Bergen County Soil Conservation District |
| NJ Water Pollution Control Act | NJ Pollutant Discharge Elimination System (NJPDES) Stormwater – Construction Activities General Permit (5G3) | NJDEP Division of Water Quality |
| NJ Water Pollution Control Act | Treatment Works Approval (for pump station, **if** combined sewer/stormwater) | NJDEP Division of Water Quality |
| NJ Solid Waste Regulations (N.J.A.C 7:26) | Approval for disruption of closed landfill site | NJDEP Division of Solid and Hazardous Waste |
| Meadowlands District Zoning Regulations (N.J.A.C. 19:4-1.1 et. seq.) | Zoning Certificate<br>Site Plan Approval<br>Construction Permit(s)<br>Stormwater Permit | NJ Sports and Exposition Authority |
| Municipal Land Use Law /Local Ordinances | Zoning Certificate<br>Site Plan Approval<br>Construction Permit(s) | Individual Municipalities (outside NJ Meadowlands District Boundary) |
| Air Quality Permit (NJAC 7:27-8.2(c)1) | Preconstruction permit and operational certificate for any fuel-burning equipment (i.e., emergency generators at pump stations). | NJDEP Division of Air Quality |
| Remedial Action Permit | At project completion (if a new feature is intended to act as a cap for contaminated soil) | NJDEP Site Remediation Program |
| NJDOT | Permits for utility accommodations, lane closures, temporary access, air safety & zoning (as applicable): | NJDOT |
| Source: AECOM, << 20171116_RBDM_APA_Permitting.docx>> | | |

**6) Lawsuits / Legal Challenges**

The Proposed Project could be subject to lawsuits or legal challenges from affected stakeholders regarding various areas of controversy. For example, there could be lawsuits regarding whether the Proposed Project includes adequate environmental restoration and/or mitigation activities, or whether the environmental analysis (i.e., NEPA process) was sufficient. There could also be legal challenges from property owners regarding potential impacts to individual properties that may result from the Proposed Project. Lawsuits or legal challenges could arise following the NJDEP's decision of how to implement the Proposed Project (AECOM, 2017).

**7) Unavailable Mitigation Credits for Wetlands and Riparian Zones**

The Proposed Project would include the design of both stormwater drainage improvements and a LOP between the developed portions of the Project Area and the tidal wetlands and waterways. As such, there is potential for impacts to existing wetlands and riparian zones, which would need to be mitigated. Considering the size and scope of the Proposed Project, (although dependent on the final designs), this would require close coordination and collaboration with the NJDEP and MIMAC to determine the best path forward to achieve the necessary mitigation, including discussion of whether wetland creation/enhancement can be conducted within the Project Area, particularly in such close proximity to Teterboro Airport; whether suitable mitigation bank credits are available in northern New Jersey for the Proposed Project to use; whether alternative wetland mitigation pathways could be negotiated and

pursued or if the Proposed Project will be required to pursue the same path as more traditional projects. This potential challenge could arise during the design stage of the Proposed Project and influence the final alternatives (AECOM, 2017).

**8) Contamination Issues**

The Project Area is known to have an extensive history of contamination due to historical dumping and industrial spills. As such, the Proposed Project must account for existing contamination during the design process and incorporate the necessary higher disposal costs and regulatory compliance requirements into the overall process. Furthermore, it is possible that unknown contamination could be discovered during the construction of the Proposed Project, which could require the reevaluation of the Proposed Project design in that location. This challenge could rise during the design and construction stages of the Proposed Project (AECOM, 2017).

**9) Future Encroachment into Green Infrastructure**

The Proposed Project includes green infrastructure features (such as bioswales, rain gardens, stormwater retention basins, etc.). In the future, it is possible that development could be proposed that could infringe upon, or replace, these features (i.e., if a road needs to be widened due to traffic congestion). Replacement of these stormwater management features could reduce both the effectiveness of other interconnected stormwater management infrastructure, as well as the overall effectiveness of the Proposed Project at reducing inland flooding from large rainfall events. This challenge could arise during the operations stage of the Proposed Project (AECOM, 2017).

## XI. Conclusion

The benefit cost analysis (BCA) was prepared for the Rebuild by Design Meadowlands Project (Alternative 3, Build Plan) on behalf of the State of New Jersey Department of Environmental Protection. The BCA was prepared by following the Guidance for Benefit-Cost Analysis included within the HUD Notice: CPD-16-06, and also adheres to the principles articulated within the document entitled OMB Circular A-94 – Guidelines and Discount Rates for Benefit-Cost Analysis of Federal Programs. The analyses presented herein are based on 2017 price levels and the application of a base 7% annual discount rate pursuant to OMB Circular A-94.

The Proposed Project is needed to address systemic inland flooding from high-intensity rainfall/runoff events and coastal flooding from storm surges, as the interplay between the two forces contributes to the reoccurring flooding conditions throughout the Project Area. In addition to flood reduction, the Proposed Project is needed to directly protect life, public health, and property. It is further needed to restore property values, improve community resilience, protect ecological resources, and improve civic, cultural, and recreational values in the Project Area. The purpose of the Proposed Project is to reduce flood risk and increase the resiliency of the communities and ecosystems in the Project Area, thereby protecting infrastructure, facilities, residences, businesses, and ecological resources from the more frequent and intense flood events anticipated to occur in the future. The ability of the Proposed Project to meet this purpose will be measured in terms of the following objectives (AECOM, 2017):

**1)** Contribute to Community Resiliency.
**2)** Reduce Risks to Public Health.
**3)** Deliver Co-Benefits.
**4)** Enhance and Improve Use of Public Space.
**5)** Consider Impacts from Sea Level Change.
**6)** Protect Ecological Resources.
**7)** Improve Water Quality.

Alternative 3 was selected as the Recommended Plan because it addresses both coastal surge and systemic inland flooding. Alternative 3 was conceived to be implementable in two project stages: the initial stage as reflected in a Build Plan, which includes all features to be constructed as part of the Proposed Project, and a second stage as reflected in a Future Plan, which includes the remaining features of Alternative 3. This second stage could be constructed over time as funding and construction feasibility permit. Implementation of the Build Plan would remain, and would be implementable within both the budget and schedule associated with the RBD funding. The Build Plan is an integrated plan that primarily addresses the systemic inland flooding that results from heavy or frequent precipitation in the Project Area. The Build Plan includes both grey and green stormwater management infrastructure features described under **Section IV** (AECOM, 2017).

The Benefit Cost Analysis demonstrates that the Build Alternative is economically feasible at a discount rate of 7%. The Project will generate net benefits (benefits exceed costs over its useful life).

**Table 10: Benefit Cost Analysis Summary**

| **Meadowlands Proposed Project: Benefit Cost Analysis Summary Cumulative Present Values (2018-2072**)-Constant 2018 Dollars | | |
|---|---|---|
| | **Cumulative Present Values** (Discount Rate = 7%) | **Cumulative Present Values** (Discount Rate = 3%) |
| **A-LIFECYCLE COSTS** | | |
| Project Investment Costs \a | $79,500,000 | $91,267,000 |
| Operations & Maintenance | $11,520,000 | $25,244,000 |
| Total Costs | **$91,020,000** | **$116,511,000** |
| **B- BENEFITS** | | |
| **B1) Resiliency Values** | **$84,771,000** | **$203,541,000** |
| Flood Damage Reduction Benefits | | |
| East Riser Ditch | $72,752,000 | $176,460,000 |
| West Riser Ditch | $7,834,000 | $16,501,000 |
| Losen Slote | $4,185,000 | $10,580,000 |
| **B2) Environmental Values** | **$180,000** | **$424,000** |
| Air Quality | $139,000 | $333,000 |
| Pollination | $37,000 | $82,000 |
| Nutrient Pollution | $4,000 | $9,000 |
| **B3) Social Values** | **$8,990,000** | **$20,134,000** |
| Recreation | $7,179,000 | $16,059,000 |
| Avoided Stormwater Treatment Costs | $1,559,000 | $3,511,000 |
| Aesthetic Value | $206,000 | $460,000 |
| Water retention/flood hazard risk reduction | $46,000 | $104,000 |
| **B4) Economic Revitalization Benefits** | **$11,077,000** | **$15,895,000** |
| Property value premium | $10,677,000 | $13,419,000 |
| Energy conservation | $151,000 | $449,000 |
| Residual value of land | $249,000 | $2,027,000 |
| | | |
| **Total Benefits = B1+B2+B3+B4** | **$105,018,000** | **$239,994,000** |
| **Benefits less Costs (Net Present Value, = B-A )** | $13,998,000 | $123,483,000 |
| **Benefit Cost Ratio (BCR, = B/A)** | **1.15** | **2.06** |

Note: \a Because design, predevelopment, site development, and construction are scheduled to occur over the period spanning from 2018 to 2022, and capital construction expenditures are phased in over these years, the cumulative present value calculation of costs (as of 2018) will appear to be lower than the nominal project investment costs shown in the total project cost (See Table 6 above) due to the application of the 7% discount rate. The nominal value of total project costs is $101,680,000 (Table 6 above), while the discounted cost is $79,500,000 (shown above in the Project Investment Costs row for the discount rate of 7%).
Source: AECOM, <<Meadowlands BCA Model_revised 2-27-18_ AB_review update RE cost.xlsx>>

**Table 10** shows the cumulative present value of the monetized benefits and costs for the Proposed Project. The largest group of benefits consists of resilience values related to flood risk protection. In summary, the lifecycle costs required to build and operate the Project (amounting to $91 million, in cumulative present value, 2018 dollars) will generate the following benefits:

- Total Benefits of $105 million, of which:
    - Resiliency Values are: $84.8 million
    - Environmental Values are: $0.2 million
    - Social Values are: $9.0 million
    - Economic Revitalization: $11.0 million

The Proposed Project's cumulative present value of net benefits (benefits minus costs) is $14 million, and the benefit cost ratio is (BCR: Benefits divided by Costs) is 1.15. These net benefits demonstrate that the Project adds significant value to the community and Meadowlands region.

A sensitivity analysis was conducted on the Project discount rate. Lowering the base discount rate from 7% down to 3% shows that the net benefits and BCR are sensitive to the application of an alternative discount rate. As the Proposed Project is not meant to discourage private investment or consumption, but is intended to create a resilient environment and community that is conducive to attracting future investment, it is unlikely that private investment will be displaced by the Project. The Project is an "enabling" infrastructure investment, a term used to describe infrastructure that facilitates economic growth and productivity. Therefore, the lower discount rate of 3% is provided to show that the BCR is higher with this lower hurdle rate. At a discount rate of 3%, the cumulative present value of net benefits from the Build Alternative is $123.5 million and the BCR is 2.06.

**Figure 4: Breakdown of Proposed Project's Benefits (7% Discount Rate)**

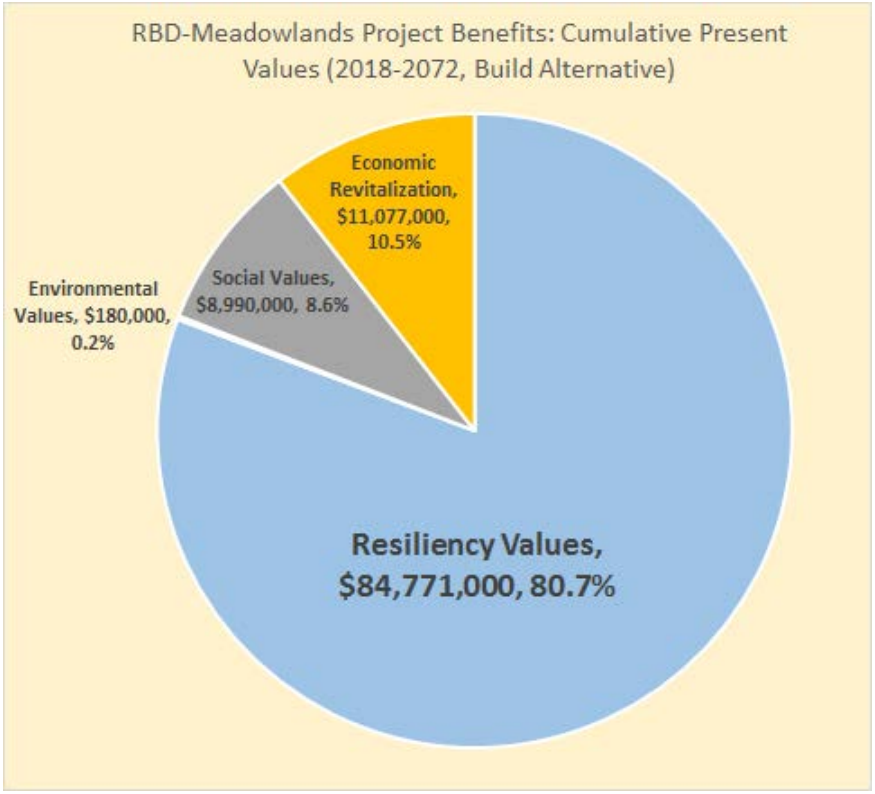
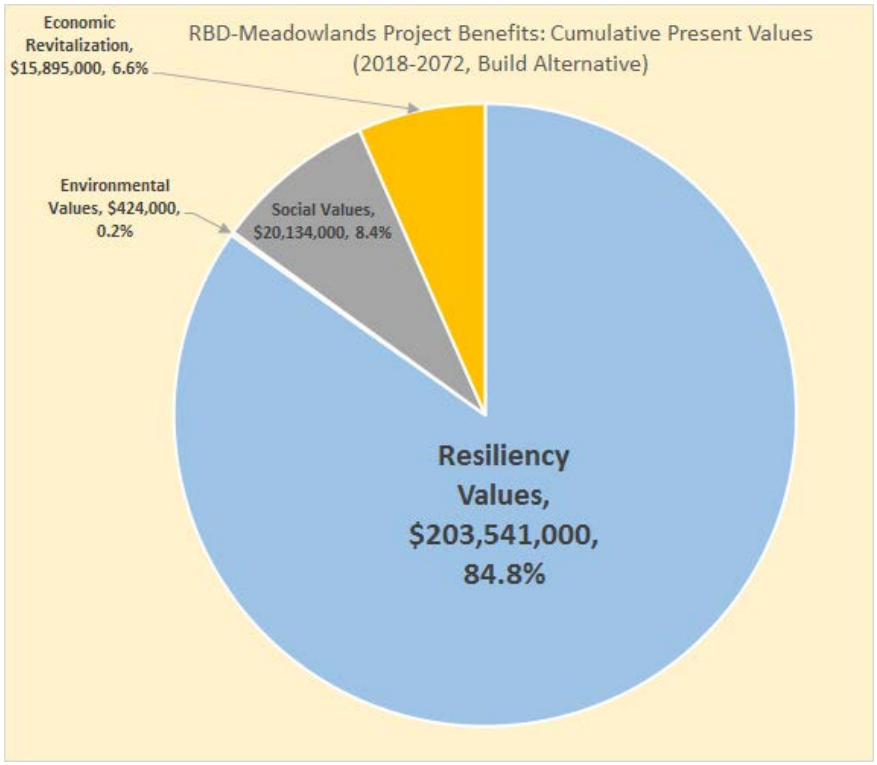



**Figure 5: Breakdown of Proposed Project's Benefits (3% Discount Rate)**



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https://www.whitehouse.gov/omb/circulars_a094

## XIII. Appendix – Benefit Cost Analysis Project Resource Statement – Proposed Project (7% Discount Rate)

| **Proposed Project, Build Plan –Benefit Cost Analysis Project Resource Statement (2018-2025)** constant 2018 US Dollars, Note: annual values are undiscounted. | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
| | | **2018** | **2019** | **2020** | **2021** | **2022** | **2023** | **2024** | **2025** |
| | | | **Construction Phase** | | | | **Operations➔** | | |
| Capital Cost Phase-in: Percent installed, % | | 2.4% | 6.3% | 35.6% | 33.2% | 22.4% | | | |
| **LIFECYCLE COSTS** | | ← | | **CAPEX Phasing** | | → | | | |
| Project Investment Costs | | $2,466,403 | $6,429,055 | $36,195,120 | $33,783,678 | $22,805,745 | | | |
| Operations & Maintenance | | $0 | $0 | $0 | $383,333 | $566,667 | $1,100,000 | $1,100,000 | $1,100,000 |
| Total O&M | | $0 | $0 | $0 | $383,333 | $566,667 | $1,100,000 | $1,100,000 | $1,100,000 |
| Total Costs | | $2,466,403 | $6,429,055 | $36,195,120 | $34,167,011 | $23,372,412 | $1,100,000 | $1,100,000 | $1,100,000 |
| **BENEFITS** | | | | | | | | | |
| **Resiliency Values** | | $0 | $0 | $0 | $1,993,725 | $6,129,851 | $6,278,527 | $6,417,237 | $6,555,948 |
| Flood Damage Reduction Benefits | | | | | | | | | |
| East Riser Ditch | | $0 | $0 | $0 | $1,740,887 | $5,222,662 | $5,222,662 | $5,354,965 | $5,487,267 |
| West Riser Ditch | | $0 | $0 | $0 | $252,838 | $758,514 | $758,514 | $755,569 | $752,624 |
| Losen Slote | | $0 | $0 | $0 | $0 | $148,675 | $297,351 | $306,704 | $316,057 |
| **Environmental Values** | | $0 | $0 | $0 | $0 | $3,986 | $15,975 | $16,132 | $16,289 |
| Air Quality | | $0 | $0 | $0 | $0 | $2,964 | $11,887 | $12,044 | $12,201 |
| Pollination | | $0 | $0 | $0 | $0 | $918 | $3,672 | $3,672 | $3,672 |
| Nutrient Pollution | | $0 | $0 | $0 | $0 | $104 | $415 | $415 | $415 |
| **Social Values** | | $0 | $0 | $0 | $0 | $223,802 | $895,208 | $895,383 | $895,558 |
| Recreation | | $0 | $0 | $0 | $0 | $179,150 | $716,602 | $716,602 | $716,602 |
| Avoided Stormwater Treatment | | $0 | $0 | $0 | $0 | $38,359 | $153,434 | $153,609 | $153,785 |
| Aesthetic Value | | $0 | $0 | $0 | $0 | $5,135 | $20,539 | $20,539 | $20,539 |
| Water retention/flood hazard risk reduction | | $0 | $0 | $0 | $0 | $1,158 | $4,633 | $4,633 | $4,633 |
| **Economic Revitalization Benefits** | | $0 | $0 | $0 | $0 | $1,312 | $16,028,137 | $6,046 | $6,842 |
| Property value premium | | $0 | $0 | $0 | $0 | $0 | $16,022,888 | $0 | $0 |
| Energy conservation | | $0 | $0 | $0 | $0 | $1,312 | $5,249 | $6,046 | $6,842 |
| Residual value of land | | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 |
| | | | | | | | | | |
| Total Benefits | | $0 | $0 | $0 | $1,993,725 | $6,358,951 | $23,217,846 | $7,334,798 | $7,474,638 |
| Benefits less Costs | | -$2,466,403 | -$6,429,055 | -$36,195,120 | -$32,173,286 | -$17,013,460 | $22,117,846 | $6,234,798 | $6,374,638 |
| Cumulative Net Present Value (Net Benefits @ 7%) | $13,997,625 | | | | | | | | |
| Cumulative Discounted Benefits: | $105,017,830 | | | | | | | | |
| Cumulative Discounted Costs: | $91,020,205 | | | | | | | | |
| **Benefit Cost Ratio (BCR)** | **1.15** | | | | | | | | |

| **Proposed Project, , Build Plan –Benefit Cost Analysis Project Resource Statement (2026-2034)** constant 2018 US Dollars | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 |
| | **2026** | **2027** | **2028** | **2029** | **2030** | **2031** | **2032** | **2033** | **2034** |
| **LIFECYCLE COSTS** | | | | | | | | | |
| Project Investment Costs | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 |
| Operations & Maintenance | $1,100,000 | $1,100,000 | $1,100,000 | $1,100,000 | $1,100,000 | $1,100,000 | $1,100,000 | $1,100,000 | $1,100,000 |
| Total O&M | $1,100,000 | $1,100,000 | $1,100,000 | $1,100,000 | $1,100,000 | $1,100,000 | $1,100,000 | $1,100,000 | $1,100,000 |
| Total Costs | $1,100,000 | $1,100,000 | $1,100,000 | $1,100,000 | $1,100,000 | $1,100,000 | $1,100,000 | $1,100,000 | $1,100,000 |
| **BENEFITS** | | | | | | | | | |
| **Resiliency Values** | $6,694,659 | $6,833,370 | $6,972,081 | $7,110,792 | $7,249,502 | $7,388,213 | $7,526,924 | $7,665,635 | $7,804,346 |
| Flood Damage Reduction Benefits | | | | | | | | | |
| East Riser Ditch | $5,619,570 | $5,751,872 | $5,884,175 | $6,016,478 | $6,148,780 | $6,281,083 | $6,413,386 | $6,545,688 | $6,677,991 |
| West Riser Ditch | $749,679 | $746,734 | $743,788 | $740,843 | $737,898 | $734,953 | $732,008 | $729,063 | $726,118 |
| Losen Slote | $325,410 | $334,764 | $344,117 | $353,470 | $362,824 | $372,177 | $381,530 | $390,884 | $400,237 |
| **Environmental Values** | $16,446 | $16,603 | $16,760 | $16,902 | $17,059 | $17,232 | $17,389 | $17,546 | $17,703 |
| Air Quality | $12,358 | $12,515 | $12,673 | $12,814 | $12,971 | $13,144 | $13,301 | $13,458 | $13,615 |
| Pollination | $3,672 | $3,672 | $3,672 | $3,672 | $3,672 | $3,672 | $3,672 | $3,672 | $3,672 |
| Nutrient Pollution | $415 | $415 | $415 | $415 | $415 | $415 | $415 | $415 | $415 |
| **Social Values** | $895,734 | $895,909 | $896,084 | $896,259 | $896,434 | $896,610 | $896,785 | $896,960 | $897,135 |
| Recreation | $716,602 | $716,602 | $716,602 | $716,602 | $716,602 | $716,602 | $716,602 | $716,602 | $716,602 |
| Avoided Stormwater Treatment | $153,960 | $154,135 | $154,310 | $154,485 | $154,661 | $154,836 | $155,011 | $155,186 | $155,361 |
| Aesthetic Value | $20,539 | $20,539 | $20,539 | $20,539 | $20,539 | $20,539 | $20,539 | $20,539 | $20,539 |
| Water retention/flood hazard risk reduction | $4,633 | $4,633 | $4,633 | $4,633 | $4,633 | $4,633 | $4,633 | $4,633 | $4,633 |
| **Economic Revitalization Benefits** | $7,639 | $8,436 | $9,233 | $10,030 | $10,827 | $11,623 | $12,420 | $13,217 | $14,014 |
| Property value premium | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 |
| Energy conservation | $7,639 | $8,436 | $9,233 | $10,030 | $10,827 | $11,623 | $12,420 | $13,217 | $14,014 |
| Residual value of land | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 |
| | | | | | | | | | |
| Total Benefits | $7,614,478 | $7,754,318 | $7,894,158 | $8,033,982 | $8,173,822 | $8,313,678 | $8,453,518 | $8,593,358 | $8,733,198 |
| Benefits less Costs | $6,514,478 | $6,654,318 | $6,794,158 | $6,933,982 | $7,073,822 | $7,213,678 | $7,353,518 | $7,493,358 | $7,633,198 |
| | | | | | | | | | |

| **Proposed Project, Build Plan –Benefit Cost Analysis Project Resource Statement (2035-2043)** constant 2018 US Dollars | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 |
| | **2035** | **2036** | **2037** | **2038** | **2039** | **2040** | **2041** | **2042** | **2043** |
| **LIFECYCLE COSTS** | | | | | | | | | |
| Project Investment Costs | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 |
| Operations & Maintenance | $1,100,000 | $1,100,000 | $1,100,000 | $1,100,000 | $1,100,000 | $1,100,000 | $1,100,000 | $1,100,000 | $1,100,000 |
| Total O&M | $1,100,000 | $1,100,000 | $1,100,000 | $1,100,000 | $1,100,000 | $1,100,000 | $1,100,000 | $1,100,000 | $1,100,000 |
| Total Costs | $1,100,000 | $1,100,000 | $1,100,000 | $1,100,000 | $1,100,000 | $1,100,000 | $1,100,000 | $1,100,000 | $1,100,000 |
| **BENEFITS** | | | | | | | | | |
| **Resiliency Values** | $7,943,056 | $8,081,767 | $8,220,478 | $8,359,189 | $8,497,900 | $8,636,611 | $8,775,321 | $8,914,032 | $9,052,743 |
| Flood Damage Reduction Benefits | | | | | | | | | |
| East Riser Ditch | $6,810,294 | $6,942,596 | $7,074,899 | $7,207,202 | $7,339,504 | $7,471,807 | $7,604,110 | $7,736,412 | $7,868,715 |
| West Riser Ditch | $723,173 | $720,227 | $717,282 | $714,337 | $711,392 | $708,447 | $705,502 | $702,557 | $699,611 |
| Losen Slote | $409,590 | $418,944 | $428,297 | $437,650 | $447,003 | $456,357 | $465,710 | $475,063 | $484,417 |
| **Environmental Values** | $17,860 | $18,017 | $18,174 | $18,331 | $18,504 | $18,661 | $18,818 | $18,960 | $19,117 |
| Air Quality | $13,772 | $13,929 | $14,087 | $14,244 | $14,416 | $14,573 | $14,730 | $14,872 | $15,029 |
| Pollination | $3,672 | $3,672 | $3,672 | $3,672 | $3,672 | $3,672 | $3,672 | $3,672 | $3,672 |
| Nutrient Pollution | $415 | $415 | $415 | $415 | $415 | $415 | $415 | $415 | $415 |
| **Social Values** | $897,311 | $897,486 | $897,661 | $897,836 | $898,011 | $898,187 | $898,362 | $898,537 | $898,712 |
| Recreation | $716,602 | $716,602 | $716,602 | $716,602 | $716,602 | $716,602 | $716,602 | $716,602 | $716,602 |
| Avoided Stormwater Treatment | $155,537 | $155,712 | $155,887 | $156,062 | $156,238 | $156,413 | $156,588 | $156,763 | $156,938 |
| Aesthetic Value | $20,539 | $20,539 | $20,539 | $20,539 | $20,539 | $20,539 | $20,539 | $20,539 | $20,539 |
| Water retention/flood hazard risk reduction | $4,633 | $4,633 | $4,633 | $4,633 | $4,633 | $4,633 | $4,633 | $4,633 | $4,633 |
| **Economic Revitalization Benefits** | $14,811 | $15,608 | $16,404 | $17,201 | $17,998 | $18,795 | $19,592 | $20,389 | $21,185 |
| Property value premium | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 |
| Energy conservation | $14,811 | $15,608 | $16,404 | $17,201 | $17,998 | $18,795 | $19,592 | $20,389 | $21,185 |
| Residual value of land | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 |
| | | | | | | | | | |
| Total Benefits | $8,873,038 | $9,012,878 | $9,152,718 | $9,292,558 | $9,432,413 | $9,572,253 | $9,712,093 | $9,851,918 | $9,991,757 |
| Benefits less Costs | $7,773,038 | $7,912,878 | $8,052,718 | $8,192,558 | $8,332,413 | $8,472,253 | $8,612,093 | $8,751,918 | $8,891,757 |
| | | | | | | | | | |

| **Proposed Project, Build Plan –Benefit Cost Analysis Project Resource Statement (2044-2052)** constant 2018 US Dollars | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | 27 | 28 | 29 | 30 | 31 | 32 | 33 | 34 | 35 |
| | **2044** | **2045** | **2046** | **2047** | **2048** | **2049** | **2050** | **2051** | **2052** |
| **LIFECYCLE COSTS** | | | | | | | | | |
| Project Investment Costs | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 |
| Operations & Maintenance | $1,100,000 | $1,100,000 | $1,100,000 | $1,100,000 | $1,100,000 | $1,100,000 | $1,100,000 | $1,100,000 | $1,100,000 |
| Total O&M | $1,100,000 | $1,100,000 | $1,100,000 | $1,100,000 | $1,100,000 | $1,100,000 | $1,100,000 | $1,100,000 | $1,100,000 |
| Total Costs | $1,100,000 | $1,100,000 | $1,100,000 | $1,100,000 | $1,100,000 | $1,100,000 | $1,100,000 | $1,100,000 | $1,100,000 |
| **BENEFITS** | | | | | | | | | |
| **Resiliency Values** | $9,191,454 | $9,330,165 | $9,468,876 | $9,607,586 | $9,746,297 | $9,885,008 | $10,023,719 | $10,162,430 | $10,301,140 |
| Flood Damage Reduction Benefits | | | | | | | | | |
| East Riser Ditch | $8,001,017 | $8,133,320 | $8,265,623 | $8,397,925 | $8,530,228 | $8,662,531 | $8,794,833 | $8,927,136 | $9,059,439 |
| West Riser Ditch | $696,666 | $693,721 | $690,776 | $687,831 | $684,886 | $681,941 | $678,996 | $676,050 | $673,105 |
| Losen Slote | $493,770 | $503,123 | $512,477 | $521,830 | $531,183 | $540,537 | $549,890 | $559,243 | $568,597 |
| **Environmental Values** | $19,274 | $19,431 | $19,588 | $19,745 | $19,953 | $20,145 | $20,336 | $20,513 | $20,690 |
| Air Quality | $15,186 | $15,343 | $15,500 | $15,658 | $15,865 | $16,057 | $16,249 | $16,425 | $16,602 |
| Pollination | $3,672 | $3,672 | $3,672 | $3,672 | $3,672 | $3,672 | $3,672 | $3,672 | $3,672 |
| Nutrient Pollution | $415 | $415 | $415 | $415 | $415 | $415 | $415 | $415 | $415 |
| **Social Values** | $898,887 | $899,063 | $899,238 | $899,413 | $899,596 | $899,779 | $899,961 | $900,144 | $900,327 |
| Recreation | $716,602 | $716,602 | $716,602 | $716,602 | $716,602 | $716,602 | $716,602 | $716,602 | $716,602 |
| Avoided Stormwater Treatment | $157,114 | $157,289 | $157,464 | $157,639 | $157,822 | $158,005 | $158,187 | $158,370 | $158,553 |
| Aesthetic Value | $20,539 | $20,539 | $20,539 | $20,539 | $20,539 | $20,539 | $20,539 | $20,539 | $20,539 |
| Water retention/flood hazard risk reduction | $4,633 | $4,633 | $4,633 | $4,633 | $4,633 | $4,633 | $4,633 | $4,633 | $4,633 |
| **Economic Revitalization Benefits** | $21,982 | $22,779 | $23,576 | $24,373 | $25,211 | $26,050 | $26,888 | $27,727 | $28,565 |
| Property value premium | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 |
| Energy conservation | $21,982 | $22,779 | $23,576 | $24,373 | $25,211 | $26,050 | $26,888 | $27,727 | $28,565 |
| Residual value of land | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 |
| | | | | | | | | | |
| Total Benefits | $10,131,597 | $10,271,437 | $10,411,277 | $10,551,117 | $10,691,057 | $10,830,981 | $10,970,905 | $11,110,814 | $11,250,722 |
| Benefits less Costs | $9,031,597 | $9,171,437 | $9,311,277 | $9,451,117 | $9,591,057 | $9,730,981 | $9,870,905 | $10,010,814 | $10,150,722 |
| | | | | | | | | | |

| **Proposed Project, Build Plan –Benefit Cost Analysis Project Resource Statement (2053-2061)** constant 2018 US Dollars | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | 36 | 37 | 38 | 39 | 40 | 41 | 42 | 43 | 44 |
| | **2053** | **2054** | **2055** | **2056** | **2057** | **2058** | **2059** | **2060** | **2061** |
| **LIFECYCLE COSTS** | | | | | | | | | |
| Project Investment Costs | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 |
| Operations & Maintenance | $1,100,000 | $1,100,000 | $1,100,000 | $1,100,000 | $1,100,000 | $1,100,000 | $1,100,000 | $1,100,000 | $1,100,000 |
| Total O&M | $1,100,000 | $1,100,000 | $1,100,000 | $1,100,000 | $1,100,000 | $1,100,000 | $1,100,000 | $1,100,000 | $1,100,000 |
| Total Costs | $1,100,000 | $1,100,000 | $1,100,000 | $1,100,000 | $1,100,000 | $1,100,000 | $1,100,000 | $1,100,000 | $1,100,000 |
| **BENEFITS** | | | | | | | | | |
| **Resiliency Values** | $10,439,851 | $10,578,562 | $10,717,273 | $10,855,984 | $10,994,695 | $11,133,405 | $11,272,116 | $11,410,827 | $11,549,538 |
| Flood Damage Reduction Benefits | | | | | | | | | |
| East Riser Ditch | $9,191,741 | $9,324,044 | $9,456,347 | $9,588,649 | $9,720,952 | $9,853,255 | $9,985,557 | $10,117,860 | $10,250,162 |
| West Riser Ditch | $670,160 | $667,215 | $664,270 | $661,325 | $658,380 | $655,434 | $652,489 | $649,544 | $646,599 |
| Losen Slote | $577,950 | $587,303 | $596,656 | $606,010 | $615,363 | $624,716 | $634,070 | $643,423 | $652,776 |
| **Environmental Values** | $20,866 | $21,043 | $21,219 | $21,396 | $21,572 | $21,749 | $21,925 | $22,102 | $22,279 |
| Air Quality | $16,778 | $16,955 | $17,132 | $17,308 | $17,485 | $17,661 | $17,838 | $18,014 | $18,191 |
| Pollination | $3,672 | $3,672 | $3,672 | $3,672 | $3,672 | $3,672 | $3,672 | $3,672 | $3,672 |
| Nutrient Pollution | $415 | $415 | $415 | $415 | $415 | $415 | $415 | $415 | $415 |
| **Social Values** | $900,510 | $900,692 | $900,875 | $901,058 | $901,240 | $901,423 | $901,606 | $901,789 | $901,971 |
| Recreation | $716,602 | $716,602 | $716,602 | $716,602 | $716,602 | $716,602 | $716,602 | $716,602 | $716,602 |
| Avoided Stormwater Treatment | $158,736 | $158,918 | $159,101 | $159,284 | $159,467 | $159,649 | $159,832 | $160,015 | $160,198 |
| Aesthetic Value | $20,539 | $20,539 | $20,539 | $20,539 | $20,539 | $20,539 | $20,539 | $20,539 | $20,539 |
| Water retention/flood hazard risk reduction | $4,633 | $4,633 | $4,633 | $4,633 | $4,633 | $4,633 | $4,633 | $4,633 | $4,633 |
| **Economic Revitalization Benefits** | $29,404 | $30,243 | $31,081 | $31,920 | $32,758 | $33,597 | $34,435 | $35,274 | $36,112 |
| Property value premium | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 |
| Energy conservation | $29,404 | $30,243 | $31,081 | $31,920 | $32,758 | $33,597 | $34,435 | $35,274 | $36,112 |
| Residual value of land | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 |
| | | | | | | | | | |
| Total Benefits | $11,390,631 | $11,530,540 | $11,670,448 | $11,810,357 | $11,950,266 | $12,090,174 | $12,230,083 | $12,369,992 | $12,509,900 |
| Benefits less Costs | $10,290,631 | $10,430,540 | $10,570,448 | $10,710,357 | $10,850,266 | $10,990,174 | $11,130,083 | $11,269,992 | $11,409,900 |
| | | | | | | | | | |

| **Proposed Project, Build Plan –Benefit Cost Analysis Project Resource Statement (2062-2070)** constant 2018 US Dollars | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | 45 | 46 | 47 | 48 | 49 | 50 | 51 | 52 | 53 |
| | **2062** | **2063** | **2064** | **2065** | **2066** | **2067** | **2068** | **2069** | **2070** |
| **LIFECYCLE COSTS** | | | | | | | | | |
| Project Investment Costs | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 |
| Operations & Maintenance | $1,100,000 | $1,100,000 | $1,100,000 | $1,100,000 | $1,100,000 | $1,100,000 | $1,100,000 | $1,100,000 | $1,100,000 |
| Total O&M | $1,100,000 | $1,100,000 | $1,100,000 | $1,100,000 | $1,100,000 | $1,100,000 | $1,100,000 | $1,100,000 | $1,100,000 |
| Total Costs | $1,100,000 | $1,100,000 | $1,100,000 | $1,100,000 | $1,100,000 | $1,100,000 | $1,100,000 | $1,100,000 | $1,100,000 |
| **BENEFITS** | | | | | | | | | |
| **Resiliency Values** | $11,688,249 | $11,826,960 | $11,965,670 | $12,104,381 | $12,243,092 | $12,381,803 | $12,520,514 | $12,659,224 | $12,797,935 |
| Flood Damage Reduction Benefits | | | | | | | | | |
| East Riser Ditch | $10,382,465 | $10,514,768 | $10,647,070 | $10,779,373 | $10,911,676 | $11,043,978 | $11,176,281 | $11,308,584 | $11,440,886 |
| West Riser Ditch | $643,654 | $640,709 | $637,764 | $634,819 | $631,873 | $628,928 | $625,983 | $623,038 | $620,093 |
| Losen Slote | $662,130 | $671,483 | $680,836 | $690,190 | $699,543 | $708,896 | $718,250 | $727,603 | $736,956 |
| **Environmental Values** | $22,455 | $22,632 | $22,808 | $22,985 | $23,161 | $23,338 | $23,514 | $23,691 | $23,868 |
| Air Quality | $18,367 | $18,544 | $18,721 | $18,897 | $19,074 | $19,250 | $19,427 | $19,603 | $19,780 |
| Pollination | $3,672 | $3,672 | $3,672 | $3,672 | $3,672 | $3,672 | $3,672 | $3,672 | $3,672 |
| Nutrient Pollution | $415 | $415 | $415 | $415 | $415 | $415 | $415 | $415 | $415 |
| **Social Values** | $902,154 | $902,337 | $902,520 | $902,702 | $902,885 | $903,068 | $903,251 | $903,433 | $903,616 |
| Recreation | $716,602 | $716,602 | $716,602 | $716,602 | $716,602 | $716,602 | $716,602 | $716,602 | $716,602 |
| Avoided Stormwater Treatment | $160,380 | $160,563 | $160,746 | $160,929 | $161,111 | $161,294 | $161,477 | $161,659 | $161,842 |
| Aesthetic Value | $20,539 | $20,539 | $20,539 | $20,539 | $20,539 | $20,539 | $20,539 | $20,539 | $20,539 |
| Water retention/flood hazard risk reduction | $4,633 | $4,633 | $4,633 | $4,633 | $4,633 | $4,633 | $4,633 | $4,633 | $4,633 |
| **Economic Revitalization Benefits** | $36,951 | $37,789 | $38,628 | $39,467 | $40,305 | $41,144 | $41,982 | $42,821 | $43,659 |
| Property value premium | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 |
| Energy conservation | $36,951 | $37,789 | $38,628 | $39,467 | $40,305 | $41,144 | $41,982 | $42,821 | $43,659 |
| Residual value of land | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 |
| | | | | | | | | | |
| Total Benefits | $12,649,809 | $12,789,718 | $12,929,626 | $13,069,535 | $13,209,444 | $13,349,352 | $13,489,261 | $13,629,170 | $13,769,078 |
| Benefits less Costs | $11,549,809 | $11,689,718 | $11,829,626 | $11,969,535 | $12,109,444 | $12,249,352 | $12,389,261 | $12,529,170 | $12,669,078 |
| | | | | | | | | | |

| **Proposed Project, Build Plan –Benefit Cost Analysis Project Resource Statement (2071-2072)** constant 2018 US Dollars | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | 54 | 55 | | | | | | | |
| | **2071** | **2072** | | | | | | | |
| **LIFECYCLE COSTS** | | | | | | | | | |
| Project Investment Costs | $0 | $0 | | | | | | | |
| Operations & Maintenance | $1,100,000 | $1,100,000 | | | | | | | |
| Total O&M | $1,100,000 | $1,100,000 | | | | | | | |
| Total Costs | $1,100,000 | $1,100,000 | | | | | | | |
| **BENEFITS** | | | | | | | | | |
| **Resiliency Values** | $12,936,646 | $13,075,357 | | | | | | | |
| Flood Damage Reduction Benefits | | | | | | | | | |
| East Riser Ditch | $11,573,189 | $11,705,492 | | | | | | | |
| West Riser Ditch | $617,148 | $614,203 | | | | | | | |
| Losen Slote | $746,309 | $755,663 | | | | | | | |
| **Environmental Values** | $24,044 | $24,221 | | | | | | | |
| Air Quality | $19,956 | $20,133 | | | | | | | |
| Pollination | $3,672 | $3,672 | | | | | | | |
| Nutrient Pollution | $415 | $415 | | | | | | | |
| **Social Values** | $903,799 | $903,982 | | | | | | | |
| Recreation | $716,602 | $716,602 | | | | | | | |
| Avoided Stormwater Treatment | $162,025 | $162,208 | | | | | | | |
| Aesthetic Value | $20,539 | $20,539 | | | | | | | |
| Water retention/flood hazard risk reduction | $4,633 | $4,633 | | | | | | | |
| **Economic Revitalization Benefits** | $44,498 | $10,345,336 | | | | | | | |
| Property value premium | $0 | $0 | | | | | | | |
| Energy conservation | $44,498 | $45,336 | | | | | | | |
| Residual value of land | $0 | $10,300,000 | | | | | | | |
| | | | | | | | | | |
| Total Benefits | $13,908,987 | $24,348,896 | | | | | | | |
| Benefits less Costs | $12,808,987 | $23,248,896 | | | | | | | |
| | | | | | | | | | |