5.0
THE **ROADMAP**

INTRODUCTION

The roadmap articulates what could happen when, what it might cost based on current understanding, how it could potentially be funded, what is needed to support implementation, and who will need to take the lead. The roadmap is divided into two sections:

- **Roadmap for capital projects** (physical and nature-based solutions): The roadmap organizes capital projects ***geographically by city***, even though different entities might need to lead different projects.
- **Roadmap for non-capital actions** (policy and governance; outreach, education, and capacity building; service and program development; and emergency response and preparedness)

Over the next 15 to 20 years, implementation of this roadmap could dramatically increase livability in the face of climate change.

WHAT IS A CAPITAL PROJECT?

A capital project involves construction, usually major construction, to provide, expand, or improve an asset. Capital projects usually include planning, design, permitting, construction, and must typically be operated and / or maintained over their useful life. The useful life is how long an asset can be enjoyed before it likely requires major renovation (usually in the form of a new capital project).

A living plan

Resilient NENJ's Action Plan should be considered a living document. Resilient NENJ reflects a regional planning effort; as such, the timing, design, and approach to many solutions will be affected by findings of feasibility assessments, the implementation of other capital improvements, political will and public support, and funding availability. Further, Resilient NENJ exists in a dramatically changing risk context that scientists, planners, engineers, and others are all actively working to understand and anticipate. As new data and science emerge, and the people, places, and needs of the region evolve, new and different actions may be needed. The roadmap outlines recommended conceptual implementation schedules for the next 15 years, with 2022 as the base year. Future updates will be needed to chart next steps beyond this timeframe.

Monitoring plan implementation and success

It will be critical for Resilient NENJ and its partners to monitor changing data, conditions, community needs, as well as the implementation and lessons learned from recommended actions, and calibrate approach as needed over time. The Resilient NENJ Steering Committee should convene annually, at a minimum, to discuss goals, progress, resource needs, community feedback, and any necessary adjustments. The plan should be re-evaluated for progress, success, and the roadmap updated every five years or at another regular interval to ensure that the initiative remains current and responsive to the needs of its partner communities, organizations, agencies, and the people who live, work, and play in the region. These re-evaluations will likely result in new and updated initiatives and associated adjustment to the roadmap, as needed.

NEWARK RIVERFRONT PARK

This new and improved park amenity along the Passaic provides both recreation & green space, as well as some protection from coastal inundation.

Image Source: *Waterfront Alliance*

5.1
ROADMAP FOR CAPITAL PROJECTS - PHYSICAL AND NATURE BASED SOLUTIONS

Some of Resilient NENJ's recommendations are for capital projects. Most of these revolve around flood risk due to the urgency of that hazard, though the projects also provide other community benefits. This section provides the roadmap for capital projects, which are those projects that will result in physical changes to the environment through direct (typically major) construction activities. This section includes, but does not typically identify, specific smaller scale stormwater and green infrastructure projects that should occur on a rolling basis and wherever feasible.

Regionwide, Resilient NENJ recommends about $12.7 billion in capital investment to address the current understanding of near- and long-term flood risk. Together, these investments could address $31 billion in losses predicted by the future Hurricane Sandy model, over $1 billion in losses from stormwater flood events that can happen as frequently as every five years, and help address a significant portion of the over $5 billion in predicted losses modeled for areal flooding. These investments will also help address urban heat, air quality, pedestrian mobility, and improve public health.

CAPITAL PROJECTS will directly reduce risk through changes to the built and natural environment, but they will not eliminate it. This roadmap for capital projects must be partnered with the roadmap for other actions (like engagement and policy change) to keep chipping away at risk and make it manageable. The roadmap for capital projects is distinct from other actions because of their scale, complexity, and the common processes required for implementation.

Green street planters, an example of green-infrastructure techniques.
***Image Source:** EPA*

Levels of protection and levels of service

The magnitude of flooding a coastal solution can manage is its level of protection.

Resilient NENJ's Action Plan looks at coastal strategies that can address flooding from Hurricane Sandy high water marks plus 2.4 feet, or the flood elevation associated with the 0.2-percent annual chance coastal flood plus 2.4 feet for sea level rise, whichever is higher. In areas where the Action Plan recommends bulkhead raising as a first line of defense, the recommended level of protection is more common events, such as high tides, to be defined through feasibility and design. First line of defense solutions could also act to reduce wave heights during a storm surge depending on the elevation that is achieved. As of August 2022, the preliminary preferred solution for the **HAT**[1] study could include a flood gate at the Kill Van Kull (see **Section 3.2.1**). Should that plan proceed, the necessary height and designs to reduce coastal flooding could be reduced in Newark and the west side of Bayonne and Jersey City, and allow for more flexibility in resilience features and project design (see **Section 3.2.1** for more on this topic).

The magnitude of rainfall a stormwater solution can manage is its level of service.

Addressing flooding from rainfall (where water falls from the sky) requires different approaches from addressing flooding from the sea or rivers (where water approaches over land). Coastal flood solutions are limited technically by how high they can go or how much water and force they can endure. Rainfall flooding solutions are often about managing water as it falls and are limited by how much water a system can reasonably manage at any given time. Most drainage systems designed decades ago cannot manage major storms because so much water falls in a short period of time that it overwhelms the capacity of the system.

A 5-year (20-percent annual chance), 1-hour peak rainfall intensity is an industry standard level of service goal for stormwater drainage systems today and is the basis for Resilient NENJ recommendations. Many systems in place today were designed for a smaller level of service. With improvements, the system will continue to provide benefits and reduce flooding even above its target level of service, but it will not be able to manage all water at all times.

Coastal levels of protection, stormwater levels of service, and the equivalent for other hazards are not comparable

There is admittedly a significant difference between a 500-year (0.2-percent annual chance) level of protection for coastal flooding and a 5-year (20-percent annual chance) level of service for stormwater flooding, but the two cannot be compared. Even though both sources cause overland flooding, they must be managed very differently and have different technical limitations.

Resilient NENJ has not defined equivalent levels of protection or service for other climate hazards at this time.

Coastal systems will also require stormwater solutions to avoid flooding inside a coastal barrier from rainfall during a surge event

Any coastal solutions will need to be partnered with stormwater solutions designed to meet the target level of service. Resilient NENJ recommends this also be coupled with system wide analysis for larger rainfall events to ensure there is no stormwater flooding during a coastal storm event. As coastal solutions advance, engineers should analyze the 100-year 24-hour rainfall event for the area to verify that the coastal flood protection system will not increase stormwater flooding. Taking this coupled approach will provide benefits to increase system capacity during non-coastal flooding scenarios and provide increased inland storage during coastal flooding where stormwater outfalls are blocked by high water levels.

[1] *See* https://www.nan.usace.army.mil/Missions/Civil-Works/Projects-in-New-York/New-York-New-Jersey-Harbor-Tributaries-Focus-Area-Feasibility-Study/

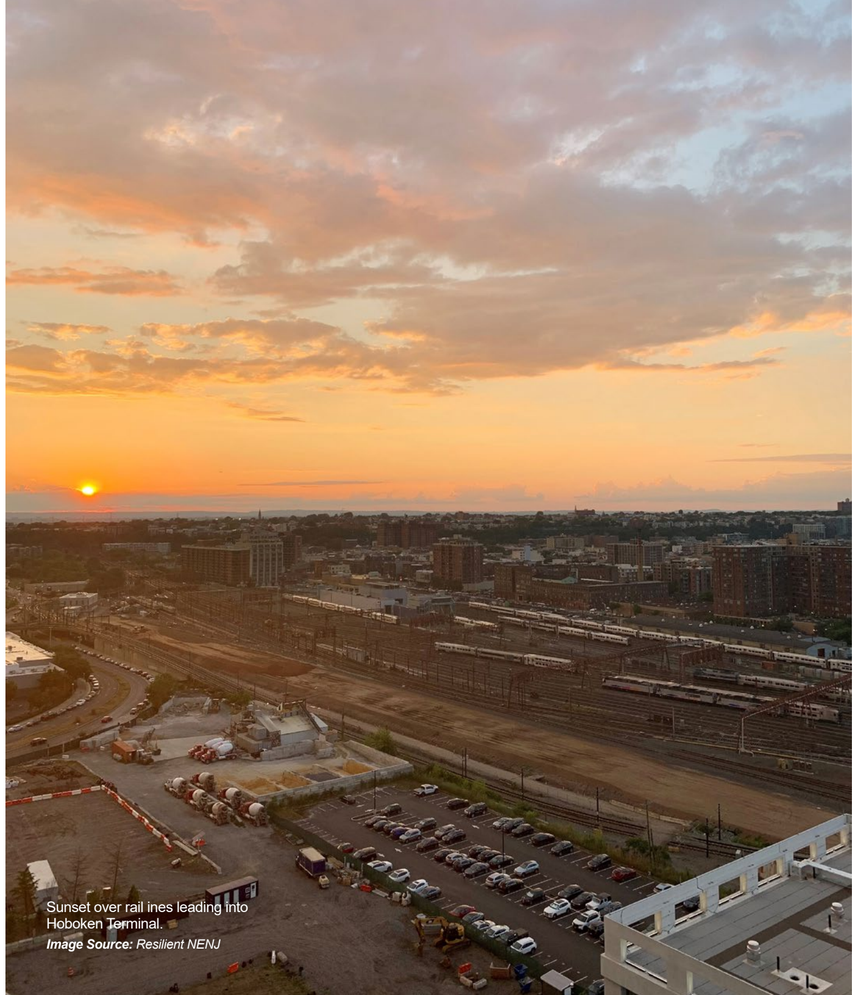
YEAR OVER YEAR EXPECTATIONS

Resilient NENJ provides initial conceptual implementation schedules in this section to help the region and its stakeholders plan for staffing and resource needs, and to articulate funding needs over time. This roadmap provides implementation schedules by geography (municpality / project area), and articulates expected planning and design, capital, and operations and maintenance funding needs year over year. Capital funding needs begin around $140 million regionwide and climb gradually until around year 10, where the capital projects portion of the plan reaches a peak proposed annual expenditure of about $1.4 billion and then declines after year 12.[2]

This investment is significant and necessary. As described in the **Flood Impact Assessment**, models predict flooding from major rainfall and storm surge will mostly get deeper, as opposed to affecting more areas. That means that the risk the region faces is here, now. In a perfect world, all capital projects Resilient NENJ recommends would be completed soon. The region is doing a lot of work to reduce risk already, as evidenced by Scenario 0 (see **Appendix A**), but it cannot keep up. The magnitude of current risk in the region outstrips its current allocations of funding and capacity to address. This Action Plan will empower residents, community-based organizations, city and state agencies, infrastructure providers, elected officials, federal agencies, businesses, and other stakeholders with the knowledge of what it will take to get this critical work done so that they can help plan and advocate appropriately.

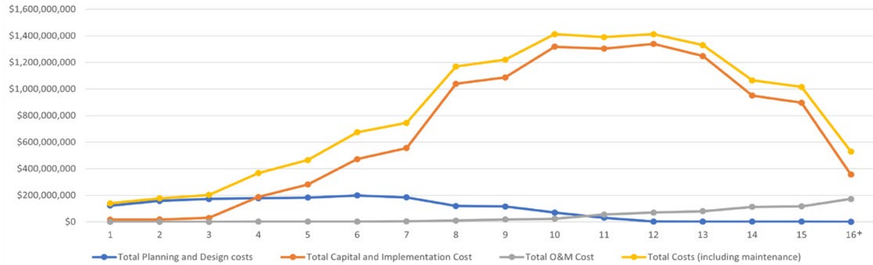
Resilient NENJ developed the proposed implementation schedules based on the following factors and considerations:

- Expected level of effort and required timing to plan, allocate funding, design, and construct improvements
- The schedule demonstrates an escalation of intensity of investment and activity over time to address rising risk while acknowledging that it will take time to build capacity to implement large scale capital improvements
- The need to start with smaller wins with visible improvements to build momentum and catalyze further momentum
- Where possible given the above factors, the schedule prioritizes projects based on risk – including flood depth, social vulnerability, exposed population, and expected losses



Sunset over rail ines leading into Hoboken Terminal.
Image Source: *Resilient NENJ*

REGIONAL ESTIMATED COST NEEDS (YEAR OVER YEAR)



[2] *Costs include costs to implement the Parallel Interceptor to the Passaic Valley Sewerage Commission Treatment Plant project that is included in the Long-term Control Plan, due to the expected flood risk reduction benefits of the project.*

FUNDING PATHWAYS

Section 4.0 provides examples of funding opportunities for the four categories of actions, and **Appendix C** provides additional detail on these funding options. **Appendix A** provides examples of specific funding sources for each action.

Example ways that different entities can contribute to funding Resilient NENJ recommended capital improvements

Federal/State/Municipal
- Grants
- Funding allocations
- Capital improvements

Infrastructure entity
- Capital improvement projects/ budget contributions
- Utility / service fee

Private property owner / Business
- Special assessments[3] with subsidies
- Public private partnerships
- Fees with a sinking fund
- Utility / service fee

Visitor
- Surcharge or fee (e.g., parking, transportation, visitor surcharge at hotels / establishments)

CONSTRUCTION IS ALWAYS DISRUPTIVE

A lot of construction activity will be needed to address risk needs now and over the coming years. This roadmap is a general guide and should be altered in collaboration with the Action Plan's proposed Infrastructure Coordination Council to coordinate construction activities and ensure that neighborhoods benefit from a "dig once" approach. Further, engagement should continue during project implementation to ensure that community members understand what is happening, when, and how they will be affected. Community members should be part of design and construction planning to maximize benefit to the community and to limit disruptions.

[3] *Special assessments levy a portion of property value needed to make public improvements.*

Where are we at in planning? How confident are we in approach, costing, and scheduling?

All recommendations are at the roadmap stage and will need to progress to feasibility and design, so the costs and concepts will certainly change during that process. The feasibility and design process will define specific sizing and locations of solutions. For example, coastal flood solutions will require special considerations for access, space, and aesthetic needs unique to any given area. Additionally, many factors will affect the actual timing of capital project implementation. Aligning and working with existing capital improvement planning cycles, which are dynamic by nature, will be an important part of the implementation process.

Nevertheless, cost estimates at the roadmap stage are important for two reasons: 1) to make sure that projects will add more value than they cost (which these recommendations do), and 2) to be able to properly plan, allocate, and advocate for the resources needed to drive change. Resilient NENJ developed cost estimates using typical costs for similar projects in the region. See **Appendix B** for more on cost development and benefits calculation.

All costs are order of magnitude for planning purposes only, with some costs for certain capital projects being at the concept level. Key assumptions by action type include the following (see **Appendix B**):

- For capital projects that address coastal flooding:
  - Initial costs based on GIS overlay of linear length or area of proposed improvements by type
  - Unit costs based on recently constructed projects & engineering guidance available from USACE
  - Costs adjusted for the region with allowance and contingency assumptions.
- For capital projects that address stormwater flooding:
  - Engineers calculated the amount of capacity that would need to be managed by city, and based on the types of recommendations and capacity share, developed costs based on recently constructed projects of similar nature in the region
- Citywide program estimates (those related to green and stormwater infrastructure and contaminated site transformation, in particular) should be considered "planning allocations." Actual costs will vary based on the number and frequency of sites chosen for implementation. There are citywide program estimates for both capital projects by geography and for program implementation at the state level. These costs are not duplicates.
- The roadmap does not include costs for projects already underway or entirely within the purview of a single agency (such as Port Authority of New York and New Jersey's facility flood protection strategy or the Rebuild by Design project in Hoboken). Costs are included for proposed projects (that are earlier stages of implementation) that align with this Action Plan, such as the Newark Flanking Plan. In this case, costs from plans associated with those projects informed estimates.

REGIONAL PHASING

This section lays out the expected lead for various activities across implementation phases covering the first 15 years. Each phase covers increments of three to four years each. Resilient NENJ recommends re-evaluation every five years. As such, new or different actions will likely emerge and affect actions within and beyond these timeframes.

The following supportive activities are necessary across all phases and across all geographies, and are not repeated in the sections below in the interest of space.

City

- Continue to track, coordinate, and support funding opportunities and pursuits
- Continue to identify key sites and plan for / implement distributed green infrastructure in right-of-way and public parcels
- Pursue smaller scale stormwater improvements in high-risk areas (e.g. Cottage Street Park Flood Mitigation Project and McGovern Park flood resilience project, see **Section 2.0**)
- Continue to target and prioritize / implement sites for resilient redevelopment and site transformation
- Submit projects under available grant funding and plan for future submittals
- Ensure that Local Hazard Mitigation Plans, capital improvement plans, and other plans that can support or drive funding also integrate Resilient NENJ recommendations
- Begin and continue implementation of LTCP projects, led by the respective sewer department or authority of each municipality

Region

- Track, coordinate, and support funding opportunities and pursuits
- Track and engage around the NY & NJ Harbor & Tributaries Focus Area Feasibility Study (HATS)[4] (see **Section 3.2**)
- Help target and prioritize distributed green infrastructure in right of way and public parcels, as well as opportunities for resilient transformation of contaminated sites
- Provide a forum for engagement around project planning, design, and construction
- Help coordinate investments in areas to facilitate a “dig once” approach to limit disruption during construction

State

- Integrate near-term projects in the Ida CDBG-DR Action Plan for funding and pursue additional congressional allocations
- Allocate funding to support implementation
- Coordinate with the region to support advancement of key projects
- Help coordinate investments in areas to facilitate a “dig once” approach to limit disruption during construction

Federal

- Integrate recommendations from Resilient NENJ into federal appropriations and planning projects, such as HATS[4] (USACE, FEMA, United States Congress)
- Allocate funding toward implementation of proposed projects

Residents

Business/ Industry

- Reach out to local, state, & federal elected officials to support relevant project recommendations
- Explore opportunities to integrate green infrastructure and other hazard related improvements into property
- Participate in project design and engagement opportunities
- Raise bulkheads as they are replaced (waterfront property owners)

Major Property Owners

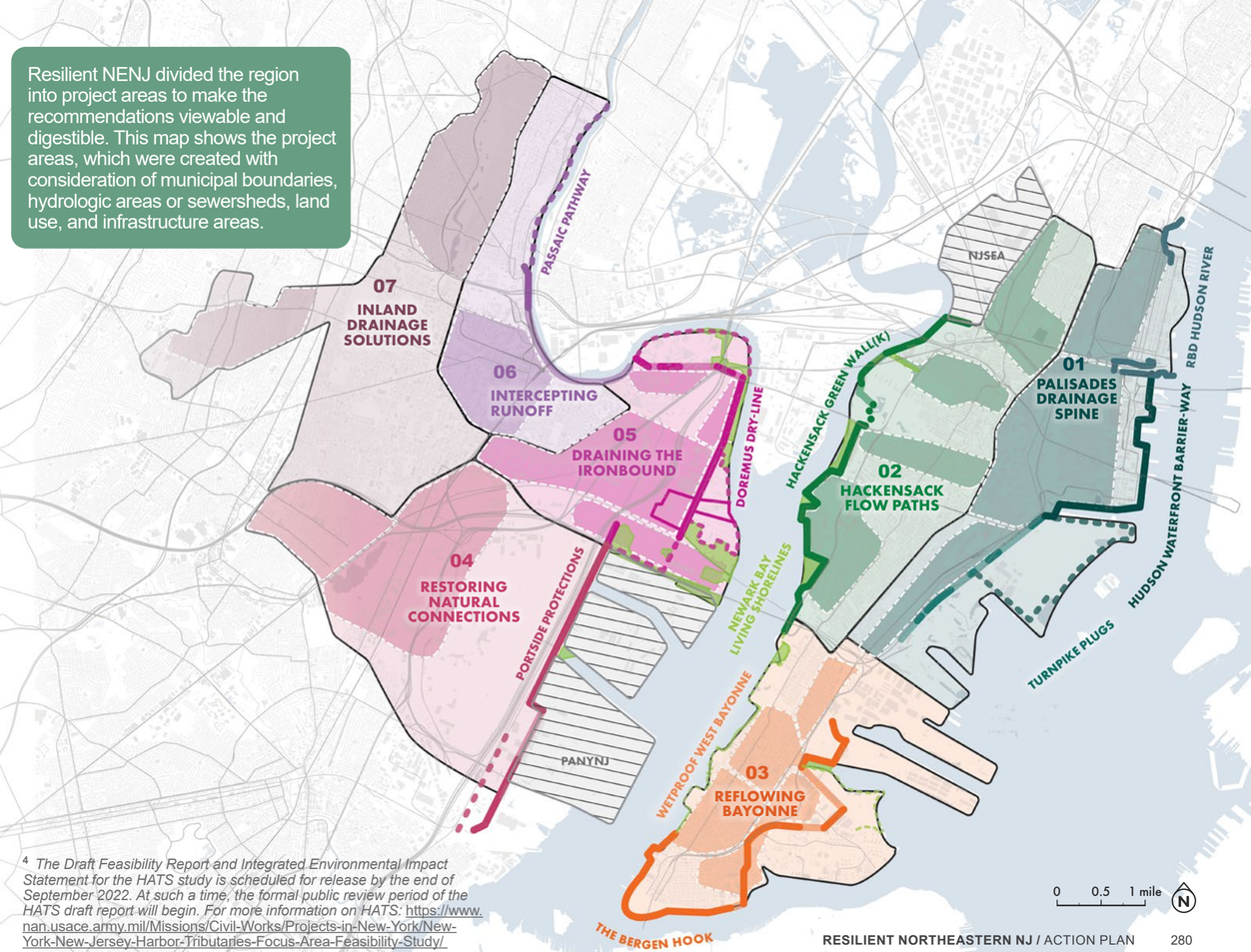
- Reach out to local, state, and federal elected officials to support relevant project recommendations
- Integrate green infrastructure and other hazard related improvements into property
- Redevelop contaminated sites in alignment with Action Plan recommendations
- Raise bulkheads as they are replaced (waterfront property owners)
- Participate in project design and engagement opportunities

Academia

CBOs

- Reach out to local, state, and federal elected officials to support relevant project recommendations
- Participate in and support project design and engagement opportunities
- Partner on funding opportunities, where appropriate

Resilient NENJ divided the region into project areas to make the recommendations viewable and digestible. This map shows the project areas, which were created with consideration of municipal boundaries, hydrologic areas or sewersheds, land use, and infrastructure areas.



[4] *The Draft Feasibility Report and Integrated Environmental Impact Statement for the HATS study is scheduled for release by the end of September 2022. At such a time, the formal public review period of the HATS draft report will begin. For more information on HATS:* https://www.nan.usace.army.mil/Missions/Civil-Works/Projects-in-New-York/New-York-New-Jersey-Harbor-Tributaries-Focus-Area-Feasibility-Study/

CAPITAL PROJECTS FOR CONSIDERATION IN JERSEY CITY

Key technical considerations

- There is a large elevation difference between neighborhoods in Jersey, such as The Heights and Downtown. This places extra stormwater pressure in low-lying areas. Nonetheless, higher elevation areas like the Heights are also susceptible to rainfall flooding due to capacity limitations of the drainage systems, increasing impervious surface, and hyper-local topography.
- Portions of Jersey City are comprised of a hard bedrock layer located only a few feet below the ground surface, making it difficult for rain to infiltrate and complicating the inclusion of drainage infrastructure.
- Large areas of Downtown Jersey City are built on historical fill. This complicates coastal measures because of variable underground conditions but also presents challenges to drainage due to low-lying areas that don't have a natural flow path to the New York Bay.
- Several major transportation corridors within the New York City Metropolitan Area pass through Jersey City. These require unique resiliency considerations and require careful coordination with NJ Transit, NJ Turnpike Authority, NJDOT, Port Authority of New York and New Jersey, as well as other key agencies.

Environmental benefits and considerations

- A Long-Term Control Plan has been developed to reduce combined sewer overflows from Jersey City. Ecosystem restoration projects along the coast can increase resiliency while providing additional water quality benefits in conjunction with the LTCP – and can create improved habitats for people and wildlife alike.
- Liberty State Park is a critical habitat area in Jersey City and is home to various migratory birds and other wildlife. Creating additional green space through greenways, open space, and green infrastructure and restoring wetlands will enhance ecosystems and habitat connectivity. These projects will also mitigate urban heat island effect by increasing use of less heat-absorptive materials.

Social and economic benefits and considerations

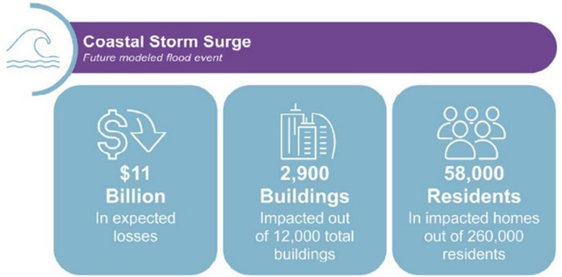
- Jersey City is already home to some large and well-loved park spaces. Connecting these spaces and other neighborhoods through greenways and walkways that can double as resiliency features improves waterfront access and recreational opportunities, which has other benefits for public health and well-being. However, access to existing spaces that are being reconstructed to incorporate resiliency measures, such as the Hudson River Waterfront Walkway or existing parks, could be temporarily limited during the construction period.
- Jersey City is a transit-rich community that is very accessible to local amenities and the region. Resiliency measures that encourage sustainable and affordable development will help support continued growth.
- Several projects protect roadways and flood-prone intersections, which will preserve mobility and reduce economic impacts associated with disruptions to travel. Roadway projects could incorporate green infrastructure in the right-of-way and bike lane creation for improved mobility.

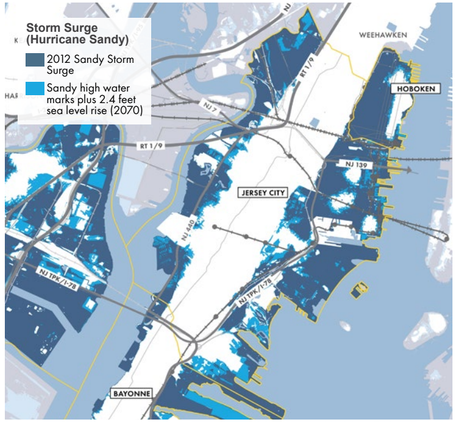
CAPITAL PROJECTS TO ADDRESS COASTAL STORM SURGE AND TIDAL FLOODING

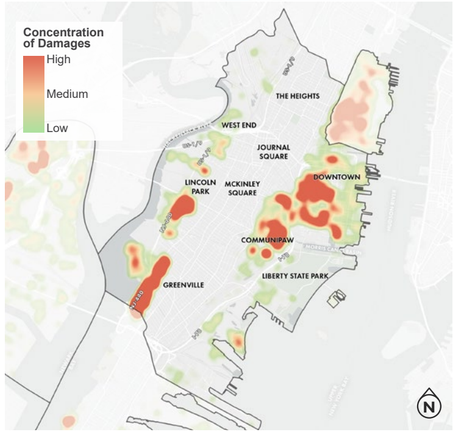
Storm surge flooding on both coasts can impact a variety of types of land uses and assets. The Flood Impact Assessment estimated that the highest expected damages from a future Sandy-like storm surge event could occur in Downtown, Communipaw, Country Village and Society Hill, and the West Side neighborhood including Hudson Mall. Coastal storm surge flooding enters on the east through the Morris Canal Basin and floods the Communipaw neighborhood, including public housing complexes that are at risk, one of the areas of highest social vulnerability in the city. The coastal strategy builds on recommendations from the Jersey City Adaptation Master Plan and proposes multiple lines of defense. These include raising existing segments of the Hudson River Waterfront Walkway to provide an outer shell of coastal protection, constructing the proposed Hackensack River Greenway at a higher elevation for protection, and raising additional roadway segments to create a full line of protection where needed. This component will preserve the valued walkways that provide waterfront access and recreational value, while advancing additional walkways construction and integrating resilience. The Action Plan also recommends providing site level adaptation to protect critical infrastructure at Port Jersey and cutting off key flood pathways with deployable gates that will be integrated with NJTA's Newark Bay-Hudson Corridor Extension program. These gates would be a second line of defense behind the raised walkways, and their use limited because of the importance of waterfront access.

What does that mean in terms of costs and losses avoided?

Resilient NENJ's coastal flood protection project recommendations in Jersey City may cost about $3.4 billion (about one third of which is associated with the Hackensack River Greenway project) and may have about $66 million in annual operating costs. The solutions may be designed to meet or exceed the flood heights expected from the modeled future Sandy event. This means $11 Billion in expected losses avoided to 2,900 buildings and 58,000 residents from a future Sandy event.







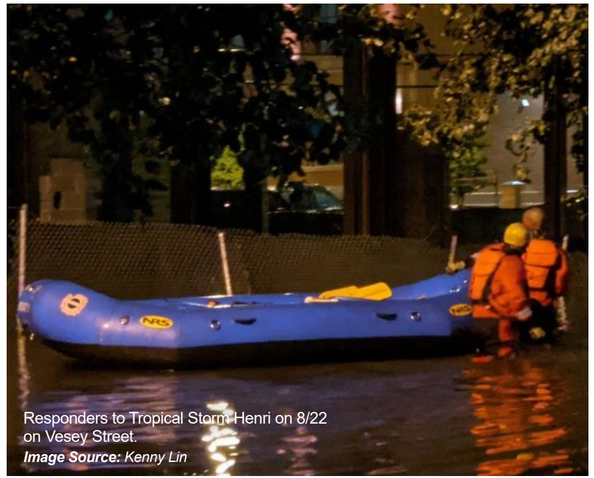
CAPITAL PROJECTS TO ADDRESS RAINFALL AND OTHER CLIMATE HAZARDS

The strategy to address rainfall flooding and other climate hazards includes various tactics for reducing impervious surfaces and improving stormwater management. The Action Plan recommends distributed green infrastructure, in alignment with the Jersey City Municipal Utilities Authority (JCMUA) LTCP, which set a goal to capture runoff from 7-percent of the city's impervious surface with green infrastructure. The JCMUA is already advancing feasibility studies for distributed green infrastructure at over 40 sites, and is planning multiple sewer separation projects, which involve redirecting sanitary (domestic and business) sewage. One sewer separation project involves constructing a new facility with a pump station to address flow needs during high tide.

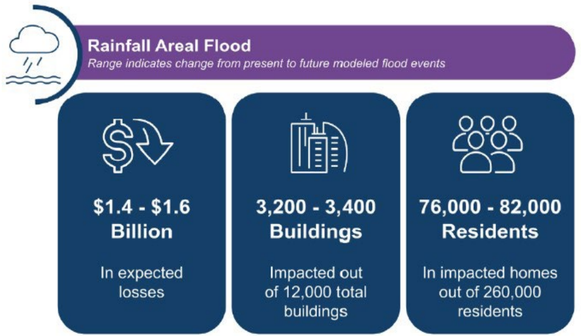
The strategy also includes stormwater management and retention at publicly owned, impervious, and vacant sites, including converting contaminated sites to open space and integrating stormwater management. McGovern Park is an example of a project that is already being designed and pursued for funding, and Bayfront is an example of a formerly contaminated site that is being redeveloped to include open space alongside mixed use spaces, while also being elevated. These actions are complemented by stormwater retention projects run by NJDOT that use available right-of-way space along highways.

Another tactic to reduce rainfall flooding impacts involves sewer separation in key rainfall hotspots such as Communipaw and Sip Avenues, which are also priority areas for combined sewer overflow reduction. The Action Plan also recommends integration with NJTA's Newark Bay-Hudson Corridor Extension Program to use space beneath the NJ Turnpike for a deep tunnel to alleviate flooding problems at problem intersections beneath the elevated aqueduct, and use of space along the turnpike in some areas for stormwater retention.

The plan's final recommendation to reduce rainfall flooding impacts involves ditch enhancement and creation to alleviate flooding in the Jersey City Heights area.



Responders to Tropical Storm Henri on 8/22 on Vesey Street.
***Image Source:** Kenny Lin*



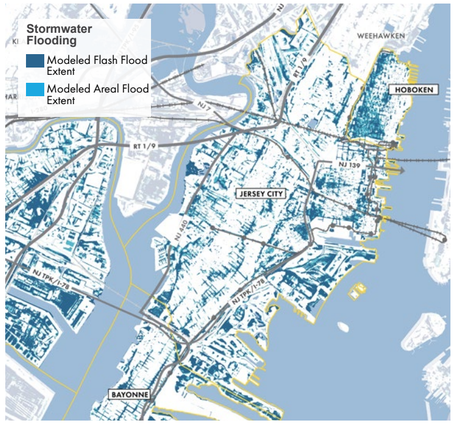
What does that mean in terms of costs and losses avoided?

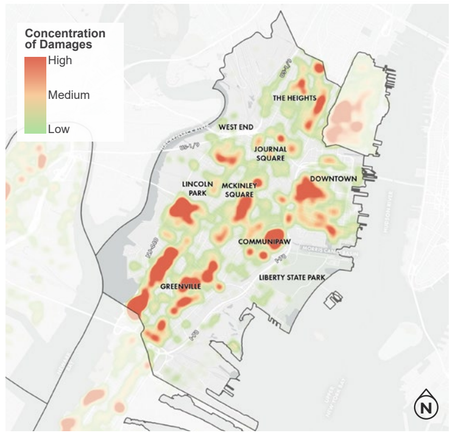
Resilient NENJ estimates it will cost about $1.1 billion to bring the city's drainage system to a 5-year level of service over time (not including Long-term Control Plan costs) and will add about $16 million in increased annual operating costs once all efforts are complete. All recommendations are at the roadmap stage and will need to progress to feasibility and design, so the costs are likely to change during that process. That may sound like a lot of money, and it is, but Resilient NENJ models for areal flooding (about 8 to 9 inches of rainfall over a 24-hour period) show $1.4 billion to $1.6 billion in expected losses if such an event occurred citywide. While the recommended improvements will not eliminate this magnitude of rainfall flood hazard, they could significantly reduce impacts, and major rainfall events are happening more and more frequently. Further, losses from flooding due to a much more frequent, 5-year event (about 4 inches of rainfall over a 24-hour period) could be $383 million in the city, and the proposed actions would largely eliminate these losses. Over time, as rain falls and fewer losses and disruptions occur, these benefits will add up and more than make up for the investment.

3,200 – 3,400 out of 12,000 total buildings in Jersey City are at risk of flooding from a major areal flood event and stand to benefit from the proposed improvements.

76,000 to 82,000 residents out of a total of 260,000 residents could directly benefit from flood risk reduction to their homes. The entire community could benefit from reduced roadway and community impacts.

Resilience is not just about reducing the hazard itself. Changing the way we work together, as outlined later in this roadmap, will also increase the benefits of these projects.





CAPITAL PROJECTS FOR CONSIDERATION IN HOBOKEN

Key technical considerations

- Hoboken is densely populated with overlapping needs for public right-of-way space. Balancing these needs will be important for leveraging the right-of-way for resiliency measures.
- Elevations in Hoboken are higher on the east and west sides of the city, creating difficult conditions for natural drainage and increasing flooding on the western edge of the city.
- The Hoboken Terminal is a key transportation hub within the region. This area is vulnerable flooding but is also a key pathway for coastal flooding into the city and potential drainage out of the city.

Environmental benefits and considerations

- With the Rebuild by Design – Hudson River project and Southwest Resiliency Park, Hoboken currently serves as a model for how the rest of the region can successfully adapt to climate change and increase public green space within the city.
- Ecosystem restoration projects along Hoboken's coastline will help to soften the edge and provide additional water quality benefits to the Hudson River.

Social and economic benefits and considerations

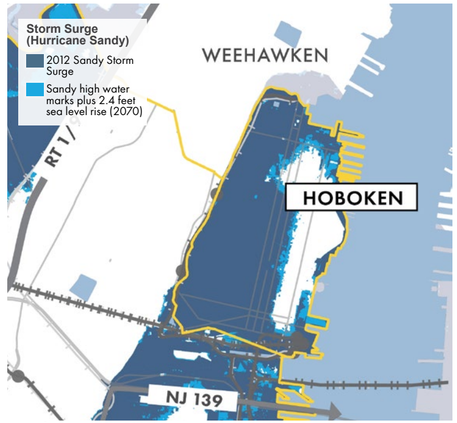
- The recommended deep tunnel spine along western Hoboken would alleviate flooding in low-lying southwest Hoboken, which has the highest concentration of low income and BIPOC people in the city.
- In addition to resiliency benefits, green infrastructure in the public right-of-way improves roadway safety and pedestrian accessibility throughout the city.
- The Hudson River Waterfront Walkway in Hoboken, that connects various pier parks, is a critical asset in Hoboken and strengthening this amenity to sea level rise and storm surge will be critical to preserving Hoboken's character.

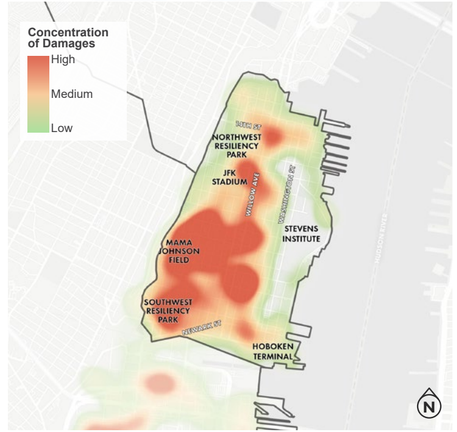
CAPITAL PROJECTS TO ADDRESS COASTAL STORM SURGE AND TIDAL FLOODING

Hurricane Sandy demonstrated Hoboken's high vulnerability to storm surge flooding. The city incurred the highest damages per capita of the four cities in the region.[5][6] Flood pathways for storm surge include the northern border at Weehawken Cove and southern border from the Long Slip Canal and area of Hoboken Terminal. As described in **Section 2.7**, the Rebuild by Design-Hudson River project is a partnership between NJDEP, the City of Hoboken, North Hudson Sewerage Authority, and other partners to address both coastal and rainfall flooding. The coastal storm surge component, dubbed "Resist," includes flood protection structures to cut-off the flood pathways. In addition to being expected to protect 85-percent of Hoboken's population that resides within the FEMA-mapped special flood hazard area, the structure will provide community benefits through integration of public amenities and green spaces where possible. To complement the coastal protection that will be provided by the Rebuild by Design project, the City of Hoboken is also exploring a pilot project for shellfish restoration near Weehawken Cove as well as possible road raising in southern Hoboken. Road raising would also improve mobility during rainfall flooding events. In addition, the City could explore other projects to provide protection to areas that are seaward of the Resist structure, such as a living shoreline along the Hudson River or strengthening or raising of the existing Hudson River Waterfront Walkway that lines the river.

What does that mean in terms of costs and losses avoided?

Complementing the $230 million Rebuild by Design project and should Hoboken decide to leverage the board walk in the future to further reduce coastal flood risk, the living shoreline recommendation will add about $48 million in capital costs and about $717,000 in operating costs to contribute to reduced coastal flood risk. The models estimate $7.2 billion in expected losses avoided to 700 buildings and 43,000 residents from a future Sandy event alone from these efforts.



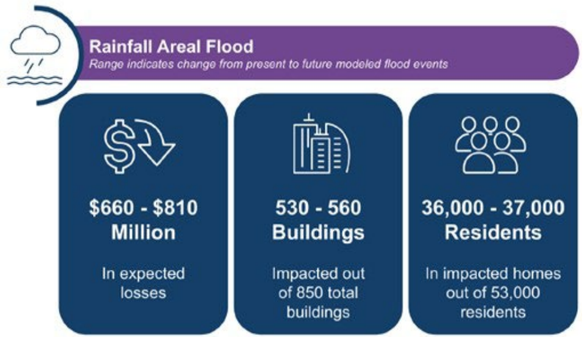


[5] *NJ Office of the State Comptroller:* https://nj.gov/comptroller/sandytransparency/funds/tracker/
[6] *NJOIT Open Data Center:* https://data.nj.gov/Government-Finance/Sandy-PA-Master-Data/j356-d76p/data

CAPITAL PROJECTS TO ADDRESS RAINFALL AND OTHER CLIMATE HAZARDS

The City of Hoboken is advancing various projects to address rainfall flooding through the Rebuild by Design-Hudson River project, as well as several other projects that are not under the Rebuild by Design umbrella. Hoboken's strategy relies heavily on subsurface stormwater management in parks, integrating green infrastructure in the designs as well as in roadway right-of-way areas. Southwest Park, 7th and Jackson Street Park, and Northwest Resiliency Park are complete or near complete parks that follow this model. The City also hopes to expand Southwest Park and is undertaking several storm sewer separation projects in northern Hoboken. To continue to address rainfall flooding, particularly in the hotspot area of southwest Hoboken, the City could revisit a previously raised concept to create a drainage corridor along its western border. A deep tunnel spine could carry large volumes of stormwater from the low-lying western area while avoiding disruption to this densely developed area.

Green infrastructure demonstration projects at Hoboken's City Hall.
Image Source: *Mayor of Hoboken Facebook Page*



What does that mean in terms of costs and losses avoided?

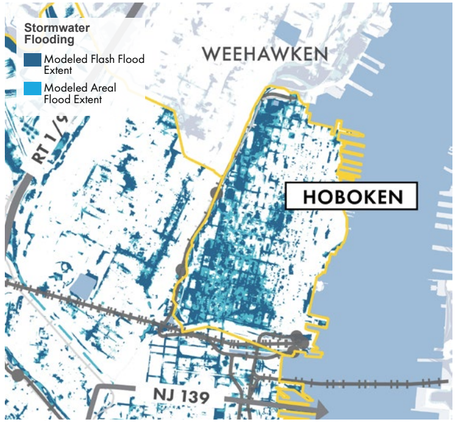
Resilient NENJ estimates close to $800 million for stormwater projects in and immediately adjacent to Hoboken. About $700 million of that total cost is currently estimated to complete the Deep Tunnel Spine along West Hoboken, and this project is expected to provide significant benefit to Jersey City, as well. Based on share of benefits, about $522 million (of the total $800 million) is needed to bring Hoboken's level of service to the 5-year, 1 hour peak amount of rainfall.

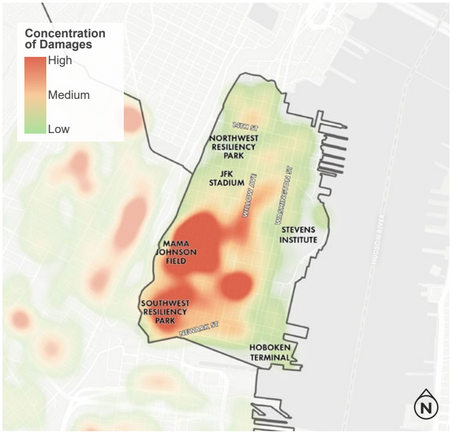
Resilient NENJ models for areal flooding (about 8 to 9 inches of rainfall over a 24-hour period) show $660 million to $810 million in expected losses for such an event in Hoboken. While the recommended improvements will not eliminate this magnitude of rainfall flood hazard, they could significantly reduce impacts, and major rainfall events are happening more and more frequently. Further, losses from flooding due to a much more frequent, 5-year event (about 4 inches of rainfall over a 24-hour period) could be $119 million in the city, and the proposed actions would largely eliminate these losses. Over time, as rain falls and fewer losses and disruptions occur, these benefits will add up and more than make up for the investment.

530 to 560 out of 850 total buildings in Hoboken are at risk of flooding from a major areal flood event and stand to benefit from the proposed improvements

36,000 to 37,000 residents out of a total of 53,000 residents could directly benefit from flood risk reduction to their homes. The entire community could benefit from reduced roadway and community impacts.

Resilience is not just about reducing the hazard itself. Changing the way we work together, as outlined further in the roadmap, will also increase the benefits of these projects.

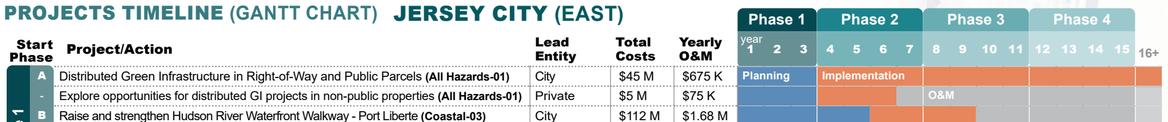




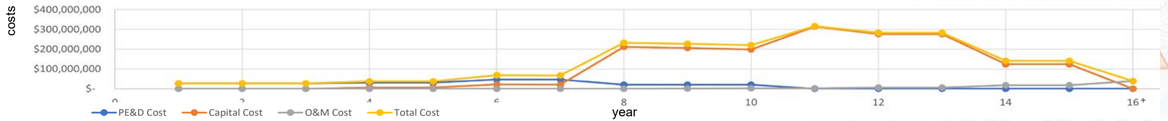
TIMELINE & COSTS

PROJECTS TIMELINE (GANTT CHART) JERSEY CITY (EAST)

Start Phase		Project/Action	Lead Entity	Total Costs	Yearly O&M
Phase 1	A	Distributed Green Infrastructure in Right-of-Way and Public Parcels **(All Hazards-01)**	City	$45 M	$675 K
	-	Explore opportunities for distributed GI projects in non-public properties **(All Hazards-01)**	Private	$5 M	$75 K
	B	Raise and strengthen Hudson River Waterfront Walkway - Port Liberte **(Coastal-03)**	City	$112 M	$1.68 M
	C	Sewer Separation along Communipaw flow east **(Stormwater-01)**	City	$30 M	$450 K
	D	Deep Tunnel Spine along NJ Turnpike **(Stormwater-02)**	Regional	$700 M	$10.5 M
	E	Expand Stormwater Management in Liberty State Park Wetlands **(Stormwater-04)**	NJDEP	$5 M	$75 K
	-	Remediation / resilience projects at contaminated sites **(All Hazards-02)**	City or Region	$10 M	$150 K
Phase 2	F	Raise and strengthen Hudson River Waterfront Walkway - Downtown **(Coastal-03)**	City/State	$555 M	$8.32 M
	G	Liberty Park walkway raising as first line of defense **(Coastal-03)**	NJDEP	$811 M	$12.2 M
	H	Increase Surface Flows and Retention between Turnpike and Rail **(Stormwater-03)**	NJTA	$35 M	$525 K
	I	NJ Turnpike Flood Barriers and Gates **(Coastal-01)**	NJTA	$245 M	$3.7 M
				$2.55 B	**$38.3 M**

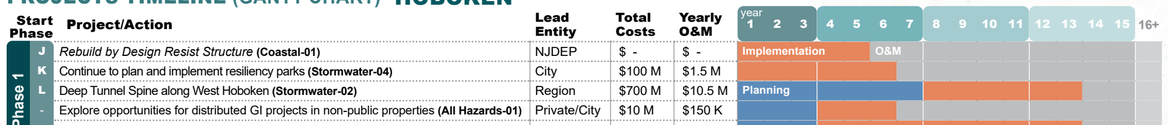


ESTIMATED COST NEEDS (YEAR OVER YEAR)

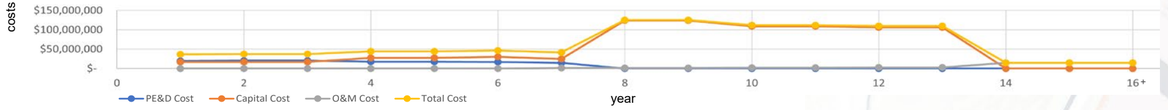


PROJECTS TIMELINE (GANTT CHART) HOBOKEN

Start Phase		Project/Action	Lead Entity	Total Costs	Yearly O&M
Phase 1	J	*Rebuild by Design Resist Structure* **(Coastal-01)**	NJDEP	$ -	$ -
	K	Continue to plan and implement resiliency parks **(Stormwater-04)**	City	$100 M	$1.5 M
	L	Deep Tunnel Spine along West Hoboken **(Stormwater-02)**	Region	$700 M	$10.5 M
	-	Explore opportunities for distributed GI projects in non-public properties **(All Hazards-01)**	Private/City	$10 M	$150 K
	M	Distributed Green Infrastructure in Right-of-Way and Public Parcels **(All Hazards-01)**	City	$90 M	$1.3 M
	-	Remediation / resilience projects at contaminated sites **(All Hazards-02)**	City/Region	$42.3 M	$634 K
Phase 2	N	Hoboken Living Shoreline **(Coastal-05)**	City	$47.8 M	$717 K
	O	Evaluate need to raise / strengthen existing Hoboken HRWW **(Coastal-03)**	City	$ -	$ -
				$990 M	**$14.8 M**



ESTIMATED COST NEEDS (YEAR OVER YEAR)



Recommended capital projects are concept only and, unless otherwise noted or already being advanced by other entities, require feasibility evaluations as next steps.

PROJECT AREA #01
PALISADES DRAINAGE SPINE + HUDSON RIVER BARRIERS

The Palisades outcrop is a defining feature that runs through the center of Jersey City, west of Hoboken. Recommended actions seek to relieve pressure for low-lying areas at the base of the outcrop through a deep tunnel "spine", while managing flooding at higher elevations through stormwater management sites. These recommended stormwater actions are paired with coastal protections such as RBD Hudson River and protections along the waterfront and NJ Turnpike.

LEGEND

COASTAL ALIGNMENTS

Coastal Barriers
- Flood Barrier
- Raised Walkway/Boardwalk
- Raised Roads
- Planned Land Raising
- Areas for Adaptation
- Flood Gates
- Tie-Ins to High Ground

DRAINAGE SOLUTIONS

Underground Conveyance
- Deep Tunnel
- Sewer Separation
- Connections to Explore

Overland Conveyance
- Secondary Ditch

Retention & Storage
- Retention Sites
- Detention Sites

Outfalls & Pumping
- New Pump Station
- Enhance Existing Pump Station
- New Outfalls

GREEN INFRASTRUCTURE
- Pilot Resilience Hub
- Potential Resilience Hubs

Wetland Actions
- Living Shoreline (new seeding)

Green Infrastructure Corridors
- Primary Green Street
- Secondary Green Street

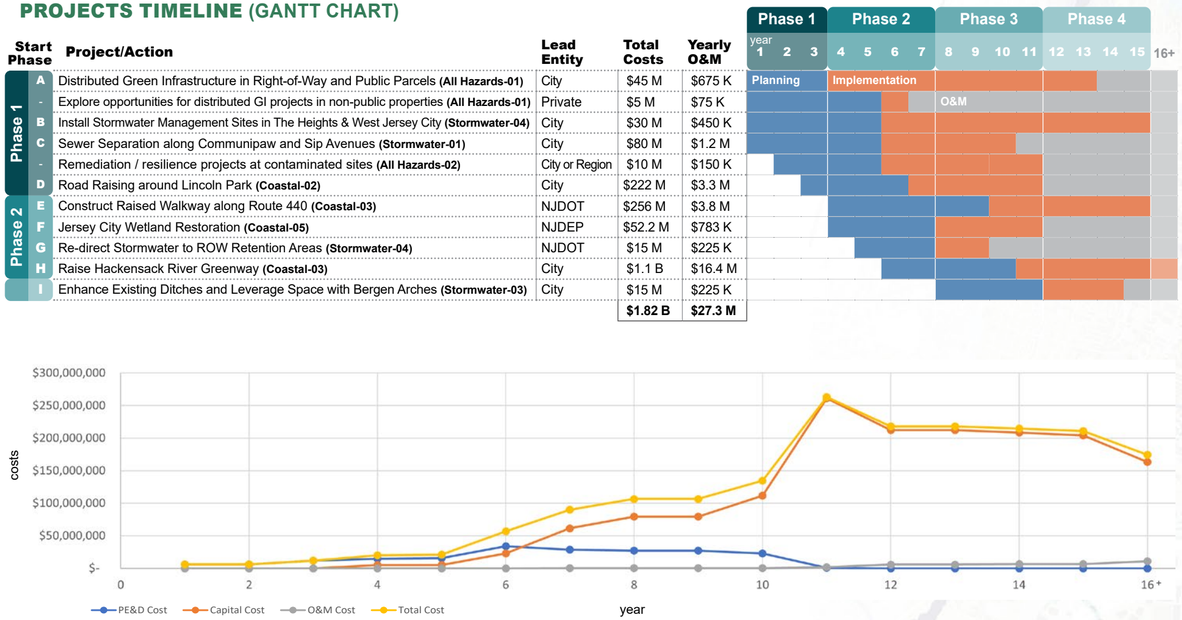
Greenways
- Proposed New Greenway Stretches
- Existing Greenways, Walkways & Boardwalks
- Greenway Corridors Proposed by Others

TIMELINE & COSTS

JERSEY CITY (WEST)

PROJECTS TIMELINE (GANTT CHART)

Start Phase		Project/Action	Lead Entity	Total Costs	Yearly O&M
Phase 1	A	Distributed Green Infrastructure in Right-of-Way and Public Parcels **(All Hazards-01)**	City	$45 M	$675 K
	-	Explore opportunities for distributed GI projects in non-public properties **(All Hazards-01)**	Private	$5 M	$75 K
	B	Install Stormwater Management Sites in The Heights & West Jersey City **(Stormwater-04)**	City	$30 M	$450 K
	C	Sewer Separation along Communipaw and Sip Avenues **(Stormwater-01)**	City	$80 M	$1.2 M
	-	Remediation / resilience projects at contaminated sites **(All Hazards-02)**	City or Region	$10 M	$150 K
	D	Road Raising around Lincoln Park **(Coastal-02)**	City	$222 M	$3.3 M
Phase 2	E	Construct Raised Walkway along Route 440 **(Coastal-03)**	NJDOT	$256 M	$3.8 M
	F	Jersey City Wetland Restoration **(Coastal-05)**	NJDEP	$52.2 M	$783 K
	G	Re-direct Stormwater to ROW Retention Areas **(Stormwater-04)**	NJDOT	$15 M	$225 K
	H	Raise Hackensack River Greenway **(Coastal-03)**	City	$1.1 B	$16.4 M
	I	Enhance Existing Ditches and Leverage Space with Bergen Arches **(Stormwater-03)**	City	$15 M	$225 K
				$1.82 B	**$27.3 M**



PROJECT AREA #02

HACKENSACK FLOW PATHS + GREEN WALL(K) + NEWARK BAY LIVING SHORELINES (EAST)

Sewer capacity limitations in western Jersey City lead to sewer back-ups and flooding. Recommendations in this project area focus on separating sewers, increasing stormwater storage and flow to the Hackensack River. This is paired with coastal protections, and new and enhanced wetlands and living shorelines along the river.

Recommended capital projects are concept only and, unless otherwise noted or already being advanced by other entities, require feasibility evaluations as next steps.

JERSEY CITY PHASING

Phase I (Years 1 to 3)

Phase 1 focuses predominantly on continuing pursuit of stormwater improvements in high-risk areas (such as the 2021 grant submitted for stormwater improvements at McGovern Park), and planning for green infrastructure and site transformation projects. Phase 1 also begins planning for large retention sites, sewer separation, road and walkway raising, and deep tunnel projects.

City

- Target and prioritize sites for resilient redevelopment and site transformation
- Continue planning for large retention sites and sewer separation projects
- Begin early planning and coordination (Hoboken and Jersey City) with the region and state for consideration of the Deep Tunnel Spine
- Begin early planning of road and walkway raising projects

Region

- Support coordination and initial planning with Hoboken and NJTA for the Deep Tunnel Spine along NJ Turnpike
- Initiate planning for wetland restoration projects (NJDEP)
- Target and prioritize distributed green infrastructure in right of way and public parcels

State

- Integrate stormwater management into the wetlands restoration work in Liberty State Park Wetlands (NJDEP)
- Begin engaging around the concept of the Deep Tunnel Spine (NJTA)

Phase 2 (Years 4 to 7)

Given adequate funding and capacity, Phase 2 sees construction initiated for most improvements planned in Phase 1 with the exception of the Deep Tunnel Spine along NJ Turnpike, which will likely continue to require significant planning and design efforts in this phase. The schedule recommends beginning planning of raised walkways along Route 440 and the Jersey City Waterfront, and coordination with state agencies for actions that will affect rail and state roadways.

City

- Given funding, complete planning and initiate construction of projects planned through Phase 1
- Initiate planning to Raise Jersey City Waterfront Walkway

Region

- Begin coordinating with Jersey City and Bayonne for Force Mains and Pump Stations to the New York Bay
- Support coordination with state agencies for flood improvement projects affecting transportation agency assets
- Support coordination for feasibility and design for the Deep Tunnel Spine along NJ Turnpike with Hoboken, Jersey City, and NJTA

State

- Complete stormwater management improvements in Liberty State Park Wetlands (NJDEP)
- Begin planning for Route 440 flood protection walkway and right of way retention area projects (NJDOT) and Hackensack River Greenway
- Begin planning for NJ Turnpike and rail flood protection and stormwater management projects (NJTA)
- Initiate planning for wetland restoration projects (NJDEP)

Phase 3 (Years 8 to 11)

Phase 3 sees the region and city initiate planning to raise the existing and planned portions of the Hackensack River Greenway and Enhance Existing Ditches and leverage space with Bergen Arches, and continuing planning and design to raise the Jersey City Waterfront Walkway; coordination for flood improvement projects that affect state agency assets like the NJ Tpke. Retention and right of way projects that affect transportation projects will ideally move toward implementation. Priority sewer separation, stormwater management, and Port Jersey flood protections should be complete by the end of Phase 3.

City

- Begin planning to enhance existing ditches and leverage space with Bergen Arches
- Complete planning and initiate implementation of remaining Phase 2 projects
- Complete sewer separation on Communipaw and Sip Avenues
- Complete road raising around Lincoln Park
- Complete planning and begin construction of Jersey City Waterfront Walkway and Hackensack River Greenway

Region

- Continue coordination activities from Phase 2

State

- Begin construction for Route 440 and right of way retention area projects (NJDOT)
- Complete projects to Increase Surface Flows and Retention between Turnpike and Rail (NJTA)
- Complete implementation of NJ Turnpike Flood Barriers and Gates (NJTA)
- Construct wetland restoration projects (NJDEP)

Phase 4 (Years 12 to 15+)

Phase 4 will ideally see continued implementation and maximization of green infrastructure and green space, small scale stormwater management, and site transformation. Most other projects could be complete by this time, except for major walkway improvements, Greenway and Bergen Arch improvements, and the Deep Tunnel project.

City

- Complete stormwater projects in the Heights and West Jersey
- Complete New York Bay walkway elevation project
- Continue construction on the Jersey City Waterfront Walkway, Hackensack River Greenway, and begin construction of Bergen Arches projects
- Continue supporting implementation of the Deep Tunnel Spine along NJ Turnpike

Region

- Continue supporting implementation of the Deep Tunnel Spine along NJ Turnpike

State

- Continue Route 440 raised walkway project implementation (NJDOT)
- Continue construction of the Deep Tunnel Spine along NJ Turnpike in coordination with the region, Hoboken, and Jersey City (NJTA)

HOBOKEN PHASING

Phase I (Years 1 to 3)

Phase 1 sees a continuation of NJDEP's existing efforts with Rebuild by Design and related projects and adds initial coordination and discussion with Jersey City to explore the feasibility of a Deep Tunnel Spine along West Hoboken. During this time, the city could also continue to target and prioritize sites for resilient transformation and green infrastructure.

City

- Coordinate with NJDEP on Rebuild by Design implementation and the City of Hoboken's portions of the project
- Coordinate across jurisdictions to explore planning and feasibility study for the Deep Tunnel Spine along West Hoboken (Jersey City, Hoboken, Region, State)
- Construct Northwest Resiliency Park and Southwest Park Expansion at Block 10

Region

- Begin coordinating with the State, Jersey City, and Hoboken to explore planning and feasibility of the Deep Tunnel Spine along West Hoboken
- Target, prioritize, and begin construction of distributed green infrastructure in right of way and public parcels

State

- Begin construction of the Rebuild by Design project
- Support initial feasibility study, planning, and coordination for the Deep Tunnel Spine along West Hoboken (agency engagement will be dependent on locations explored)

Phase 2 (Years 4 to 7)

Phase 2 explores the feasibility of raising or strengthening the existing Hoboken Hudson River Waterfront Walkway, as well as continued coordination toward design of the Deep Tunnel Spine along West Hoboken.

City

- Continue Rebuild by Design project construction and begin to close out the project
- Explore feasibility of raising or strengthening the Existing Hoboken Hudson River Waterfront Walkway
- Construct 800 Monroe Resiliency Park, Hoboken Housing Authority Resiliency Park
- Continue NHSA Long Term Control Plan implementation
- Construct Distributed Green Infrastructure in Right-of-Way and Public Parcels

Region

- Continue coordinating with Jersey City and Hoboken to design the Deep Tunnel Spine along West Hoboken

State

- Continue coordinating with the region toward design of the Deep Tunnel Spine along West Hoboken
- Initiate planning for living shoreline projects (NJDEP)

Phase 3 (Years 8 to 11)

Phase 3 sees construction of the wetland restoration projects and Deep Tunnel Storage Spine along West Hoboken, as well as design to raise or strengthen the existing Hoboken Hudson River Waterfront Walkway.

City

- Rebuild by Design likely to be complete by this time
- Design raising or strengthening the Existing Hoboken Hudson River Waterfront Walkway

Region

- Construct Distributed Green Infrastructure in Right-of-Way and Public Parcels

State

- If confirmed through feasibility assessment and funding, begin construction of the Deep Tunnel Spine along West Hoboken in coordination with appropriate stakeholders depending on final selected location
- Support implementation of the Deep Tunnel Spine along West Hoboken (agency engagement will be dependent on final location)
- Construct living shoreline projects (NJDEP)

Phase 4 (Years 12 to 15+)

Phase 4 sees construction of improvements to the Hoboken Hudson River Waterfront Walkway and continued implementation of the Deep Tunnel Spine.

City

- Construct improvements to the Existing Hoboken Hudson River Waterfront Walkway• Complete implementation of the Deep Tunnel Spine along West Hoboken
- Complete Distributed Green Infrastructure in Right-of-Way and Public Parcels

Region

- Complete implementation of the Deep Tunnel Spine along West Hoboken

State

- Complete implementation of the Deep Tunnel Spine along West Hoboken

CAPITAL PROJECTS FOR CONSIDERATION IN BAYONNE

Key technical considerations

- Portions of East Bayonne are built on historical fill or piers, complicating coastal protection actions and requiring pumping to address drainage challenges.
- Current industrial areas, such as Constable Hook, require careful consideration for preservation of industrial water-dependent uses.
- Redevelopment along the waterfront provides opportunities to work with the private sector on coastal protection measures but the lack of consistent public land for alignments potential raises challenges.

Environmental benefits and considerations

- Bayonne, as a combined sewer community, can achieve significant benefits to water quality and public health by implementing projects that keep stormwater out of the combined sewer system.
- Large areas of Bayonne's waterfront are currently or were historically industrial. Protecting these areas is important to the regional economy and to preventing environmental impacts to Bayonne residents but actions need to be sensitive to the challenges of developing infrastructure on contaminated sites.
- Re-direction of stormwater to separate outfalls along Newark Bay can alleviate pressure on Bayonne's existing sewer system. These projects can be effectively integrated with projects designed for coastal storm surge protection of parks and homes along the waterfront but will require coordination to achieve regulatory approvals and protect water quality.
- The opportunity to combine public access with coastal protection actions expands Bayonne's existing efforts to re-connect the community with the waterfront.

Social and economic benefits and considerations

- Redevelopment is thriving in Bayonne. Protecting these investments will safeguard the economy.
- Reducing the frequency of flooding from rainfall in Bayonne will reduce risk of community downturn. In particular, a force main project to increase stormwater pumping to New York Bay and sewer separation projects will address rainfall flooding in the highest social vulnerability areas of Bayonne.
- Including walkability and green space through capital projects will improve quality of life and social connectivity across the community.
- Continuing to transform contaminated sites into community assets improves public health while providing a host of other economic, environmental, and social benefits, depending on the final use of the site and the extent to which the design integrates stormwater and other climate-hazard related improvements.

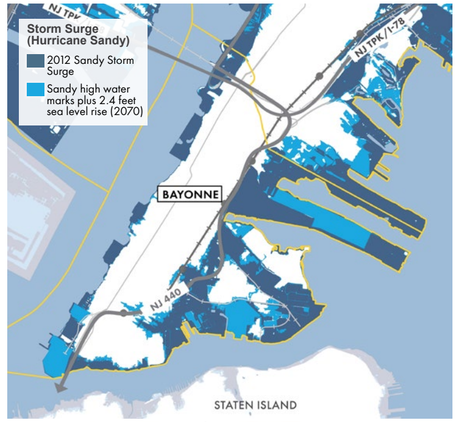
CAPITAL PROJECTS TO ADDRESS COASTAL STORM SURGE AND TIDAL FLOODING

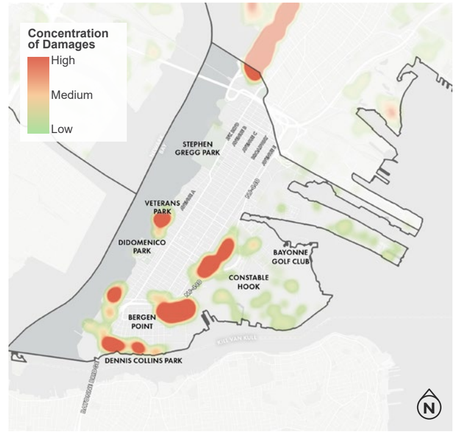
Storm surge flooding will likely impact Bayonne's current or formerly industrial areas and waterfront parks along the western and southern shorelines. The **Flood Impact Assessment** estimates that 1,000 of nearly 6,000 buildings in Bayonne could be impacted from a future Sandy-like event, with 70-percent of losses coming from industrial buildings. Continuation and expansion of the City of Bayonne's strategy to incorporate higher resilience-related standards into redevelopment plans will be key for addressing flood risk in industrial areas important to protect due to their value for the regional economy and possible presence of toxic substances. Constable Hook is an example of such an area that could be prime for a resilient redevelopment plan. The Action Plan also recommends flood barriers and road raising to protect residential and commercial areas. Coastal storm surge protection could also involve a series of projects to raise segments of existing walkway and park waterfronts or construct a new elevated walkway along with park waterfront, integrated with the proposed Hackensack River Greenway and redevelopment projects. Other opportunities include projects to provide individual or site-level protection to waterfront parks and homes along the Newark Bay. These solutions should provide at or above the future Sandy level or 0.2-percent annual chance flood elevation plus sea level rise protection level, whichever is higher.

What does that mean in terms of costs and losses avoided?

Not including actions that Port Jersey may take to mitigate losses to their assets, Resilient NENJ's coastal flood protection project recommendations may cost about $1.1 billion and may have about $16.2 million in annual operating costs,[7] 10 percent of the city's annual operating budget. The solutions may be designed to meet or exceed the flood heights expected from the modeled future Sandy event. This means $1.9 billion in expected losses avoided[8] to 1,000 buildings and 7,300 residents during a single future Sandy-like event.

[7] *This includes capital costs for site level protection of waterfront homes along Newark Bay, but does not include maintenance costs for those homes (estimated at $3 million distributed across all property owners should protections be implemented).*
[8] *Costs and losses avoided do not include Port Jersey assets*





CAPITAL PROJECTS TO ADDRESS RAINFALL AND OTHER CLIMATE HAZARDS

As seen in the other municipalities in the region, Bayonne's aging combined sewer system is an important contributor to rainfall flooding challenges in the city. Limited sewer capacity in high intensity rain events like the remnants of Hurricane Ida leads to rainfall flooding across the city, including along the Broadway commercial corridor, residential areas along Avenue A, and problem underpasses along the Hudson Bergen Light Rail corridor. Implementation of the strategies recommended in this Action Plan will reduce recurrent rainfall flooding by expanding capacity of the sewer system through new force mains and expanded pump stations, while taking stormwater out of the system through targeted sewer separation and stormwater management and green infrastructure at distributed public and private sites.

The presence of contaminated sites presents challenges for potential stormwater management projects such as retention sites because of the possible disruption or spread of contaminants, but also presents opportunities for contaminated sites to be remediated and transformed while incorporating stormwater management, green infrastructure, and open space. Parks and existing open space provide another possible opportunity for stormwater integration, particularly with implementation of the recommendation to advance Green Acres guidance for such projects, as outlined in **Section 3.2**. Bayonne submitted a successful FEMA grant application in 2021 to advance subsurface stormwater management and associated sewer capacity improvements at Cottage Street Park, for example. This project mirrors the recently completed project at Fitzpatrick Park, a formerly contaminated site.

The recommended sewer system projects to improve drainage will be integrated with components of the city's Long-Term Control Plan (LTCP), which is undergoing review by NJDEP and is estimated to cost upwards of $347 million.[9] Both the recommended actions in this Action Plan and the LTCP will yield benefits for water quality and public health by reducing combined sewer overflows and sewer back-ups. The green infrastructure recommendations in this Action Plan will also support advancement of the LTCP goal to manage 3-5-percent of Bayonne's CSO volume with green infrastructure, which will have additional air quality, urban heat island effect mitigation, and quality of life benefits.

As described in the Flood Impact Assessment, Resilient NENJ modeled major flash flooding and areal rainfall events that would exceed design capacities of any drainage system. Resilient NENJ also modeled potential losses from a 5-year rainfall event given a) current conditions[10] and b) if the capacity of the system increased to handle this level of rainfall. The Resilient NENJ technical team expects the Action Plan recommendations to bring the stormwater system to an industry standard 5-year level of service citywide.

A 5-year rainfall event is one with a 1 in 5, or 20-percent, annual chance of being met or exceeded, based on historical data.

Level of service is the expected magnitude event a drainage system can be expected to manage.

A 5-year, 1-hour peak rainfall intensity is an industry standard level of service goal for stormwater drainage systems.

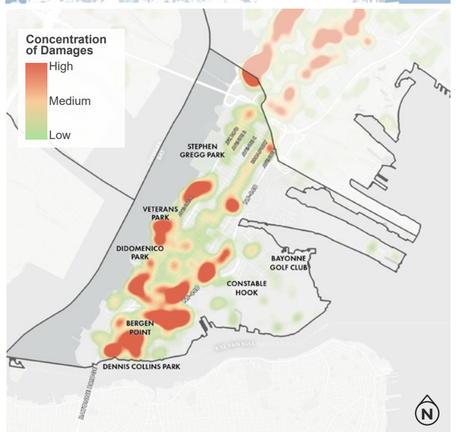
What does that mean in terms of costs and losses avoided?

Resilient NENJ estimates it will cost about $428 million to bring the city's drainage system to a 5-year level of service over time,[11] and it could cost about $6.5 million in increased annual operating costs once all efforts are complete. All recommendations are at the roadmap stage and will need to progress to feasibility and design, so the costs are likely to change during that process. That may sound like a lot of money, and it is, but Resilient NENJ models for areal flooding (about 8 to 9 inches of rainfall over a 24-hour period) show $470 million to $530 million in expected losses if such an event occurred citywide. While the recommended improvements will not eliminate this magnitude of rainfall flood hazard, they could significantly reduce impacts, and major rainfall events are happening more and more frequently. Further, losses from flooding due to a much more frequent, 5-year event (about 4 inches of rainfall over a 24-hour period) could be $85 million in the city, and the proposed actions would largely eliminate these losses. Over time, as rain falls and fewer losses and disruptions occur, these benefits will add up and more than make up for the investment.

1,400 – 1,500 out of 6,000 total buildings in Bayonne are at risk of flooding from a major areal flood event and stand to benefit from the proposed improvements

16,000 – 18,000 residents out of a total of 65,000 residents could directly benefit from flood risk reduction to their homes. The entire community could benefit from reduced roadway and community impacts.

Resilience is not just about reducing the hazard itself. Changing the way we work together, as outlined later in this roadmap, will also increase the benefits of these projects.



[9] *Based on the 2020 Bayonne Selection and Implementation of Alternatives Report, 27.8 MGD conveyance alternative*

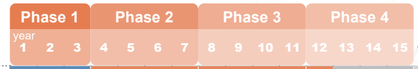
[10] *Current conditions vary across the region, but Resilient NENJ assumed current levels of service to be generally around 1-year 1-hour peak intensity based on technical expert and stakeholder review*

[11] *Costs would be in addition to the Long-term Control Plan estimates*

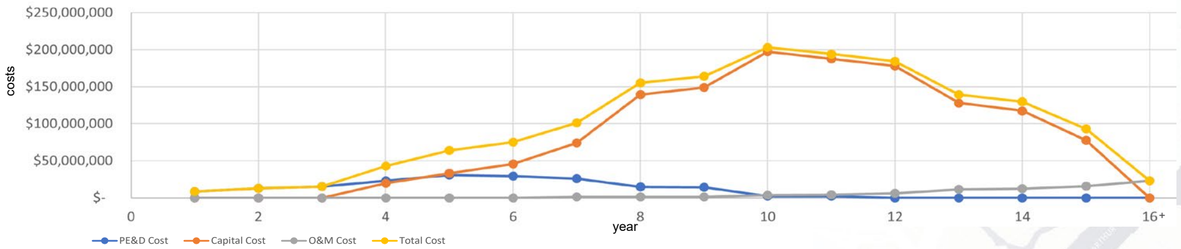
TIMELINE & COSTS

PROJECTS TIMELINE (GANTT CHART)

Start Phase		Project/Action	Lead Entity	Total Costs	Yearly O&M
Phase 1	A	Distributed Green Infrastructure in Right-of-Way and Public Parcels **(All Hazards-01)**	City or Region	$90 M	$1.3 M
	B	Explore opportunities for distributed GI projects in non-public properties **(All Hazards-01)**	Private	$10 M	$150 K
	C	Bayonne wetland restoration **(Coastal-05)**	NJDEP	$27.7 M	$415 K
	D	Raise existing waterfront / walkway - New York Bay **(Coastal-03)**	City	$30 M	$450 K
	E	Integrate Waterfront Raising with Redevelopment - Newark Bay **(Coastal-03)**	Private	$64.4 M	$966 K
	F	Constable Hook Bulkhead Raising **(Coastal-01)**	City	$42.3 M	$635 K
	-	Explore other opportunities for sewer separation projects **(Stormwater-01)**	City	$2.5 M	$37.5 K
	G	Remediation / resilience projects at contaminated sites **(All Hazards-02)**	City or Region	$20 M	$300 K
	H	Provide Site and Building Level Adaptations in Port Jersey **(Coastal-04)**	PANYNJ	$ -	$ -
	I	Integrate waterfront resilience / elevation into Bergen Point **(Coastal-03)**	City	$178 M	$2.7 M
Phase 2	J	Sewer Separation to Dedicated Outfalls along Newark Bay **(Stormwater-01)**	City	$75 M	$1.12 M
	K	Force Mains and Pump Stations to Kill Van Kull **(Stormwater-02)**	Region	$50 M	$750 K
	L	Route 440 and Rail Corridor Flood Protections **(Coastal-01)**	NJDOT	$222 M	$3.3 M
	M	Force Mains and Pump Stations to NY Bay (shared JC & Bayonne) **(Stormwater-02)**	City	$200 M	$3 M
	-	Continue to identify priority sites for building or area-level flood protection **(Coastal-04)**	City	$2.5 M	$37.5 K
	N	Protect Parks and Waterfront Homes along Newark Bay - south **(Coastal-04)**	City	$10.2 M	$153 K
	O	Protect Parks and Waterfront Homes along Newark Bay - north **(Coastal-04)**	City & County	$411 M	$6.16 M
	P	East 22nd St Road Raising **(Coastal-02)**	City	$21 M	$316 K
	Q	Constable Hook Barrier **(Coastal-01)**	Private	$70 M	$1.05 M
				$1.53 B	**$22.9 M**



ESTIMATED COST NEEDS (YEAR OVER YEAR)



Recommended capital projects are concept only and, unless otherwise noted or already being advanced by other entities, require feasibility evaluations as next steps.

PROJECT AREA #03
REFLOWING BAYONNE + THE BERGEN HOOK

Bayonne's drainage is limited by pump station capacity, so recommended actions focus on increasing sewer and pumping capacity and separating sewers to support conveyance. These recommendations are complemented by individual site protections, integration of resilience into waterfront parks, and coastal protections at Constable Hook.

LEGEND

COASTAL ALIGNMENTS

Coastal Barriers
- Flood Barrier
- Raised Walkway/Boardwalk
- Raised Roads
- Bulkhead Enhancement
- Planned Land Raising
- Areas for Adaptation
- Flood Gates
- Tie-Ins to High Ground

DRAINAGE SOLUTIONS

Underground Conveyance
- New Mains
- Piped Lines
- Sewer Separation

Retention & Storage
- Retention Sites
- Detention Sites

Outfalls & Pumping
- New Pump Station
- Enhance Existing Pump Station
- New Outfalls

GREEN INFRASTRUCTURE
- Pilot Resilience Hub
- Potential Resilience Hubs

Wetland Actions
- Restore Existing Wetland Functions

Green Infrastructure Corridors
- Primary Green Street
- Secondary Green Street

Greenways
- Proposed New Greenway Stretches
- Existing Greenways, Walkways & Boardwalks
- Greenway Corridors Proposed by Others

BAYONNE PHASING

Phase I (Years 1 to 3)

Phase 1 focuses predominantly on continued implementation of successful precedent projects in Bayonne, and planning for additional stormwater, green infrastructure, and site transformation projects, as well as engagement and initial planning around shoreline protections and sewer separation.

City

- Work with industry to explore bulkhead raising as first line of defense in Constable Hook
- Begin planning for walkway / park and bulkhead raising projects
- Plan for and begin sewer separation efforts

State

- Plan and begin implementing wetland restoration projects (NJDEP)

Major Property Owners / Infrastructure

- Integrate bulkhead elevation into replacement and repair cycle
- Explore opportunities to elevate walkways and parks
- Plan for Site and Building Level Adaptations in Port Jersey (PANYNJ)

Residents / Business/ Industry

- Integrate bulkhead elevation into replacement and repair cycle

Phase 2 (Years 4 to 7)

Phase 2 begins construction of smaller scale new green infrastructure, stormwater, and resilient transformation projects, as well as improvements to existing walkways. Planning and coordination begins for the pump station and force main projects, as well as the Route 440 and Rail Corridor flood protections and road raising projects.

City

- Begin planning force main projects
- Begin planning for road raising projects
- Initiate implementation of raised walkways
- Identify priority sites for building or area-level flood protection

Region

- Begin coordinating with Jersey City and Bayonne for Force Mains and Pump Stations to Kill van Kull
- Begin planning process to Protect parks and waterfront homes along Newark Bay

State

- Begin construction of Site and Building Level Adaptations in Port Jersey (PANYNJ)
- Begin planning for Route 440 and Rail Corridor Flood Protections (NJDOT)
- Continue wetland restoration projects (NJDEP)

Major Property Owners

- Integrate bulkhead elevation into replacement and repair cycle
- Elevate walkways and waterfronts with redevelopment

Residents / Business/ Industry

- Integrate bulkhead elevation into replacement and repair cycle

Phase 3 (Years 8 to 11)

By Phase 3, all current recommended capital projects are in planning or have begun construction.

City

- Complete walkway projects
- Begin planning the Constable Hook Barrier in collaboration with private property owners
- Initiate implementation of building or area level flood protection
- Complete planning and initiate implementation of remaining Phase 2 projects
- Implement road raising projects
- Implement Bergen Point flood protection

State

- Begin construction for Route 440 and Rail Corridor Flood Protections (NJDOT)
- Complete Port Jersey building and site level adaptations (PANYNJ)

Major Property Owners

- Begin planning the Constable Hook Barrier
- Initiate implementation of Constable Hook bulkhead raising
- Integrate bulkhead elevation into replacement and repair cycle
- Elevate walkways with redevelopment

Residents / Business/ Industry

- Integrate bulkhead elevation into replacement and repair cycle

Phase 4 (Years 12 to 15+)

In Phase 4, if funded, all current proposed projects could be in implementation with several actions pursued in Phase 1 complete, including those that will have the most immediate quality of life impacts: walkway improvements and raisings, sewer separations, and hopefully numerous green infrastructure, smaller scale stormwater, and resilient transformation projects.

City

- Implement Constable Hook Barrier in collaboration with private property owners
- Continue implementation to Protect parks and waterfront homes along Newark Bay
- Complete implementation of sewer separation and force main projects
- Complete sewer separation project

State

- Continue Route 440 and Rail Corridor Flood Protections

Major Property Owners

- Implement of the Constable Hook Barrier
- Complete walkway and bulkhead raising projects
- Integrate bulkhead elevation into replacement and repair cycle

Residents / Business/ Industry

- Integrate bulkhead elevation into replacement and repair cycle

CAPITAL PROJECTS FOR CONSIDERATION IN NEWARK

Key technical considerations

- Newark's sewer system dates to the mid nineteenth century, resulting in variability throughout the city on the capacity and condition of the drainage infrastructure.
- Historical drainage paths to Newark Bay have been filled in as the area has developed, and industrial and transportation properties have created barriers to drainage for neighborhoods like the Ironbound.
- Hundreds of contaminated sites are located throughout Newark, complicating the ability to manage stormwater locally and optimize the location of protection systems.
- Large properties owned and operated by the Port Authority of New York and New Jersey are located on the southern side of Newark. Careful coordination with the Port Authority is required to meet their needs while improving resiliency for the city.

Environmental benefits and considerations

- Newark is highly susceptible to heat impacts, which are only expected to become worse in the future. Adding distributed green infrastructure practices through the city will provide resiliency benefits in addition to reducing heat island impacts.
- Residents have reported instances of sewer back-ups into streets, which have possible health impacts due to exposure to raw sewage. Measures to remove bottlenecks and improve sewer system capacity will ensure proper functioning of the system.
- Residents have also reported exposure to toxic floodwaters, where water has mixed with toxic substances in industrial areas. Resilience projects that clean-up contaminated sites will address this issue while removing environmental stressors.

Social and economic benefits and considerations

- Flood risks in Newark are unevenly carried by low-income populations. Improving resiliency throughout the city makes it safer and more affordable for the entire community.
- Large public properties within the city can be leveraged to provide regional stormwater management, while also adding public improvements and amenities for Newark residents.
- Newark's industrial areas contribute to the local and regional economy by providing jobs and ensuring the movement of goods. Nevertheless, several people who participated in the Resilient NENJ process raised environmental justice and public health concerns about potential impacts from those uses to nearby communities and residents. It is therefore important to both protect those assets from climate hazards that could disrupt their function and exacerbate public health concerns, and also to find ways to reduce emissions, incorporate green space, and mitigate urban heat island effect. Such solutions could both improve quality of life and protect the regional economy.

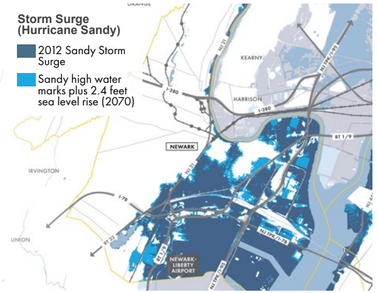
CAPITAL PROJECTS TO ADDRESS COASTAL STORM SURGE AND TIDAL FLOODING

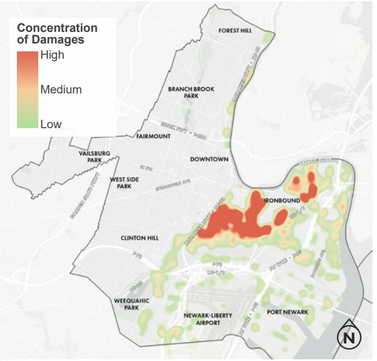
In Newark, coastal storm surge is expected to primarily impact the areas of the Ironbound neighborhood, Doremus Avenue, Newark Liberty International Airport, and Port Newark. Most of the land area that is currently east of Doremus Avenue and comprising the airport and port were formerly wetlands that were filled in. Based on the Flood Impact Assessment, the most significant damages from storm surge in Newark are expected to be incurred in the Ironbound neighborhood. The Newark Flanking Plan project, which is the preferred alternative recommended by the USACE Passaic River Tidal Area project, is expected to address a large portion of storm surge flooding for the Ironbound Neighborhood, which is one of the most densely populated neighborhoods within Newark. Resilient NENJ recommends advancement of this project, and the other recommended projects focus on the remaining areas of storm surge flood risk, primarily the Doremus area and portions of the Passaic River waterfront. Protection of PANYNJ's port and airport areas is also critical to the functioning of Newark and the wider region, and PANYNJ is advancing planning separately for mitigation of flooding at their assets.

The recommended strategy to address storm surge flooding relies on a series of physical barriers to block flood pathways, including both structures such as flood barriers and raised roadways. Raised roads along Corbin Street and several other segments could both protect transportation access while protecting inland areas from storm surge. These projects could integrate green infrastructure in their design for additional co-benefits. Areas that are east and north of the road raising and flood barrier alignment would be protected through phased bulkhead raising during repair and replacement, as well as through individual site protection. Bulkhead raising would also mitigate tidal or more frequent flooding over the longer-term. Resilient NENJ also recommends wetland restoration in the Newark Bay to create habitat, improve water quality, and provide wave attenuation.

What does that mean in terms of costs and losses avoided?

Resilient NENJ recommends about $3.1 billion in coastal flood protection projects in Newark over time that could cost $46 million annually for operations and maintenance. A high-level estimate for wetlands restoration accounts for about half of the costs due to the fact that removal of infrastructure would be required. Other significant shares of costs come from road raising, flood protection in the Doremus area, and protection of key energy assets. Costs don't incorporate on-site protection of PANYNJ and PVSC assets because those projects are underway following independent planning initiatives, but do include the Newark Flanking Plan current cost estimate. Investment in the Resilient NENJ Action Plan could address $11 billion in estimated losses from a single future Sandy event.





CAPITAL PROJECTS TO ADDRESS RAINFALL AND OTHER CLIMATE HAZARDS

Rainfall flooding impacts are already felt widely across Newark, especially in areas such as the Ironbound neighborhood, Ivy Hill, Vailsburg, and areas around Weequahic Park. Residents in these neighborhoods have reported experiencing flooding to varying extents almost every time that there is heavy rainfall, which impacts their mental health and quality of life. The Resilient NENJ Flood Impact Assessment estimates that, in addition to these areas, the most significant impacts from rainfall flooding could be in Roseville, West Side, Clinton Hill, and Upper Clinton Hill. As in other cities within the region, limited sewer capacity and increasing amounts of impervious surface exacerbate rainfall flooding.

The recommended approach to address rainfall flooding and other climate-related hazards includes a variety of strategies to reduce bottlenecks in the combined sewer system and improve its capacity through sewer separation, redirection, and distributed green infrastructure and stormwater management. The recommendations include improvements to the surface-level drainage ditch system in areas around Newark Airport to improve drainage in the Ironbound neighborhood. A regional parallel interceptor to convey additional flow to the PVSC Wastewater Treatment Plant, which is one of the alternatives under consideration for the PVSC LTCP, is key to the strategy for increasing sewer system capacity. The Ironbound, Downtown, Ivy Hill, Vailsburg, Mount Pleasant, and Broadway are neighborhoods where stormwater management through retention and detention sites will be key to addressing rainfall flooding. This can involve partnerships with universities, integration of stormwater management in existing public spaces, or integration of stormwater management into remediation projects for contaminated sites. Recommendations also include improvements to drainage associated with the lakes at Branch Brook Park and Weequahic Park, which are interconnected with the Newark sewer system, and exploration of sewer separation and deep tunnel opportunities.

Flooding along Doremus Ave caused by the remnants of Hurricane Ida.
Image Source: *Newark Office of Planning & Zoning*

Rainfall Areal Flood
Range indicates change from present to future modeled flood events

$2.7 - $3.0 Billion
In expected losses

5,900 - 6,300 Buildings
Impacted out of 25,000 total buildings

78,000 - 85,000 Residents
In impacted homes out of 280,000 residents

What does that mean in terms of costs and losses avoided?

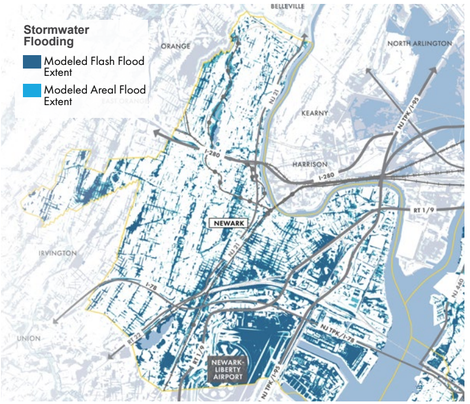
Resilient NENJ currently recommends about $2.7 billion in capital improvements to bring the city's stormwater system to a 5-year, 1 hour peak rainfall level of service and address other climate hazard related needs at the same time. These improvements could add about $40.4 million a year in annual maintenance costs once complete.

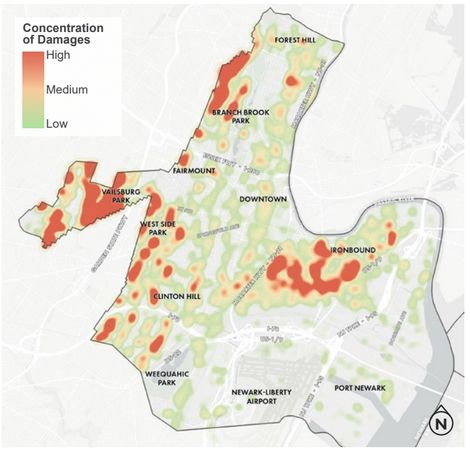
Resilient NENJ models for areal flooding (about 8 to 9 inches of rainfall over a 24-hour period) show $2.7 to $3 billion in expected losses for such an event (if it occurred citywide) in Newark. While the recommended improvements will not eliminate this magnitude of rainfall flood hazard, they could significantly reduce impacts, and major rainfall events are happening more and more frequently. Further, losses from flooding due to a much more frequent, 5-year event (about 4 inches of rainfall over a 24-hour period) could be about $510 million in the city, and the proposed actions would largely eliminate these losses. Over time, as rain falls and fewer losses and disruptions occur, these benefits will add up and more than make up for the investment.

5,900 to 6,300 out of 25,000 total buildings in Newark are at risk of flooding from a major areal flood event and stand to benefit from the proposed improvements

75,000 to 85,000 residents out of a total of 280,000 residents could directly benefit from flood risk reduction to their homes. The entire community could benefit from reduced roadway and community impacts.

Resilience is not just about reducing the hazard itself. Changing the way we work together, as outlined in **Section 3.3** of the roadmap, will also increase the benefits of these projects.

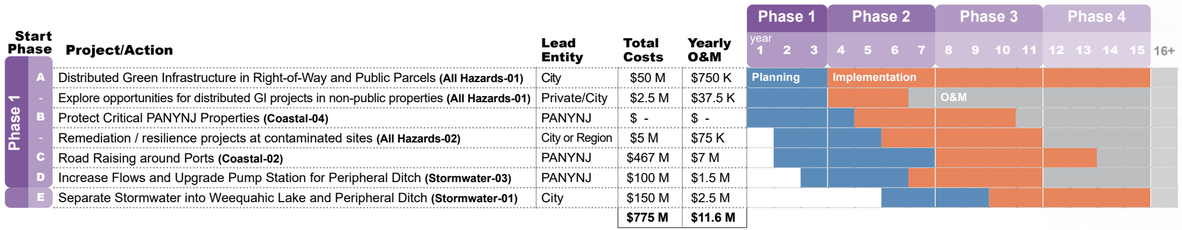




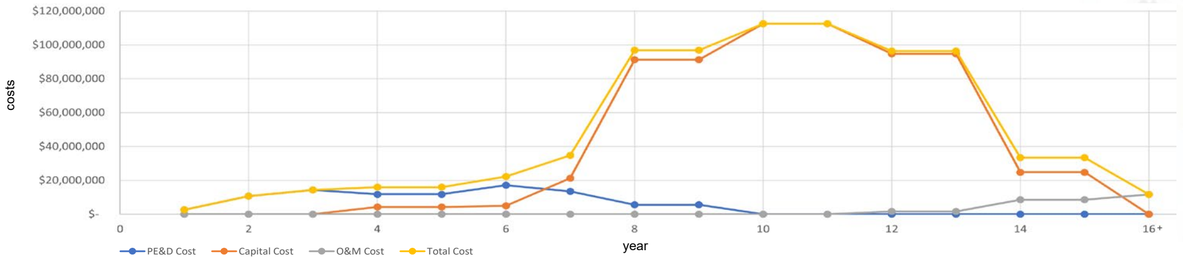
TIMELINE & COSTS

PROJECTS TIMELINE (GANTT CHART)

Start Phase		Project/Action	Lead Entity	Total Costs	Yearly O&M
Phase 1	A	Distributed Green Infrastructure in Right-of-Way and Public Parcels **(All Hazards-01)**	City	$50 M	$750 K
	B	Explore opportunities for distributed GI projects in non-public properties **(All Hazards-01)**	Private/City	$2.5 M	$37.5 K
	C	Protect Critical PANYNJ Properties **(Coastal-04)**	PANYNJ	$ -	$ -
	D	Remediation / resilience projects at contaminated sites **(All Hazards-02)**	City or Region	$5 M	$75 K
		Road Raising around Ports **(Coastal-02)**	PANYNJ	$467 M	$7 M
		Increase Flows and Upgrade Pump Station for Peripheral Ditch **(Stormwater-03)**	PANYNJ	$100 M	$1.5 M
	E	Separate Stormwater into Weequahic Lake and Peripheral Ditch **(Stormwater-01)**	City	$150 M	$2.5 M
				$775 M	**$11.6 M**

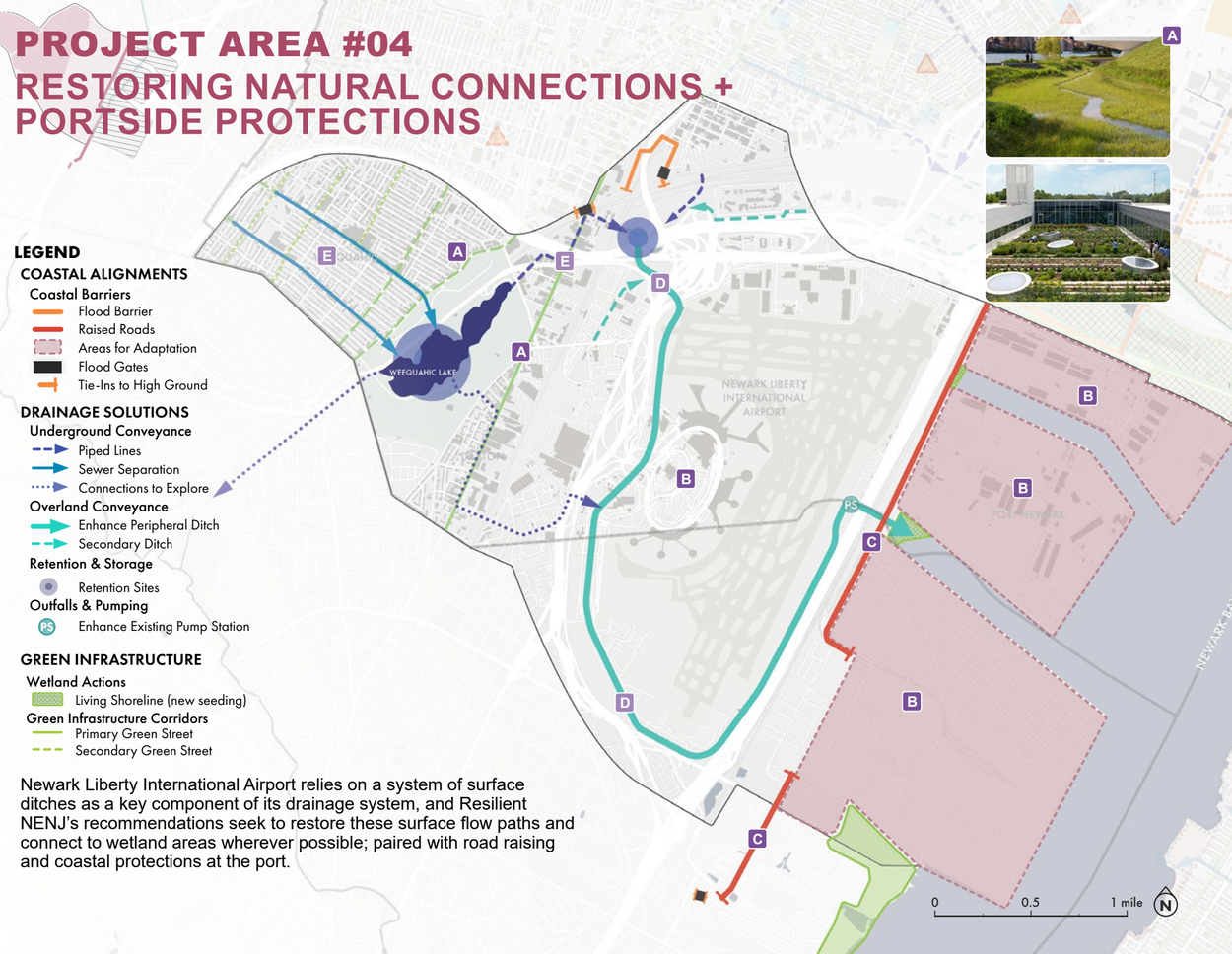


ESTIMATED COST NEEDS (YEAR OVER YEAR)



Recommended capital projects are concept only and, unless otherwise noted or already being advanced by other entities, require feasibility evaluations as next steps.

PROJECT AREA #04
RESTORING NATURAL CONNECTIONS + PORTSIDE PROTECTIONS

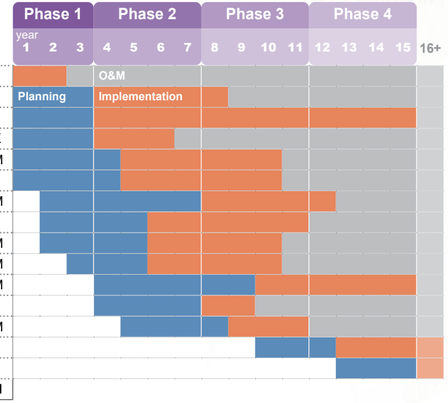


Newark Liberty International Airport relies on a system of surface ditches as a key component of its drainage system, and Resilient NENJ's recommendations seek to restore these surface flow paths and connect to wetland areas wherever possible; paired with road raising and coastal protections at the port.

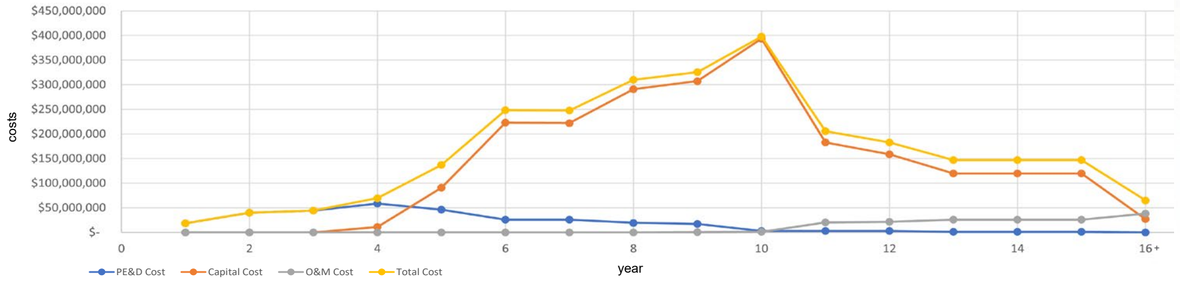
TIMELINE & COSTS

PROJECTS TIMELINE (GANTT CHART)

Start Phase		Project/Action	Lead Entity	Total Costs	Yearly O&M
Phase 1	F	Provide Site Protection for PVSC Treatment Plant **(Coastal-04)**	PVSC	$ -	$ -
	G	Remove Surface Flow Bottlenecks for Ironbound Drainage **(Stormwater-03)**	City	$40 M	$600 K
	H	Distributed Green Infrastructure in Right-of-Way and Public Parcels **(All Hazards-01)**	City	$50 M	$750 K
	-	Explore opportunities for distributed GI projects in non-public properties **(All Hazards-01)**	Private	$2.5 M	$37.5 K
	I	Alternatives to address air quality and flood risk at key sites in Doremus **(Coastal-04)**	PANYNJ	$489 M	$7.35 M
	J	Newark Flanking Plan **(Coastal-01)**	USACE	$45 M	$675 K
	K	Port Area Flood Barriers **(Coastal-01)**	PANYNJ	$311 M	$4.66 M
	-	Remediation / resilience projects at contaminated sites **(All Hazards-02)**	City or Region	$5 M	$75 K
	L	Doremus Flood Barriers **(Coastal-01)**	City	$644 M	$9.66 M
	M	Separate Stormwater from South St / South Ironbound to Jasper Creek **(Stormwater-01)**	City	$90 M	$1.35 M
	N	Ironbound Outlet Measures (wetland restoration visualized, alt: deep tunnel) **(Coastal-05)**	City	$700 M	$10.5 M
	O	Restore Newark Bay Wetlands **(Coastal-05)**	NJDEP	$30 M	$450 K
	P	Doremus Area Road Raising **(Coastal-02)**	City	$77.8 M	$1.17 M
	Q	Explore Sewer Separation along Raymond Boulevard **(Stormwater-01)**	City	$60 M	$900 K
	R	Passaic Riverfront Bulkhead Raising (during replacement and repair) **(Coastal-01)**	City	$30 M	$450 K
				$2.6 B	**$38.6 M**



ESTIMATED COST NEEDS (YEAR OVER YEAR)



Recommended capital projects are concept only and, unless otherwise noted or already being advanced by other entities, require feasibility evaluations as next steps.

PROJECT AREA #05
DRAINING THE IRONBOUND + DOREMUS DRY-LINE + NEWARK BAY LIVING SHORELINES (WEST)

The Ironbound neighborhood is lower in elevation than its surroundings and acts as a bowl that collects stormwater from surrounding areas during rain AND coastal events. The recommended actions drain the bowl and convey stormwater to living shorelines along Newark Bay. This in conjunction with the planned USACE Newark Flanking Plan, strengthened bulkheads, and inland coastal protections will create a more resilient Ironbound.

LEGEND

COASTAL ALIGNMENTS

Coastal Barriers
- Flood Barrier
- Raised Roads
- Bulkhead Enhancement
- Planned Land Raising
- Flood Gates
- Tie-Ins to High Ground

DRAINAGE SOLUTIONS

Underground Conveyance
- Planned Parallel Interceptor
- Piped Lines
- Sewer Separation
- Connections to Explore
- New Outfalls

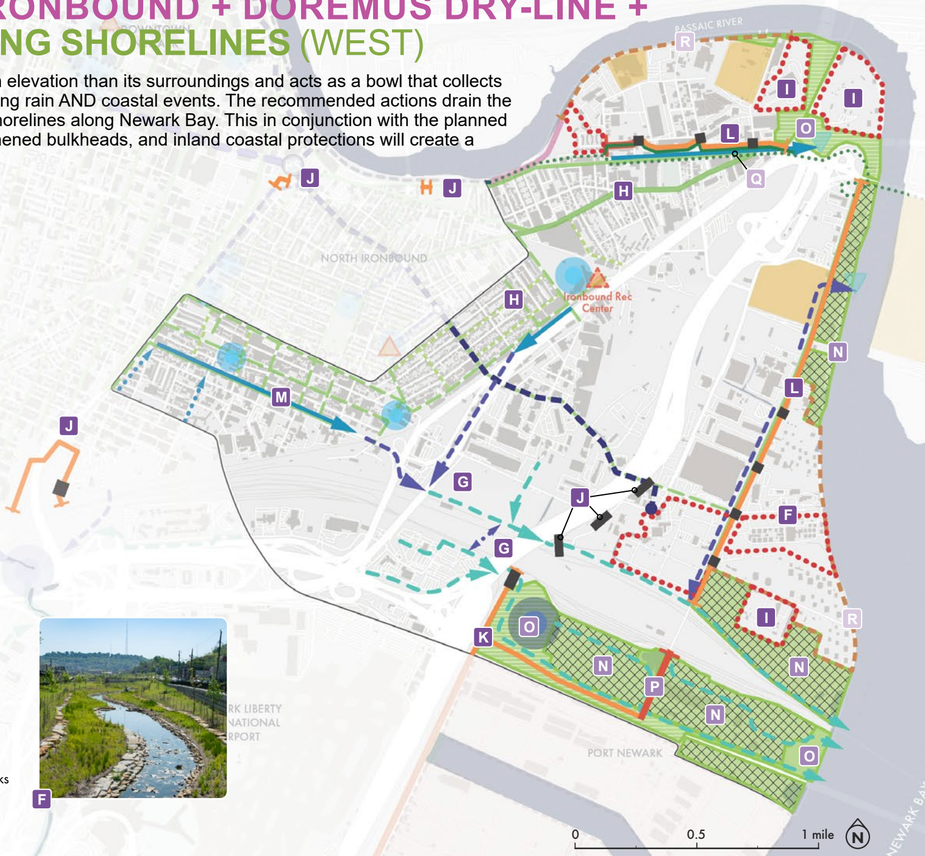
Retention & Storage
- Retention Sites
- Detention Sites

GREEN INFRASTRUCTURE
- Potential Resilience Hubs

Wetland Actions
- Enhance Existing Wetland
- Restore Existing Wetland Functions
- Living Shoreline (new seeding)
- Restored Wetlands (post retreat)

Green Infrastructure Corridors
- Primary Green Street
- Secondary Green Street

Greenways
- Proposed New Greenway Stretches
- Existing Greenways, Walkways & Boardwalks
- Greenway Corridors Proposed by Others

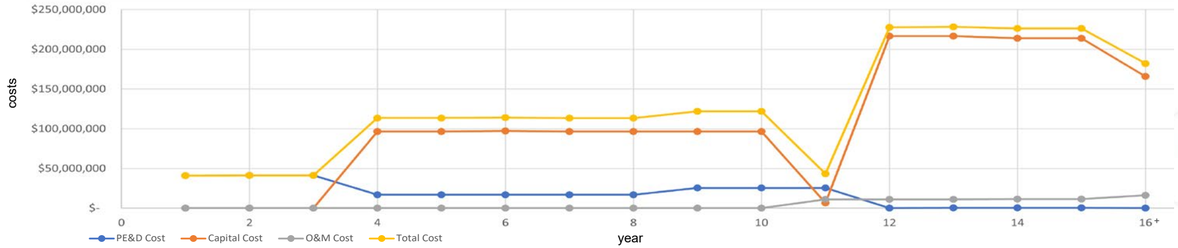


TIMELINE & COSTS

PROJECTS TIMELINE (GANTT CHART)

Start Phase		Project/Action	Lead Entity	Total Costs	Yearly O&M
Phase 1	S	Distributed Green Infrastructure in Right-of-Way and Public Parcels **(All Hazards-01)**	City	$50 M	$750 K
	T	Parallel Interceptor to PVSC Treatment Plant (LTCP) **(Stormwater-02)**	PVSC	$714 M	$10.7 M
	U	Partner with Universities for Retention Projects **(Stormwater-04)**	Institutions	$25 M	$375 K
	V	Expand Regional Retention Opportunities in the Ironbound **(Stormwater-04)**	City	$30 M	$450 K
	-	Explore opportunities for distributed GI projects in non-public properties **(All Hazards-01)**	Private/City	$2.5 M	$37.5 K
	-	Remediation / resilience projects at contaminated sites **(All Hazards-02)**	City or Region	$5 M	$75 K
	W	Downtown Deep Tunnel **(Stormwater-02)**	City	$900 M	$13.5 M
	X	Evaluate & Strengthen Riverfront Park Walkway **(Coastal-03)**	City	$256 M	$3.8 M
	Y	Passaic Riverfront Bulkhead Raising (during replacement and repair) **(Coastal-01)**	City	$14.5 M	$218 K
				$1.99 B	**$29.9 M**

ESTIMATED COST NEEDS (YEAR OVER YEAR)



Recommended capital projects are concept only and, unless otherwise noted or already being advanced by other entities, require feasibility evaluations as next steps.

PROJECT AREA #06
INTERCEPTING RUNOFF + PASSAIC PATHWAY

Solutions in this project area lean on the proposed parallel interceptor under consideration by PVSC to increase stormwater collection capacity, while addressing coastal flooding through bulkhead enhancement and connecting and greening downtown with drainage and green infrastructure improvements.

LEGEND

COASTAL ALIGNMENTS
- Coastal Barriers
  - Reassess Existing Walkway (over time)
  - Raised Roads
  - Bulkhead Enhancement
  - Tie-Ins to High Ground

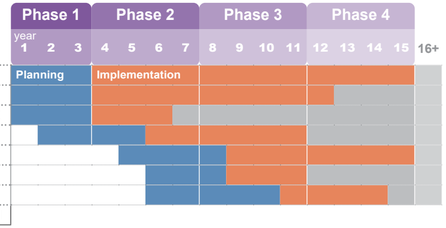
DRAINAGE SOLUTIONS
- Underground Conveyance
  - Planned Parallel Interceptor
  - Deep Tunnel
  - Piped Lines
  - Sewer Separation
  - Connections to Explore
- Retention & Storage
  - Detention Sites
  - Tie-Ins
- Outfalls & Pumping
  - New Pump Station

GREEN INFRASTRUCTURE
- Pilot Resilience Hub
- Potential Resilience Hubs
- Green Infrastructure Corridors
  - Primary Green Street
  - Secondary Green Street
- Greenways
  - Proposed New Greenway Stretches
  - Existing Greenways, Walkways & Boardwalks
  - Greenway Corridors Proposed by Others

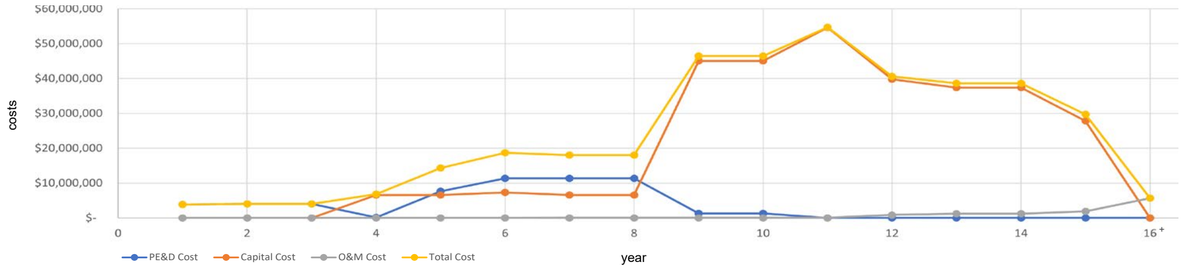
TIMELINE & COSTS

PROJECTS TIMELINE (GANTT CHART)

Start Phase		Project/Action	Lead Entity	Total Costs	Yearly O&M
Phase 1	Z	Distributed Green Infrastructure in Right-of-Way and Public Parcels **(All Hazards-01)**	City	$50 M	$750 K
	a	Expand Regional Retention Opportunities in Ivy Hill **(Stormwater-04)**	City	$25 M	$375 K
	-	Explore opportunities for distributed GI projects in non-public properties **(All Hazards-01)**	Private/City	$2.5 M	$37.5 K
	-	Remediation / resilience projects at contaminated sites **(All Hazards-02)**	City or Region	$5 M	$75 K
	b	Branch Brook Park and Neighborhood Improvements **(Stormwater-01)**	City	$200 M	$3 M
	c	Re-direct Branch Brook Park Overflows to Second River **(Stormwater-03)**	City	$50 M	$750 K
	d	Expand Capacity of Elizabeth River Tributary through Vailsburg **(Stormwater-03)**	City	$45 M	$675 K
				$377 M	**$5.66 M**



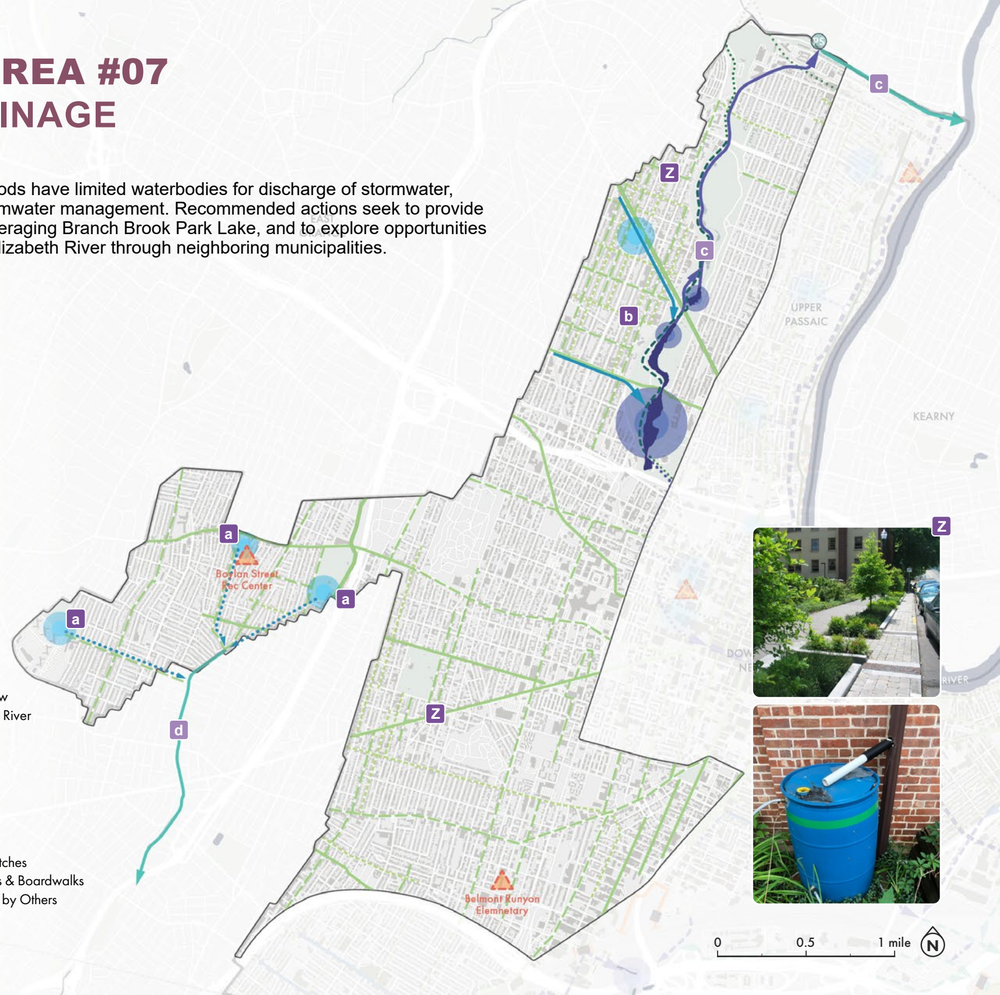
ESTIMATED COST NEEDS (YEAR OVER YEAR)



Recommended capital projects are concept only and, unless otherwise noted or already being advanced by other entities, require feasibility evaluations as next steps.

PROJECT AREA #07
INLAND DRAINAGE SOLUTIONS

Newark's western neighborhoods have limited waterbodies for discharge of stormwater, presenting challenges for stormwater management. Recommended actions seek to provide sites for storage, including leveraging Branch Brook Park Lake, and to explore opportunities for incraesing outflow to the Elizabeth River through neighboring municipalities.



NEWARK PHASING

Phase I (Years 1 to 3)

Phase 1 actions in Newark require significant interagency collaboration toward key stormwater projects, as well as the initiation of planning for stormwater projects within the City's purview in high-risk areas. Newark Flanking Plan continues to proceed and planning begins for Doremus Flood Barriers.

- Begin key initial collaboration efforts, as follow:
  - Begin to engage with the region and Seton Hall University and NJIT toward planning of stormwater management efforts to benefit Ivy Hill and Downtown, respectively
  - Engage with the Passaic Valley Sewerage Commission (PVSC) to begin planning for the parallel interceptor to the PVSC treatment plant as outlined in the Long-term Control Plan (LTCP)
  - Initiate planning to Increase Flows and Upgrade the Pump Station for the Peripheral Ditch in collaboration with PANYNJ
- Initiate planning to Remove Flow Bottlenecks for Ironbound Drainage
- Explore regional retention opportunities in Ivy Hill and Ironbound
- Initiate planning for Doremus Flood Barriers
- Begin considerations around separating stormwater from South Street and other areas in the Ironbound to Jasper Creek
- Target and prioritize Distributed green infrastructure in right of way and public parcels
- Support engagement around Port Area Flood Barriers and Road Raising around Ports in collaboration with the State, PANYNJ, and city of Newark

- Support engagement toward partnerships with Seton Hall University and NJIT toward planning of stormwater management efforts to benefit Ivy Hill and Downtown, respectively
- Initiate engagement to plan to Increase Flows and Upgrade the Pump Station for the Peripheral Ditch in collaboration with the City of Newark and PANYNJ
- Support engagement around Port Area Flood Barriers and Road Raising around Ports in collaboration with the State, PANYNJ, & city of Newark

- Partner with the City of Newark and the region to begin to explore the retention project recommendations in Ivy Hill and Downtown (Seton Hall University and NJIT)
- Continue planning to protect key energy, airport, and port assets (PANYNJ)
- Begin planning for Port Area Flood Barriers and Road Raising around Ports in collaboration with the State, region, and PANYNJ
- Complete flood protection solutions underway at PVSC (Sewer Authority)
- Initiate planning for the parallel interceptor to the PVSC treatment plant as outlined in the LTCP (PVSC)
- Initiate planning to Increase Flows and Upgrade the Pump Station for the Peripheral Ditch in collaboration with the City of Newark

- Plan and engage around the Newark Flanking Plan initiative (USACE)

Phase 2 (Years 4 to 7)

Phase 2 sees several early projects move toward construction, assuming necessary funding and coordination occurs during the Phase 1 period. Phase 2 requires significant capacity from the city and key stakeholders to initiate and continue collaboration and bring new key projects into design while transitioning existing projects to construction.

- In collaboration with Seton Hall, begin construction of the retention projects to benefit Ivy Hill (Stevens)
- Work with PVSC to initiate planning for the Downtown Deep Tunnel (Sewer Authority)
- Initiate construction of the following Phase 1 planning & design projects:
  - Remove Surface Flow Bottlenecks for Ironbound Drainage
  - Regional retention opportunities in Ivy Hill and Ironbound
  - Doremus Flood Barriers
  - Separating stormwater from South Street and other areas in the Ironbound to Jasper Creek
- Initiate planning for the following projects:
  - Doremus Area Road Raising
  - Branch Brook Park and Neighborhood Improvements
  - Re-direct Branch Brook Park Overflows to Second River
  - Separate Stormwater into Weequahic Lake and Peripheral Ditch
  - Expand Capacity of Elizabeth River Tributary through Vailsburg
- Support engagement around Port Area Flood Barriers and Road Raising around Ports in collaboration with the State, PANYNJ, and city of Newark

- As needed, support engagement with the City of Newark and PVSC toward the Downtown Deep Tunnel project
- Support engagement around Port Area Flood Barriers and Road Raising around Ports in collaboration with the State, PANYNJ, and city of Newark

- Begin construction of the retention projects to benefit Ivy Hill (Seton Hall)
- Initiate construction for key projects protecting critical energy, airport, and port assets (PANYNJ)
- Continue planning for road raising and flood barriers around ports (PANYNJ)
- Develop design and move Peripheral Ditch project toward implementation
- Initiate construction for the parallel interceptor to the PVSC treatment plant as outlined in the LTCP (PVSC)
- Initiate planning for the Downtown Deep Tunnel (PVSC)

- Initiate planning for wetland restoration projects (NJDEP)
- Restore Newark Bay Wetlands (NJDEP)

- Initiate construction of the Newark Flanking Plan (USACE)

NEWARK PHASING *CONTINUED*

Phase 3 (Years 8 to 11)

Like Phase 2, Phase 3 requires significant capacity from the city to move major initiatives through planning and construction. Regional and state support in navigating interagency coordination needs during this time could be supportive. This is a time of significant construction activity in various areas across the city and car will be needed to manage impacts to residents.

- Continue to coordinate with PVSC toward the planning and design for the Downtown Deep Tunnel project
- Finalize planning & design and begin to move projects toward construction:
  - Doremus Area Road Raising
  - Separate Stormwater into Weequahic Lake and Peripheral Ditch
  - Expand Capacity of Elizabeth River Tributary through Vailsburg
- Complete the existing sewer separation projects and Doremus Area Road Raising
- Begin construction of Branch Brook Park and Neighborhood Improvements
- Complete re-direction of Branch Brook Park Overflows to Second River
- Complete the following projects that began construction in Phase 2:
  - Remove Surface Flow Bottlenecks for Ironbound Drainage
  - Doremus Flood Barriers
  - Separate Stormwater from South Street and other areas in the Ironbound to Jasper Creek
- Initiate planning to:
  - Strengthen Riverfront Park Walkway
  - Explore Sewer Separation along Raymond Boulevard

- As needed, continue to support engagement with the City of Newark and PVSC toward the Downtown Deep Tunnel project
- Support engagement around Port Area Flood Barriers and Road Raising around Ports in collaboration with the State, PANYNJ, and city of Newark

- Continue planning and design for the Downtown Deep Tunnel (PVSC)
- Complete construction and move toward closeout of the Parallel Interceptor project as outlined in the LTCP (PVSC)
- Complete the Peripheral Ditch project (PANYNJ)
- Begin construction of Port Area Flood Barriers Barriers and Road Raising around Ports in collaboration with the State, region, and city of Newark (PANYNJ)

- Construct wetland restoration projects projects and other Ironbound outlet measures (NJDEP)
- Complete construction and begin closeout of key projects to protect critical energy, airport, and port assets

- Continue construction of the Newark Flanking Plan and begin to close out the project (USACE)

Phase 4 (Years 12 to 15+)

The Newark Flanking Plan should be completed by this time, as well as several other major projects in coordination with multiple agencies. Bulkheads along the waterfront should be replaced at a higher elevation to address high tides during their repair and replacement cycles. Work in wetlands restoration, as well as coastal and stormwater projects, continue.

- Complete:
  - Regional Retention Opportunities in the Ironbound
  - Regional Retention Opportunities in Ivy Hill
  - Distributed Green Infrastructure in Right-of-Way and Public Parcels
- Begin to construct sewer separation along Raymond Boulevard
- Ensure that the Passaic Riverfront is raised during the natural replacement and repair cycle
- Construct and complete Riverfront Park Walkway Improvements

- Continue to support engagement around Port Area Flood Barriers in collaboration with the State, the City, and PANYNJ

- Closeout retention projects in partnership with Newark that will benefit Ivy hill residents (Seton Hall)
- Initiate construction of the Downtown Deep Tunnel project (PVSC)
- Move to complete the Port Area Flood Barriers and Road Raising around Ports (PANYNJ)
- Raise bulkheads during repair and replacement cycle

- Complete Newark Wetland Restoration project and other Ironbound Outlet Measures (NJDEP)

- Closeout the Newark Flanking Plan project (USACE)

5.2

ROADMAP FOR NON-CAPITAL ACTIONS - POLICY AND GOVERNANCE, OUTREACH, SERVICE AND PROGRAM DEVELOPMENT, & EMERGENCY PREPAREDNESS SOLUTIONS

The recommended strategy unites a series of capacity building measures, outreach campaigns, new or enhanced programs, policy changes, and governance structures to increase resilience. These actions complement capital projects (and vice versa). With the exception of ordinance improvements, most of these actions do not focus on reducing hazards directly. Instead, they reduce risk by improving community preparedness and **adaptive capacity** to dealing with the presence of hazards.

Since the risk from hazards like flooding and heat are already significant in the region today, and because many capital projects to physically reduce risk have longer timelines for implementation, measures that increase adaptive capacity are important to implement in the near-term. They fill the gap between now and when physical changes can happen and also can help reduce risk that will remain once those physical changes are in place (it is impossible to eliminate risk). Policy measures can also make sure that risk is not added due to business-as-usual decision making. Some of the recommendations will also help leaders make more effective use of time and funds, or will provide community members with resources to mitigate their own risks. Resilient NENJ has already begun implementing some of the recommendations during development of this Action Plan, and examples of these efforts are included in **Section 3.3**.

WHAT IS ADAPTIVE CAPACITY?

Adaptive capacity is the ability of communities, institutions, or people to adjust to potential hazards, to take advantage of opportunities, or to respond to consequences. Having strong adaptive capacity contributes to resilience—the ability to prepare and plan for, absorb, recover from, and more successfully adapt to adverse events. In the context of extreme events, people with low adaptive capacity have difficulty responding, evacuating, or relocating when necessary, and recovering from event-related health impacts.

HOW DO WE DETERMINE WHO TO TARGET IN OUTREACH?

As the Action Plan moves deeper into implementation, this tool and others descried in **Appendix I**, will continue to be critical to improving Resilient NENJ engagement processes and outcomes. For example, this tool should be used at the beginning process for any major decision or milestone to determine who must be brought to the table.

Other good questions to ask:

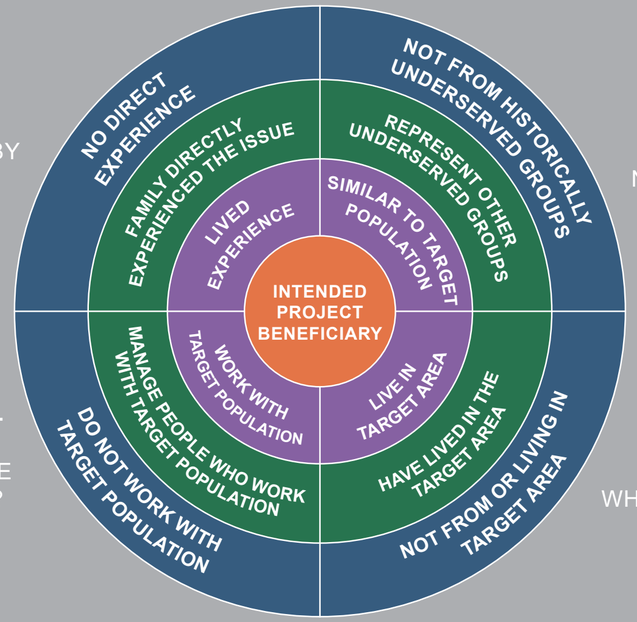
- *Who could be affected by the outcome or process of making this decision?*
- *Who could affect the outcome or process of making this decision?*

ISSUE EXPERIENCE

WHO HAS BEEN DIRECTLY IMPACTED BY FLOODING?

DEMOGRAPHIC RELEVANCE

WHO HAS BEEN HURT, UNDERSERVED, OR NOT REPRESENTED BY SIMILAR EFFORTS IN THE PAST?



DIRECT ENGAGEMENT

WHO WORKS WITH THE TARGET POPULATION?

GEOGRAPHIC RELEVANCE

WHO LIVES IN THE AREAS MOST AFFECTED?

What is the strategy?

COORDINATE

Central to many of the recommendations in this plan is continued regional coordination by the Resilient NENJ Region Team / Steering Committee. There are many benefits to regional coordination, such as pooling of shared resources, sharing of best practices, and more effective advocacy for funding. Many actions could most effectively be led at a regional scale (although they could still be implemented at local scales), such as the Resilience 101 campaign, the outreach ambassador program, programs to provide resilience-related resources to residents, and coordination with infrastructure entities. Although each of the four cities has a unique character, there are many shared qualities across the region, and many residents work and play in other cities within the region. Therefore, while other actions might make more sense at local scales because there are already existing processes in place for implementation, coordination to ensure consistency across the region could be beneficial.

Significant coordination will be needed between the municipalities, utilities, and infrastructure entities to implement the physical and nature-based capital project recommendations of this Action Plan. The recommendations seek to leverage opportunities for integration of projects that advance multiple goals into a single program, or a "dig once" approach. One example is integrating stormwater improvements, such as a deep tunnel spine or other drainage corridor, with the New Jersey Turnpike Authority's (NJTA) Newark Bay-Hudson Corridor Extension Program, which would require coordination between NJTA, municipalities, and sewer utilities. The Long-Term Control Plans for combined sewer utilities are another area where coordination will maximize flood mitigation and water quality benefits from the LTCP projects and resilience actions. The Action Plan recommends creation of a Regional Infrastructure Coordination Council to serve as the platform for this coordination and to proactively identify other opportunities for integration.

CLARIFY

Availability of clear, concise information is critical to successful decision-making at all levels. Many of the recommendations in this plan contribute to creation of a "single source of truth" related to resilience information. State agencies, such as NJDEP, can play a role by reviewing information, reviewing duplication, improving consistency and linkages to other resources, and using consistent branding on authoritative information. Stakeholders at all scales can take similar measures to improve their own information, increase transparency by ensuring websites are kept up to date and reflect ongoing efforts, and connect to other ongoing initiatives.

These information improvements will help leaders do their jobs more effectively by providing guidance on the tools, data, and models to use. Capacity at the local level can also be expanded by increasing staff dedicated to resilience and providing staff trainings (including trainings and exercises for emergency management teams), and this Action Plan recommends additional state funding to advance these goals.

The "single source of truth" will also support community members in making decisions by providing authoritative information about risks and how they are changing, how to prepare for and mitigate risks, and how to access resources after disasters. The information can be reflected in a Resilience 101 campaign that could use a range of engagement strategies and platforms to reach residents.

COMMUNICATE

Measures such as the outreach ambassador program and resilience hubs will support the sharing of the Resilience 101 campaign and other information throughout communities, so that people have access to useful information. These efforts will target and improve outreach to the most at-risk people. An outreach ambassador program will create paid positions for community members to serve as local leaders and liaisons for their neighbors. Outreach ambassadors will guide people in using the Resilience 101 campaign resources and could help alert people through door-knocking or other communications in advance of climate-related disasters. Due to the funding needs to create paid positions for the outreach ambassador program, Resilient NENJ could seek funding to advance the program at a regional scale. Resilience hubs could serve as central spaces for outreach ambassadors and could have printed copies of Resilience 101 campaign materials for sharing with residents. This plan recommends that resilience hubs are created as opportunities arise at places such as community centers, schools, public housing, or places of worship, and that they integrate risk mitigation components such as green infrastructure, stormwater management, or heating and cooling features. Pilot projects could be led by each city, using a consistent model across the region and integrating resources from the Resilience 101 campaign.

EMPOWER

While many of the actions included in this Action Plan are the responsibility of state agencies, local or county government, utilities, or infrastructure entities, all community members can play an important role in preparing for and adapting to climate change. Several recommendations are for creation of programs, guidelines, resources, or requirements by Resilient NENJ or the municipalities that empower community members to be part of the solution.

One way that community members can contribute is through waste reduction efforts, which improve water quality and prevents clogged catch basins that contribute to flooding. Adopt-a-catch-basin programs can be advanced or created to give community members responsibility for adopting and cleaning a catch basin. Other programs could provide residents with low-cost or free resources to mitigate risk, such as rain barrels (could be part of a small-scale green infrastructure program) or air conditioners.

Municipalities have ordinances, zoning resolutions, and building codes that set requirements for development and construction. Updating these requirements is an effective way for the municipalities to guide resilient actions by individual property owners, such as by requiring green infrastructure, reduced impervious surface, and higher construction elevations, as well as requiring new developments to separate stormwater from the CSO system wherever appropriate and to resolve existing stormwater flooding issues on adjoining public streets. Updates to these requirements can be completed within several months, and therefore are low-hanging fruit actions that could be advanced quickly. Two ordinances that are especially relevant for resilience are Flood Damage Prevention ordinances and Stormwater Management Ordinances, and Resilient NENJ recommends that each municipality adopts higher standards in these ordinances, in a coordinated manner for consistency across cities. At the state level, requirements associated with the contaminated site remediation process, managed by NJDEP, could be updated to ensure that remedial designs integrate climate change considerations so that cleaned up sites do not have lasting risks.

Although the Resilience 101 campaign could provide high-level information for residents to mitigate risk, more detailed resources such as Resilient Building Design Guidelines could support residents in retro-fitting their properties to protect them from flooding and other climate-related hazards. Hoboken and Jersey City already have some form of Resilient Building Design Guidelines, so Newark and Bayonne could use these examples as models, and the region could coordinate to ensure consistency. The guidelines should align with local requirements and help residents stay or become compliant. Some residents have the means to make improvements to their homes but are seeking guidance on how to cost-effectively do this. Other residents may need additional support to be able to implement changes, which could be provided through tax incentives or rebates, grant programs that fund projects, or low-interest loans. These elements could be part of a small-scale green infrastructure program, for example, to increase distributed green infrastructure practices on private properties.

EXPEDITE

Vacant, underutilized, or contaminated sites, if remediated and redeveloped, are prime opportunities to integrate stormwater management, open space, or other economic benefits. Existing park space can also be upgraded to incorporate stormwater management or other resilience components. These strategies are important components of this Action Plan because there are widespread opportunities for these projects across the region, and because they could create multiple benefits such as creating or enhancing open space, mitigating hazards such as flooding or urban heat island effect, and providing recreational value. This Action Plan (see **Section 3.2.3**) provides recommendations for prioritizing sites for transformation based on factors such as how much risk a project could eliminate, how many people would benefit, and how feasible a project might be. By prioritizing sites, the region could create a "pipeline" of projects to advance into feasibility studies, design, and construction. The NJDEP Green Acres Program could be a key part in implementing projects that transform sites, because they provide funding for open space projects. These types of site transformation projects are allowable within existing Green Acres requirements, but part of the Resilient NENJ recommendations is for the Green Acres Program to develop guidelines that clarify the approvals process to expedite projects.

HOW WILL THIS CHANGE OUR COMMUNITY?

SOCIAL AND RECREATIONAL BENEFITS AND IMPACTS

- Decision-making related to resilience and development will be streamlined and simplified with the availability of clear, concise information associated with the “single source of truth”
- Repeated disruption from construction will be minimized through coordinated construction timelines from multiple projects utilizing the “dig-once approach,” which will also translate to more effective use of tax dollars
- Efforts such as the Resilience 101 campaign, youth engagement, outreach ambassador program, adopt-a-catch-basin program, community gardens, clean-up days, and small-scale green infrastructure program will engage, involve, and educate community members about issues related to resilience and addressing the challenges. These programs will empower community members to take action and be part of the solution, while advocating for dedicated attention to resilience from higher scales of leadership.
- The Resilience 101 campaign, which will increase knowledge and connect community members to more detailed information, combined with capacity-building around flood insurance, will better position people to avoid impacts from climate-related disasters, reducing economic, physical health, and mental health impacts. Combined with Resilient Building Guidelines and increased access to resilient-related resources, community members will have more tools to directly mitigate their risks.
- Resilience hubs can provide enhanced community spaces for gathering, education, and creativity. Green infrastructure projects, which also can be integrated into the design of resilience hubs, can create educational opportunities for students to learn about nature, stormwater, and design.
- The recommended actions can have economic benefits through creation of green jobs. A small-scale green infrastructure program can incorporate a job training component that creates positions for people to support implementation of green infrastructure projects. The recommended outreach ambassador program will create paid positions for local community members to serve their neighborhoods.knowledge of what it will take to get this critical work done so that they can help plan and advocate appropriately.

ENVIRONMENTAL BENEFITS AND IMPACTS

- Although incremental and distributed, the small-scale green infrastructure program could contribute to mitigation of urban heat island effect through reduced impervious surface and use of green materials.
- The waste reduction campaign, along with other actions such as composting programs, and adopt-a-catch basin programs, can reduce trash in streets that can make its way into waterbodies and affect water quality and aquatic life. These efforts will create cleaner streets to improve quality of life in communities while reducing a contributor to flooding.

BENEFITS AND IMPACTS TO SOCIALLY VULNERABLE POPULATIONS

- The proposed outreach ambassador program will increase resilience of the most at-risk and historically excluded people by empowering leaders from these communities and leveraging existing relationships to reach people.
- The proposed strategy includes a variety of actions that improve outreach with and warnings to people who may be more difficult to reach, such as people who are blind, Deaf, hard of hearing, elderly, non-English speaking, or people with physical disabilities. Outreach that uses multiple types of engagement channels in multiple languages, warning systems through sirens, and use of the NJ Register Ready system are examples of recommendations that could improve inclusivity of these people and thereby reduce their risk.
- Higher standards in ordinances, such as requirements to incorporate green infrastructure or construct or re-construct buildings at higher elevations, often mean higher costs for construction. These impacts could be felt most by people who are lower income, and therefore it is important for these standards to be accompanied by incentives and grant programs for funding.

FEEDBACK THAT HAS CONTRIBUTED TO THE RECOMMENDATIONS

Many of the recommendations in this Action Plan were derived directly from community feedback pointing to the need for a focus on outreach, education, capacity building, and community programs. Feedback has highlighted:

- **That local government has limited capacity to focus on resilience, with competing time interests and a need for additional training and resources.** This points to the need for capacity building and greater allocation of resources and staff at the local scale, as well as greater support from the county and state levels. Local leaders also provided feedback about “portal proliferation syndrome” or the phenomenon of there being an overwhelming number of tools, applications, and resources. Creation of a “single source of truth” will support capacity building and guide leaders and decision-makers.
- **The importance of community outreach being led by local community-based organizations and individuals.** These grass-roots groups already have strong relationships and are trusted by community members and leaning on them for outreach related to resilience can both be more effective and empower them to become more involved. Community-based organizations are key to reaching vulnerable populations and those who have historically been excluded. This feedback contributed to development of the outreach ambassador program recommendation.
- **That it is difficult to know where to go for information and resources before, during, and after disasters.** People expressed not understanding their risks, not knowing who to contact, and needing to be better informed about preparedness, recovery, and actions that local governments are taking to address issues. Recommendations such as the Resilience 101 campaign, improved availability of information on websites, and creation of resilience hubs came out of this feedback. People also provided feedback about education being an important part of the solution, especially education of youth, as they will be the leaders of tomorrow. If people know the possible consequences of actions or inaction, they will more likely be driven to advocate for change.

Community tree planting event.
Image Source: *City of Jersey City*

FUNDING PATHWAYS

Although there are lower costs associated with many of the recommended non-physical actions compared to the capital projects, the majority will still require some level of funding allocation or new funding sources. **Section 4.0** *Implementation Pathways* provides examples of funding opportunities for the four categories of actions, and **Appendix C** *Funding Sources* provides additional detail on these funding options. **Appendix A** *Actions and Implementation Table* provides examples of specific funding sources for each action type.

Example ways that different entities can contribute to resourcing Resilient NENJ recommendations for actions that are not capital improvements

Federal/State/ County/Municipal	• Grants • Funding allocations • Provide staff support
Community-based organizations	• Contribute time and energy to the initiatives
Residents and Business owners	• Donate to local community-based organizations • Contribute time and energy to the initiatives

View across the Newark Bay from the boardwalk of Bayonne's Rutkowski Park.

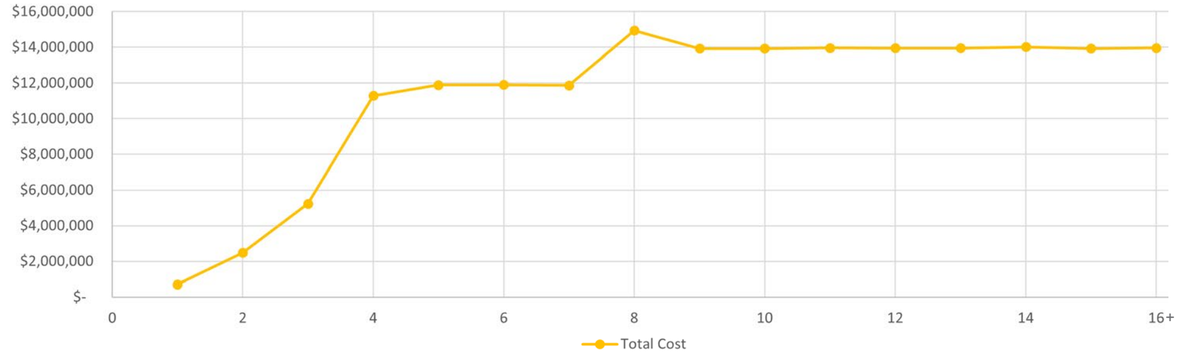
Image Source: *Hudson County Division of Planning*

YEAR OVER YEAR EXPECTATIONS

Where are we at in planning? How confident are we in costing and scheduling?

Cost expectations for the non-physical actions are highly variable because these actions are scalable. As such, costs can be thought of as estimates for budgeting purposes. The team developed costs and schedules based on expected level of coordination and timeframes informed by the project team's experience with similar projects.

REGIONAL ESTIMATED COST NEEDS (YEAR OVER YEAR)



PHASING

The phasing on the following pages summarizes actions by entity by timeframe in order to accomplish recommendations for outreach, education, and capacity building, policy and governance, service and program development, and emergency response and preparedness. Most actions are front-loaded, meaning Resilient NENJ recommends early action to maximize and begin building on benefits immediately. See **Appendix A** for additional detail on estimated costs and phasing of non-physical actions.

The following supportive activities are necessary across all phases, and so are not repeated in the sections below in the interest of space. Readers can find additional detail by action in **Section 3.0**.

- Continue to track, coordinate, and support funding opportunities and pursuits
- Allocate staff and budget to advance recommendations
- Share information across available channels
- Advance local policy and land use recommendations

- Monitor and drive implementation of regional initiatives identified in the Roadmap in **Section 5.0** and recommendations in **Section 3.0**.
- Continue to track, coordinate, and support funding opportunities and pursuits
- Provide a forum for engagement and coordination around recommendations, including with emergency management community
- Help connect stakeholders to empower coordinated action
- Continue to share resources and best practices across the region
- Continue to publish information about what is happening in the region
- Continue to develop and share engagement materials and collaborate on engagement activities where applicable
- Continue to explore the development of program frameworks based on best practices (e.g., to support composting), as applicable
- Continue regional art coordinator position to help drive inclusive engagement and elevate local voices in resilience

- Integrate near-term projects in federal Action Plans (e.g., CDBG-DR and HMGP) for funding and pursue additional congressional allocations
- Allocate state funding to support implementation activities
- Coordinate with the region to support advancement of key projects
- Allocate staff to help advance Resilient NENJ recommendations to State agencies
- Ensure connectivity and alignment between various state initiatives to provide clarity and streamline action at state, regional, and local scales
- Offer training to municipalities to incorporate resilience into planning & policy
- Continue to publish state-level guidance for municipalities on tools, data, and models to use for decision-making

- Allocate funding toward implementation of proposed projects
- Continue to participate in Resilient NENJ initiatives and engagement processes, as appropriate.
- Ensure federal funding allocations are structured to support actions that build resilience identified through Resilient NENJ.
- Continue to improve communications related to federal programs
- Continue to improve the efficiency and effectiveness of federal post-disaster programs
- Continue and expand engagement around activities of federal agencies that are resilience-related or affect resilience in the region

- Reach out to local, state, and federal elected officials to support relevant project recommendations
- Participate in project action and engagement opportunities (join Resilient NENJ mailing list or follow Resilient NENJ on social media to stay up to date on opportunities)
- Support funding of local community-based organizations to help drive implementation
- Take photos of hazard impacts and incorporate experiences into reporting systems / communicate experiences to local municipalities, utilities, and the region

- Reach out to local, state, and federal elected officials to support relevant project recommendations
- Support funding of local community-based organizations to help drive implementation
- Participate in project action and engagement opportunities
- Encourage / reward staff volunteer hours associated with engagement in resilience and waste reduction programs to promote involvement in these programs and support implementation

- Reach out to local, state, and federal elected officials to support relevant project recommendations
- Stay deeply engaged to help drive implementation and engagement around actions
- Partner on funding opportunities, where appropriate
- Participate directly in the goals, development, and implementation of Resilient NENJ initiatives
- Provide consultation to municipal leaders on what is working and not working, of people who are being left out, and of adjustments needed
- Encourage student volunteer hours and credits associated with engagement in resilience and waste reduction programs to promote involvement in these programs and support implementation

WHAT'S HAPPENING NOW

The following actions related to non-capital recommendations are already underway. For more on recommendations for policy-related updates, please see **Appendix E**.

KEY

Resilient NENJ maps roadmap steps to action descriptions for clarity. In the interest of space, this section makes use of abbreviations, as follows:

Policy
Policy and Governance (**3.3.1**)

All Hazards
Policy and governance actions under section **3.2.3** (Actions that address other climate-related and environmental justice needs)

Outreach
Outreach, education, and capacity building (**3.3.2**)

Service
Service and program development or enhancement (**3.3.3**)

EM
Emergency management and preparedness (**3.3.4**)

The numbering references the number of the action in that section. For example, **Outreach-02** refers to action number 2 in the section on Outreach, education, and capacity building (**Section 3.3.2**), which happens to be "Expand municipal leadership and capacity to manage climate risk."

- Update stormwater management ordinances (**Stormwater-07**). Jersey City and Hoboken has updated their ordinance with higher standards for stormwater management in redevelopment or new construction projects. Bayonne and Newark updates are in progress as of the writing of this Action Plan.
- Update flood damage prevention ordinances (**Coastal-07**)
- Adopt-a-catch-basin programs already exist in Jersey City in Newark. Municipal composting programs are already underway in Jersey City[1] and Hoboken[2] (**Service-02**), which involve free drop-off locations for compositing, low-cost composting pick-up, and/or low-cost materials to support backyard composting, depending on the program
- The City of Hoboken has a Chief Resilience Officer who manages the City's resilience strategy. Newark and Jersey City have Chief Sustainability Officers; these positions and staffing could potentially be expanded to increase resilience-related capacity (**Outreach-02**).
- Hoboken has an active Community Emergency Response Team (CERT) that trains residents in disaster preparedness (**Outreach-05** and **Emergency-01**)
- Hoboken has webpages to provide information on their ongoing work related to Stormwater Flood Mitigation and Coastal Flood Mitigation (**Outreach-04**). All four cities provide updates about projects through social media and the news media.
- Newark and Hoboken developed interactive flood reporters where community members can report flood locations. Jersey City and Bayonne's interactive reporters are underway (**Outreach-07**).
- The cities have begun to incorporate resilience-related higher standards into redevelopment projects. For example, Bayonne requires redevelopers to incorporate considerations related to stormwater retention, sewer separation (where feasible), and compliance with or exceedance of building code and NJDEP elevation standards. Hoboken has integrated green building design standards in redevelopment plans (**Coastal-06**).
- Hoboken, Newark, and Jersey City have stormwater utility feasibility studies underway or beginning as of September 2022.
- Hoboken has developed Resilient Building Design Guidelines and Jersey City has developed a Resilient Design Handbook (**All Hazards-03**).

- Youth engagement and Resilience 101 campaign
- Identify candidate locations for pilot resilience hubs (**Service-01**). Through the Resilient Northeastern NJ program, the City of Newark submitted an application for FEMA's BRIC grant program for creation of an Ironbound Resilience Hub, which would serve as a central location for information about resilience and climate disasters, a cooling center, and incorporates green infrastructure.
- Develop bylaws for decision making, to include voting procedures to identify which initiatives the Steering Committee or subgroups will pursue (**Policy-01**). The Steering Committee is currently advancing near and long-term planning for continuation of Resilient NENJ regional coordination.

- Provide guidance to more quickly integrate stormwater management in open space (**Stormwater-06**). Resilient NENJ and NJDEP Green Acres have been coordinating to develop guidelines.
- The State's Interagency Council on Climate Resilience was established with the task of implementing the New Jersey State Climate Change Resilience Strategy. The Council brings together various State and infrastructure entities for coordination (**Policy-01**). Under Strategy 3.1 of the strategy, the Council will serve as a forum for data and information sharing that can contribute to development of a "single source of truth" (**Outreach-01**).
- NJ MyCoast is a statewide app to collect reports of flooding, high tide, and community assets (**Outreach-07**)

- The federal government is taking steps to improve funding for resilience-related improvements (such as through the Bipartisan Infrastructure Law) and also increasing opportunities to improve equity in the distribution of that funding through the Justice 40[3] and other similar initiatives, like FEMA's BRIC program prioritization criteria.

- Residents and businesses have already become involved in various ways including participating in community clean-up days, adopt-a-catch-basin programs, participating in the Faces of Resilience campaign, by reporting flooding, and by providing feedback through Resilient NENJ.

- Various infrastructure entities, utilities, and other stakeholders came together for a Resilient NJ Cross-Region Stakeholder Meeting in May of 2021 to coordinate on the regional planning projects .

- Ironbound Community Corp. has hired a public art administrator to implement projects that integrate themes of resilience into public art projects
- Researchers at Stevens Institute of Technology are developing low-cost sensors that could be used to gather real-time data on flooding (**Outreach-07**).
- In the aftermath of the remnants of Hurricane Ida, community-based organizations partnered with the cities and FEMA to host community forums and provide residents with recovery resources (**Emergency-03**)

[1] https://www.jerseycitynj.gov/cityhall/DPW/recycle/compostyourfoodscraps
[2] https://www.hobokennj.gov/resources/compost
[3] https://www.whitehouse.gov/environmentaljustice/justice40/

PHASE 1 (YEARS 1 TO 3)

Phase 1 includes significant activity to frontload key actions that will support regional capacity to build resilience into the future, as well as to implement recommended major capital improvements.

As such, Phase 1 delineates actions based on activity type. All steps below reference their counterpart actions in **Section 3.0**. See that section for more detail on any recommendations.

OUTREACH, EDUCATION, AND CAPACITY BUILDING

City, County

- Increase staff dedicated to resilience, as needed (**Outreach-02**)
- Dedicate a portion of budget specifically to address resilience-related needs (**Outreach-02**)
- If not already, publish project-related information on municipal and county web pages (**Outreach-04**)
- Promote NJ Register Ready with community members and use database in emergency planning (**Outreach-05**, **EM-01**)
- Continue to promote existing community flood mappers for wide use through websites and social media (**Outreach-07**)
- Continue development of "shelf-ready" projects that can be rolled into emergent funding pursuits (**Outreach-08**)
- Evaluate existing and create new, where applicable, systems and processes to better position for post-disaster funding, including having current inventories of assets, priority areas and projects (including those with feasibility studies or conceptual designs) (**Outreach-08**, **EM-01**)

Region

- Compile all data used in Resilient NENJ into a single database for sharing (**Outreach-01**)
- Consider hiring a staff person to help facilitate Resilient NENJ Steering Committee, support outreach, and coordinate implementation moving forward (**Outreach-02**)
- Continue and expand the Resilience 101 campaign. Set goals and metrics for the campaign (**Outreach-03**)
- Plan and implement the outreach ambassador program in coordination with local community-based organizations (**Outreach-05**)
- Continue to promote community flood mappers and associated coordination and communication needs (**Outreach-07**)
- Continue to promote existing or explore creation of hotlines for residents to report hazards via phone (**Outreach-07**)
- Support the development of "shelf-ready" projects that can be rolled into emergent funding pursuits (**Outreach-08**)

State

- Initiate planning to advance the "single source of truth" (**Outreach-01**)
- Create a single unified brand around all things resilience-related (consider using Resilient NJ for these purposes) (**Outreach-01**)
- Initiate the statewide data gap analysis to help advance the single source of truth (**Outreach-01**)
- Explore development of (and implement by Year 3) a grant program to support hiring of resilience staff and capacity building (**Outreach-02**)
- Support compilation of community flood data reporting into the single source of truth datasets (**Outreach-07**)
- Leverage the Resilient NENJ Action Plan as a guide for allocation of post-disaster and other emergent funding (**Outreach-08**)

Federal

- Explore and consider incentivizing post-disaster redevelopment operations and plans (**Outreach-08**)

Residents, Business/Industry

- Support friends and family in registering for NJ Register Ready, as applicable (**Outreach-05**)
- Participate in the outreach ambassador programs by becoming ambassadors or leveraging resources and information shared (**Outreach-05**)

Major Property Owners

- Consider completing resilience assessments for major assets (**Outreach-02**)

Academia, CBOs

- Collaborate on creation of outreach ambassador program and recommend potential ambassadors (**Outreach-05**)
- Coordinate with municipalities and the region to implement High Resolution Rapid Refresh 48-hour modeling of severe weather and PM2.5 transport plumes to support early warning systems at various scales (Academia) (**Outreach-07**)

SERVICE AND PROGRAM DEVELOPMENT OR ENHANCEMENT

City, County

- Establish at least one pilot resilience hub in each municipality (**Service-01**)
- Continue, expand, or create adopt-a catch basin program, in partnership with the sewer utility, if applicable. Partner with CBOs and the region to advance other recommendations related to waste management (**Service-02**)

Region

- Develop framework, network, platform, and information to be shared for a regional network of resilience hubs in collaboration with regional stakeholders (**Service-01**)
- Partner with CBOs to plan a regional waste reduction outreach campaign, tailored to the needs of each municipality as appropriate (**Service-02**)

State

- Explore development of a program and dedicated funding toward resilience hubs (**Service-01**)

Federal

- Explore dedicated funding to incentivize formation of resilience hub programs in collaboration with local community-based organizations (**Service-01**)

Residents, Business/Industry

- Express needs that could be addressed through resilience hubs and support implementation as applicable (**Service-01**)

Major Property Owners

- Support program implementation as needed. For example, the e lectric utility may partner to support design of solar power or a microgrid, and the sewer utility or major property owners may partner for integration of subsurface stormwater storage.

Academia, CBOs

- Collaborate with municipalities to identify priority locations for pilot and network of resilience hubs (**Service-01**)
- Support establishment of at least one pilot resilience hub in each municipality (**Service-01**)
- Partner with the region to plan a regional waste reduction outreach campaign (**Service-02**)

EMERGENCY RESPONSE AND PREPAREDNESS

City, County

- Promote use of NJ Register Ready on city and county websites (**EM-01**)
- Evaluate use of best practices outlined in **Section 3.3.4** (**EM-01** & **02**)
- Consider creation or enhancement of Community Emergency Response Teams where not currently active. Consider leveraging region support to advance, as needed.
- Establish post-disaster funding support contracts and develop processes to position for post-disaster public funding (**Section 3.3.2**)

Region

- Explore opportunities to expand bulk debris removal following storms
- Consider leveraging existing CERTs and framework toward creation of an emergency management coordination sub-group to support resource and best practice sharing across the region, include local community based organizations and a community advisory council, as appropriate

State

- Establish single source of truth on information related to post-disaster recovery and funding (see **Section 3.3.2**)

Federal

- Establish single source of truth on information related to post-disaster recovery and funding (see **Section 3.3.2**)
- Continue to improve post-disaster program equity and clarity (**EM-03**)

Residents, Business/Industry

- Consider purchasing flood insurance even if not in a FEMA designated flood zone

Major Property Owners

- Harden or raise critical infrastructure out of the flood zone, which would help residents shelter in place and/or vertically evacuate

Academia, CBOs

- Partner with municipalities, state, and federal agencies to provide recovery support post-disaster

PHASE 1 (YEARS 1 TO 3) *CONTINUED*

POLICY AND GOVERNANCE

City / County

- Advance and share results of feasibility studies for municipal stormwater utilities with Resilient NENJ (**Policy-01**)
- Consider creating a "resilience committee" within each municipality and at the county level comprised of staff from various departments to ensure that Resilient NENJ initiative is providing the most value and service to the needs of communities within each city (and that all departments are coordinated around resilience-related needs) (**Policy-01**)

Region

- Construct a memorandum of understanding for partner entities to sign onto that includes the goals and structure for continued collaboration (**Policy-01**)
- Establish an updated meeting schedule and develop subgroups that will collaborate and advance various initiatives (**Policy-01**)
- Collaborate on key commenting opportunities that affect the region (e.g., USACE HAT Study and NJ PACT) (**Policy-01**)
- Identify a coordination lead and develop subgroups with regional stakeholders to support collaboration on advancing recommendations related to the following:
  - Coordination with industry and major property owners to advance resilience (applicable to most recommendations)
  - Infrastructure coordination council (**Policy-02**)
  - Open space and green space access (**All Hazards-01**)
  - Resilient transformation pipeline (**All Hazards-01**)
  - Flood related policy improvements
  - Climate hazard related policy improvements (**All Hazards-01**, **02**, and **03**)
  - Funding and implementation
  - Community engagement (**Outreach**)
  - Resilience hubs (**Service-01**)
- Explore the creation of a subgroup to advance regional emergency response and preparedness coordination (determine whether this might be more appropriate facilitated at state or regional level)

State

- Collaborate with Resilient NENJ, the State Council on Climate Resilience, and Silver Jackets federal agencies to develop an Infrastructure Coordination Council formed of representatives from each of these and infrastructure entities
- Identify a coordination lead and develop subgroups with regional and state stakeholders to support collaboration on advancing recommendations related to the following:
  - Data storage, maintenance, gaps, and improvements
  - Creation and maintenance of a "Single source of truth"
  - Long-term control plans
  - Climate hazard policy improvements (e.g., for contaminated sites)
  - Contaminated sites and climate hazards

Academia / CBOs

- Conduct studies on future climate impacts, especially urban heat, air pollution, and groundwater emergence and contamination, to help guide planning (**All Hazards-01a** and **01b**)
- Participate in subgroups to advance recommendations

Resilient NENJ as a regional coordinating and connecting body

The resilience needs in the region outstrip the capacity for any given group of people to manage at any given point in time. There is just not enough time in the day. There is also a significant amount of momentum and capacity within the region and its stakeholders that could help advance implementation if coordinated under the leadership of Resilient NENJ and its Steering Committee and Community Advisory Council. The power of Resilient NENJ lies in its ability to connect, coordinate, and leverage, and this power should be leaned into to implement its recommendations. Resilient NENJ has also already proven itself as a platform to support coordination between residents, municipalities, agencies, utilities, and more.

The following list is subgroups that could support Resilient NENJ recommendations at each scale.

Local	Resilient NENJ	State
Local coordination bodies can collaborate with and provide representation to regional coordinating bodies. • Resilience committees (may vary by municipality – JC START, for example, is an existing sub-group focused on advancing green infrastructure goals in Jersey City) • CERTs	Resilient NENJ Steering Committee and Community Advisory Council would create and connect regional subgroups responsible for the following: • Coordination with industry and major property owners to advance resilience (applicable to most recommendations) • Infrastructure coordination council (**Policy-02**) • Open space and green space access (**All Hazards-01**) • Resilient transformation pipeline (**All Hazards-01**) • Flood related policy & land use improvements • Climate hazard related policy & land use improvements (**All Hazards-01**, **02**, and **03**) • Funding and implementation • Continued community engagement to priority groups through implementation (**Outreach**) • Resilience hubs (**Service-01**) • Waste reduction and sustainability (**Service 02**) • Data gathering, maintenance, and coordination (e.g., pilot sensor program, public health data gathering, etc.)	Resilient NENJ's subgroups can provide representation on the following state subgroups Resilient NENJ recommends to be developed or identified. State level subgroups could bring together and coordinate across broad stakeholder groups to address issues requiring state-level alignment. These subgroups could be managed under the State's Interagency Council on Climate Resilience with an agency lead for each: • Data storage, maintenance, gaps, and improvements • Creation and maintenance of a "Single source of truth" • *Long-term control plans • *Climate hazard policy improvements • *Contaminated sites and climate hazards • Regional emergency response and preparedness coordination *Formal or informal coordination in these areas exists. Such existing coordination pathways could therefore be leveraged to help achieve the goals outlined in this Action Plan.

How might this work?

Different subgroups could provide a report out to the Steering Committee with updates and support needs each quarter. Representatives of these groups could participate in State-level sub-groups coordinated through the State's Interagency Council, which could provide updates on a similar schedule. The State's Interagency Council on Climate Resilience could consider providing an audience to the Steering Committee once per year to elevate progress, concerns, and support needs.

Who should be welcome in a subgroup?

The current Resilient NENJ model that includes representation from and coordination with agencies and organizations operating at various scales, community-based organizations, and a Community Advisory Council should continue.

PHASE 2 (YEARS 4 TO 7)

Phase 2 sees the continuation of programs implemented under Phase 1 and movement of remaining efforts planned under Phase 1 toward implementation.

- Consider expanding community hazard mapping tools to include additional hazards (e.g. extreme heat) and tie this to community alert systems (**Outreach-07**)

- Based on lessons learned from Hoboken and Jersey City pilots, explore program for installation of sensors to detect flooding, air, and heat quality in real-time to complement resident reports (**Outreach-07**)
- Support implementation of regional network of resilience hubs (**Service-01**)
- Consider expanding Resilient NENJ to consider broader sustainability needs (**Policy-01**)
- Consider developing a regional program framework to support individuals and municipalities with composting (**Service-02**)
- Support development of program guidance materials (Service recommendations)
- Help transition the objective to provide green space where it is lacking to a regionwide program (**All Hazards-01**)
- Work with the State and Infrastructure Coordination Council (see Phase 1) to develop a living, public inventory of infrastructure needs, proposed investments, and resilience-related projects so that “dig once” opportunities and opportunities to integrate resilience components in infrastructure improvements are readily identified.

- Complete the statewide data gap analysis[4] and develop an Action Plan and policy requirements to fill data gaps (**Outreach-01**)
- Implement portals, policy, and procedures to ensure alignment with and maintain the single source of truth (**Outreach-01**)
- Create funding opportunities and administration support for the distribution of resources as part of a home resilience program; develop associated guidance materials in collaboration with the region (**Service-03**)

- Continue to advance sensor technology and collaborate with the Region to explore implementation of sensors to support real-time understanding of hazards to support predictive analytics and complement other data gathering (**Outreach-07**)
- Support management of resilience hubs, and/or participate in and support promotion of outreach ambassador program to deploy ambassadors at the hubs (**Service-01**)

[4] *Resilient NENJ has included initially identified data gaps in the Flood Impact Assessment and Climate Hazard Assessment.*

PHASE 3, 4 & BEYOND (YEARS 8 TO 15+)

All recommended activities should continue and receive periodic evaluations for effectiveness and to calibrate the approach. A five-year review schedule is typical for regional planning processes and could correspond with an update to the Resilient NENJ Action Plan, which the Steering Committee, State, and stakeholders should complete every 5 years integrating new science, lessons learned, and stakeholder feedback.