

An aerial photograph of a city, likely San Francisco, with a prominent river (the San Francisco Bay) winding through it. The image is heavily darkened with a blue tint, creating a moody, high-tech atmosphere. The city's grid pattern, buildings, and green spaces are visible but muted by the overlay.

04 - THREE PATHWAYS TO A MORE RESILIENT REGION: SCENARIO DEVELOPMENT AND EVALUATION

Scenario Development
Scenario Evaluation

SCENARIO DEVELOPMENT

Scenario development is a key element to the Resilient NJ program and was guided by a methodology developed by NJDEP. The goal of the scenarios is to allow stakeholders and decision-makers to understand various pathways to enhancing resilience, as well as the benefits, challenges, and trade-offs associated with different approaches.

The three scenarios developed for the RRBC region respond to the climate risks the region faces now—which will only increase over the next 50 years—and are consistent with the regional vision developed in collaboration with the communities and the Steering Committee.

A broad range of resilience strategies can be leveraged to realize the Raritan River and Bay Communities' vision for the future of "A thriving region of interconnected watersheds, with complementary environmental, social, economic, and governance systems working together to reduce flood risk of communities and infrastructure, restore natural systems, and adapt to a changing climate." To better understand the pros and cons of different strategies, the project team developed three scenarios, or suites of actions, that illustrate different pathways to achieving this vision.

Scenario 1 focuses on protection of critical infrastructure assets, economic centers, and populated areas through a mix of green and grey strategies. Scenario 2 focuses on minimizing exposure to flood risk through reducing the amount of development within the floodplain and restoring

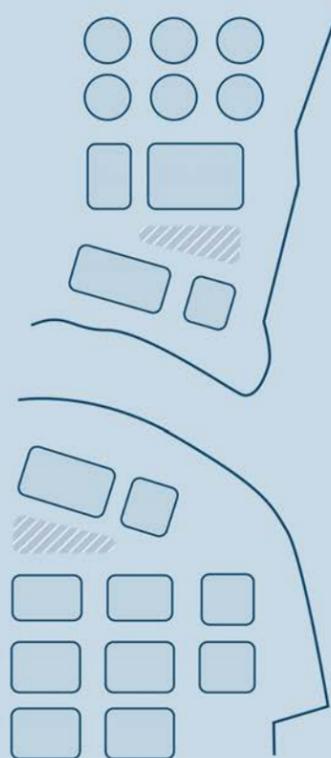
natural ecosystems and processes. Scenario 3 focuses on how redevelopment and growth can be directed in a way that reduces flood risk and shapes a more sustainable future.

These scenarios illustrate the pros and cons of different strategies for flood risk reduction and helped facilitate robust stakeholder and community discussion of tradeoffs and priorities. To the extent possible, each of the three scenarios:

- Responds to the region's resilience vision;
- Reduces the anticipated impacts of future flooding and Additional Climate Hazards ;
- Includes actions that address immediate flood concerns;
- Protects or enhances natural resources and ecosystems; and
- Addresses the needs of socially vulnerable and under-resourced populations.

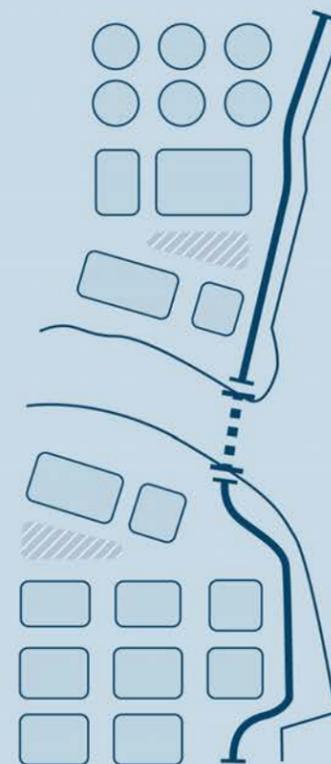
For the purposes of scenario evaluation, the project team developed strategies for all six sub-watersheds under each of the three scenarios. This approach allowed the project team to tailor flood risk reduction and resilience strategies to address the unique characteristics of each sub-watershed. To determine a preferred scenario for the region overall, the team conducted a thorough evaluation of all three scenarios within each sub-watershed. The evaluation process, described in additional detail in the following section, allowed the team to compare the performance of each scenario within sub-watersheds. Unsurprisingly, some scenarios are rated higher or lower in certain sub-watersheds than in others. This highlights the necessity of a regional scenario that would be flexible enough to meet the diverse needs of this large region while also working towards a shared vision of the future.

SCENARIO 0: BASELINE



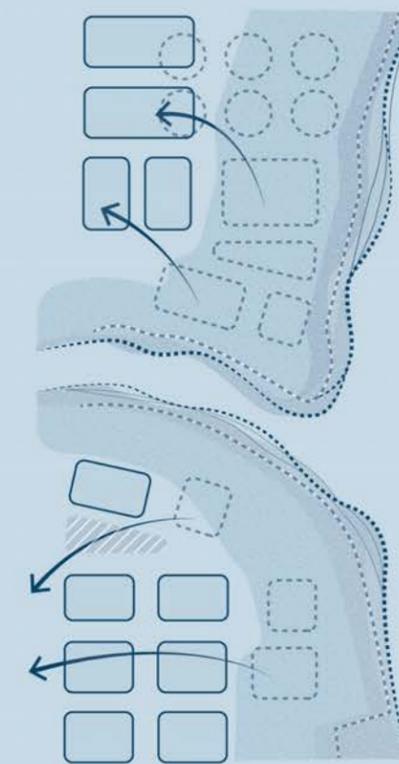
Scenario 0 (the baseline scenario) assumes continuation of ongoing and planned projects in the region.

SCENARIO 1: PROTECT Critical Assets & Economic Centers



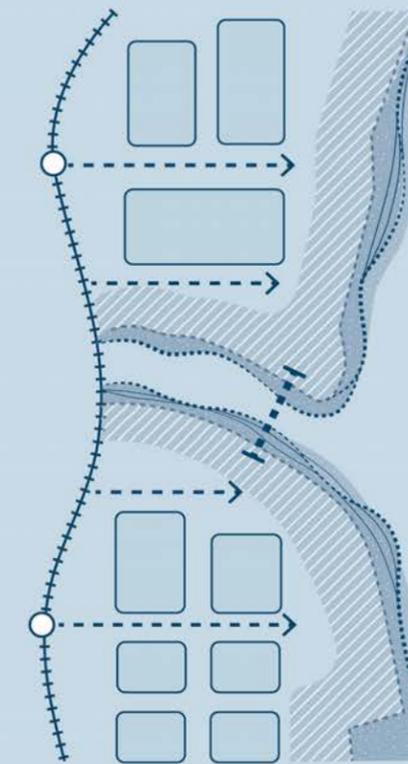
Scenario 1 focuses on protection of critical infrastructure assets, economic centers, and populated areas through a mix of green and grey strategies.

SCENARIO 2: RESTORE Natural Systems & Minimize Exposure



Scenario 2 focuses on minimizing exposure to flood risk by reducing the amount of development within the floodplain and restoring natural ecosystems and processes.

SCENARIO 3: TRANSITION Smart Growth for a New Economy



Scenario 3 focuses on redirecting redevelopment and growth to reduce flood risk, and invest in mobility systems to shape a more sustainable future.

SCENARIO 0: BASELINE

In recognition of the numerous and ongoing resilience activities across the state and in the region, the project team started with the development of a baseline scenario, dubbed “scenario 0,” that imagines a continuation of the projects and activities going on the region now. This includes actions at the statewide level on policy and governance, planning work within the region at the county or municipal level, as well as initiatives by regional non-profit organizations.

Statewide Initiatives

Under the Governor Phil Murphy Administration, New Jersey has taken a proactive approach in preparing for climate change by introducing Executive Orders that create new statewide planning and policy mechanisms as well as requiring municipalities to consider climate change and resilience in their state-mandated master planning process. Existing statewide initiatives include the following:

- Executive Order 89, which requires the state to develop a Statewide Climate Change Resilience Strategy and created an Interagency Council on Climate Resilience
- Executive Order 100, which launched New Jersey Protecting Against Climate Threats (NJPACT), an initiative aimed at modernizing land use requirements to incorporate climate change. Administrative Order 2020-01 implements EO 100 and set deadlines for NJDEP rule changes
- NJDEP initiated a regulatory program in 2015 requiring utilities operating combined sewer systems to develop Long-Term Control Plans (LTCP) that identify projects to be implemented in the coming decades to reduce combined sewer overflows

- In March 2019, the Stormwater Utility Law, officially known as the “Clean Stormwater and Flood Reduction Act,” was signed into law. This law authorizes local and county governments and certain utilities the ability to create stormwater utilities that can assess fees and use the revenue to maintain stormwater management infrastructure
- The State has also begun tackling its legacy of pollution and environmental racism through the Environmental Justice Bill (S232, September 2020), which requires NJDEP review of new construction, expansions, or permit renewals at facilities causing pollution in overburdened communities

New legislation passed in the State Assembly (New Jersey Assembly Bill 2785) requires the land use plan element of municipal master plans to include climate change-related hazard vulnerability assessments

Regional Initiatives

Regionally, there have been numerous resilience-related planning initiatives in the RRBC region over the last two decades, but the bulk of resilience planning began after Hurricane Sandy. The region was impacted especially hard by flooding during Sandy, and the storm motivated additional resilience planning and climate-related initiatives. There have been more than 70 studies, reports, and action plans focused on the region since 2012, covering a wide range of topics. In addition to resilience, planning in the region has addressed riverfront activation, watershed management, and open space.

County Initiatives and Resilience Projects

Other recent and ongoing resilience-related initiatives currently being undertaken by Middlesex County include:

- **The Middlesex County Hazard Mitigation Plan:** To stay up to date with Federal Emergency Management Agency (FEMA) requirements, Middlesex County released an updated Multi-Jurisdictional All-Hazards Mitigation Plan in January 2022.
- **Destination 2040:** In 2018, Middlesex County began development of a new strategic plan titled Destination 2040, which will serve as a business plan for county operations. The plan will outline a 20-year outlook and strategic initiatives to undertake over the next 3-5 years. The plan will cover economic and workforce development; healthy, safe, and inclusive communities; land use, development, and housing; sustainability and community

In addition to the planning initiatives discussed above, there are many additional resilience projects that have already been completed, are currently in design or construction, or are being planned by the RRBC municipalities, Middlesex County, state and federal agencies, and regional infrastructure entities.

List Of Ongoing And Planned Projects

Ongoing and planned municipal projects include a subset of projects closely related to resilience and reducing the impacts of climate change. The list included here may not capture related efforts.

Carteret

- CA1. Rahway River Basin, New Jersey Coastal Storm Risk Management Feasibility Study
- CA2. Tremley Point Connector Road
- CA3. DuPont Chemical Site Brownfield Remediation
- CA4. Noe Street Park
- CA5. Carteret Ferry Terminal
- CA6. Carteret Marina Renovation
- CA7. Carteret Riverwalk

Woodbridge

- WB1. Stream Bank Stabilization of the Pumpkin Patch Brook
 - WB2. Woodbridge Marina Expansion
 - WB3. Reconstruction of Cove Creek Culvert
 - WB4. Reconstruction of Route 35 Culvert
 - WB5. Valley Road Streambank Restoration
 - WB6. Lyman Creek Streambank Restoration
 - WB7. Metuchen Ave Creek Streambank Restoration
 - WB8. CPV Woodbridge Energy Center
 - WB9. Woodbridge Waterfront Park
- Woodbridge Town Center Advanced Microgrid (municipality-wide)*
- Township Drainage Improvement (municipality-wide)*

Perth Amboy

- PA1. Perth Amboy High School (Emergency Shelter)
 - PA2. Rudyk Park Semi-permeable Plaza
 - PA3. Harbortown Infrastructure and Walkway
 - PA4. Route 35 Road Diet
 - PA5. Middlesex County Park
 - PA6. NYNJHAT Study Alternatives 3A & 3B – Arthur Kill Gate
 - PA7. Bulkhead Repair and Beach Nourishment
 - PA8. Perth Amboy Station Renovation
 - PA9. Borinqueneer Park
 - PA10. Raritan River Bridge Replacement
 - PA11. Middlesex Greenway Waterfront Spur
 - PA12. Route 9 and 35 Victory Circle Elimination Project
- Perth Amboy CSO Mandate (municipality-wide)*

South Amboy

- SA1. South Amboy Ferry Terminal
- SA2. Outerbridge Renewable Connector (planned)

Sayreville

- SY1. MCUA Flood Mitigation and Permanent Restoration of the Sayreville Pump Station

South River

- SR1. South River Ecosystem Restoration and Flood Resiliency Enhancement Project

Old Bridge

- OB1. Laurence Harbor Beach Replenishment
- OB2. Raritan Bay Slag Superfund Site (planned)

SCENARIO 0: BASELINE



LEGEND

Resilience Projects

- Completed
- Planning / Construction
- Conceptual / Unknown
- Redevelopment Areas
- Open space conservation/recreation zones
- Watershed Boundary
- Municipal Boundary
- Study Area Boundary

RESILIENCE TOOLBOX

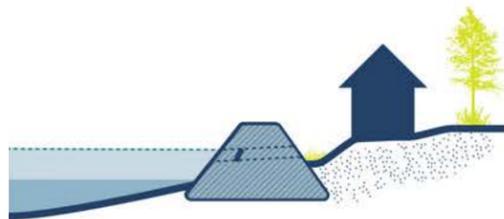
There are many possible solutions that can be implemented to address flooding. As a first step in developing scenarios, the project team developed a [Resilience Toolbox](#) of potential options and asked for feedback from the Steering Committee and broader public.

The toolbox includes physical and nature-based solutions, policy and governance solutions, and individual and community-based actions. Physical and nature-based solutions include projects that change the built environment to address flood risk. Policy and governance related solutions are

solutions that affect what decisions related to flooding are made, how, and by whom. Individual and community-based solutions are solutions that increase the social resilience of a community.

The toolbox is also an ongoing resource to provide information to stakeholders about potential strategies. The document summarizes key information about each solution including:

- Types of hazards the solution addresses
- The types of areas in which the solution could be applied
- Scale of the intervention (individual site, multiple sites, etc.)
- Possible co-benefits (benefits other than reduced flooding)
- Level of potential disruption from construction or implementation
- Other constraints and considerations



Reduce flood hazards through water management infrastructure or policy and building practices that work to either keep water out or reduce the force of flood waters.

- Coastal or riverine barriers
- Elevation of land



Reduce impacts of flooding by improving adaptive capacity through education, policy, and changes in community and personal behavior, or through adapting buildings, infrastructure, and other assets.

- Floodproofing of buildings
- Riparian management
- Shoreline restoration
- Improved stormwater management



Reduce exposure to flood risk by managing growth or investment in areas exposed to flood hazards and moving highly at-risk communities or assets.

- Relocation
- Increasing density outside the floodplain

RESILIENCE TOOLBOX EXAMPLE



ADAPT TO PRESENCE OF WATER

STRATEGY TYPE

WETLAND PRESERVATION/RESTORATION/EXPANSION



DESCRIPTION

Wetland restoration involves returning the natural functions of former or degraded wetlands that have been filled, drained, or impounded to promote stable water exchanges into and out of the wetland.

PHYSICAL CATEGORY

CATEGORY: RIPARIAN MANAGEMENT

TOOLBOX EVALUATION CRITERIA

HAZARD ADDRESSED



SCALE OF IMPLEMENTATION



CO-BENEFITS



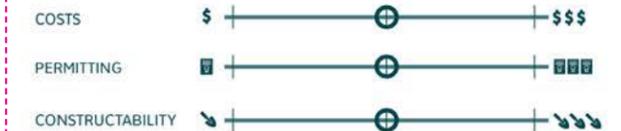
LEVEL OF POTENTIAL DISRUPTION



APPLICABLE AREAS



CONSTRAINTS AND CONSIDERATIONS

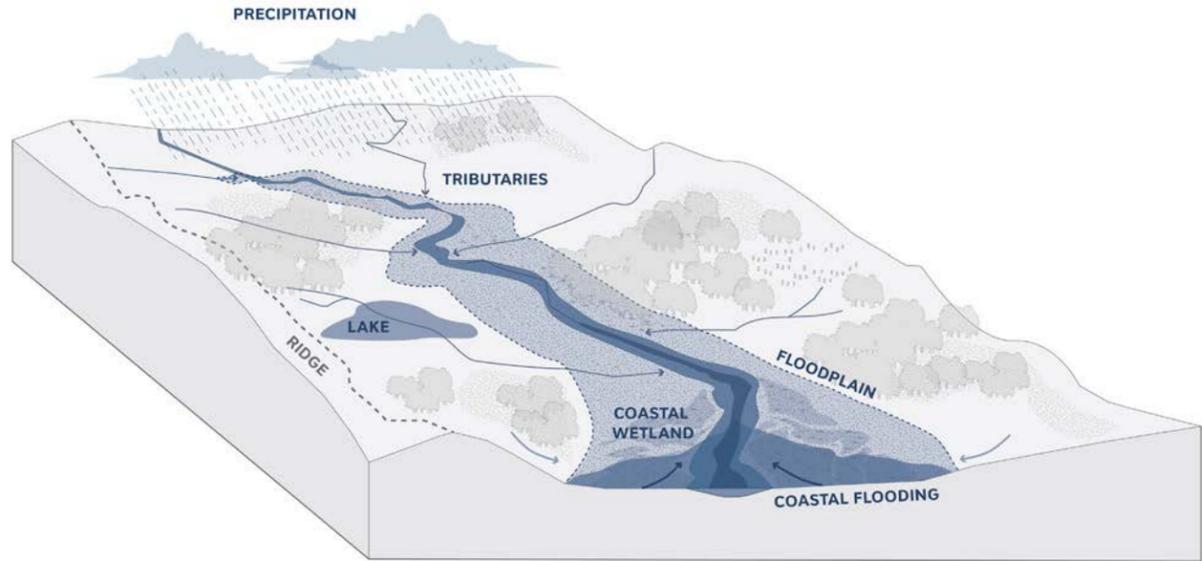


APPLYING A WATERSHED-BASED PLANNING APPROACH

The RRBC region lies at the intersection of three major watersheds: the Arthur Kill; the Monmouth; and the Lower Raritan, South River, and Lawrence. A watershed can most easily be thought of as an area within which, wherever water falls, it will all eventually flow to the same place. Watersheds can cross municipal and state boundaries, which can present a challenge when planning for flooding and risk reduction. To address this challenge, the project team adopted a watershed-based planning approach in scenario development. A watershed-based approach can lead to more effective outcomes in reducing flood risk and institutionalizes coordination to address shared risks within sub-watershed boundaries.

To facilitate this watershed-based approach, the project team created several sub-geographies based on hydrologic unit code 14 (HUC14) watershed boundaries and the shared flood risks and land use patterns within each. This report refers to these areas as sub-watersheds. They are:

- Arthur Kill Waterfront
- Woodbridge Creek
- Raritan Riverfront and Bay
- South River/ Washington Canal
- Cheesequake/ Laurence Harbor
- Rahway River and Tributaries



WHAT IS A WATERSHED?
A watershed can most easily be thought of as an area within which, wherever water falls, it will all eventually flow to the same place. As watersheds can cross municipal and state boundaries, a watershed-based approach to planning instead of a municipality-based approach will lead to more effective outcomes in reducing flood risk.

SUB-WATERSHEDS

Rahway River and Tributaries is bounded by the Woodbridge Creek subwatershed to the east, Raritan River subwatershed to the south and the Woodbridge municipal boundary to the north.

Woodbridge Creek is bounded by the Woodbridge Creek subwatershed and Rahway River to the north.

Arthur Kill Waterfront is bounded by Arthur Kill Waterfront Subwatershed (below Grasselli), Rahway River to the north and Harbortown to the south.

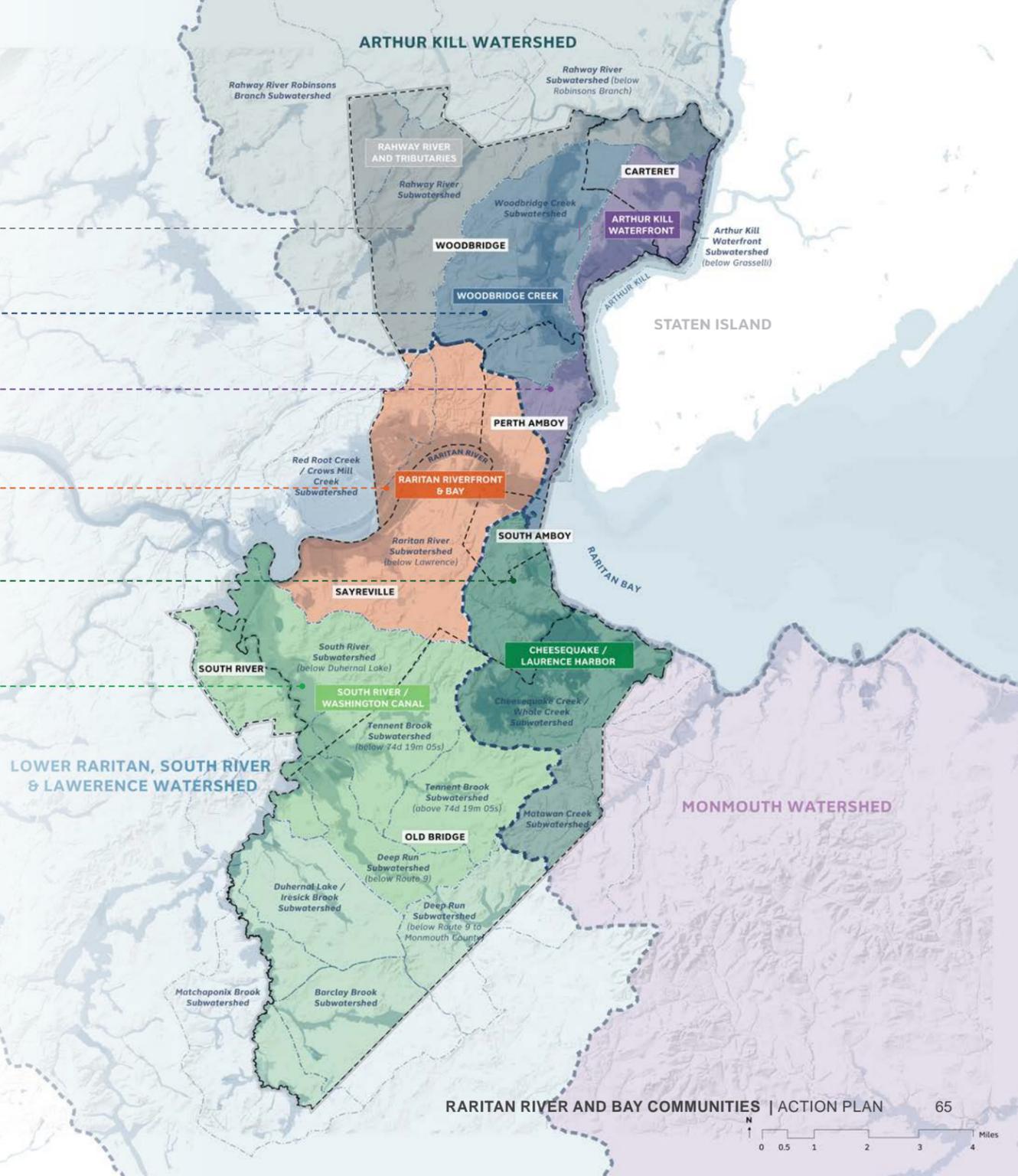
Raritan Riverfront and Bay is bounded by Harbortown to the north, Raritan River subwatershed (below Lawrence) to the south, Woodbridge and Sayreville municipal boundaries to the west.

Cheesequake / Laurence Harbor is bounded by Cheesequake Creek / Whale Creek subwatershed and the Old Bridge municipal boundary to the east.

South River / Washington Canal is bounded by South River Subwatershed (below Duhernal Lake), Tennant Brook and Deep Run subwatersheds and the South River municipal boundary to the west.

- Arthur Kill Waterfront
- Woodbridge Creek
- Rahway River and Tributaries
- Raritan Riverfront and Bay
- South River / Washington Canal
- Cheesequake / Laurence Harbor

Data Source: NJGIS Hydrological Unit Code 14



SCENARIO 1: PROTECT CRITICAL ASSETS AND ECONOMIC CENTERS

This scenario focuses on protection of critical infrastructure assets, economic centers, and populated areas through a mix of green and grey strategies. In this scenario, the existing patterns of development are not significantly modified, and assets are protected in their current location and configuration. It also includes shoreline barriers to protect from coastal and tidal flooding, improved capacity of stormwater management systems to manage heavy rainfall, and site- and building-scale adaptation of critical infrastructure.

Example strategies under this scenario include:

- Shoreline barriers to protect low-lying areas from coastal and tidal flooding
- Increasing capacity of stormwater systems to manage heavy rainfall
- Building- and site-scale adaptation of critical infrastructure

Community Feedback

This scenario responds directly to feedback the project team heard across the region from community members and other stakeholders, who are concerned about damage from future flood events. The project team received positive feedback on how this scenario prioritizes risk reduction. The project team also heard skepticism from some members of the community regarding the feasibility of some of the proposed strategies due to their high costs, extensive permitting requirements, and/or the need for significant ongoing agency coordination to implement.

Example Strategies by Sub-Watershed

Arthur Kill Waterfront

- Site-specific adaptation of critical utilities
- Site-specific adaptation of oil and gas terminals
- Installation of berm/floodwall with multi-use paths along the waterfront for public access

Woodbridge Creek

- Increased resilience of transportation systems, specifically flood-prone roadways
- Culvert modification and enlargement
- Building-scale adaptation of pump station

Raritan Riverfront and Bay

- Increased storm sewer capacity in Perth Amboy and incorporation of underground water storage in Washington Park and other open spaces
- Site-specific adaptation of critical facilities
- Installation of berm/floodwall with multi-use paths along the waterfront from Sadowski Parkway to Woodbridge Riverfront Park for public access

South River/ Washington Canal

- Elevation of Jernee Mill Road and site-specific protection of adjacent industrial sites
- Development of strategic evacuation plan for Winding Woods Apartment Complex for implementation in advance of major flood events
- Increased temporary impoundment along the South River

Cheesequake/ Laurence Harbor

- Flood risk mitigation along Garden State Parkway
- Surge barrier/tide gate and pump station at mouth of Cheesequake Creek
- Permanent stabilization for Shoreland Circle to prevent future road collapse due to coastal storms

Rahway River and Tributaries

- Culvert modification and enlargement
- Increased flood storage capacity on publicly owned lands through hybrid and structural solutions
- Flood risk mitigation of oil and gas terminals

Examples of Strategies in Scenario 1

Flood Barriers

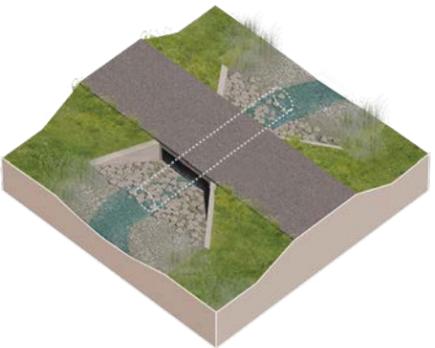


Shoreline barriers, like berms and levees, protect low-lying areas from coastal and tidal flooding.



WATERFRONT BULKHEAD REPAIR
Perth Amboy, NJ

Stormwater Management



Increasing capacity of stormwater systems helps manage heavy rainfall.



WOODBIDGE CENTER DR INTERSECTION IMPROVEMENTS
Woodbridge, NJ

Floodproof / Harden



Building- and site-scale adaptation of critical infrastructure can include floodproofing, hardening or perimeter protection strategies.



SAYREVILLE PUMP STATION
Sayreville, NJ

PROTECT CARTERET, PERTH AMBOY, WOODBIDGE

LEGEND

STRATEGIES

- Site or building level adaptation of critical facilities
- Create floodable spaces on publicly owned lands
- Increase stormwater system capacity or diversion upstream
- Protect / adapt critical transportation infrastructure
- Multi-purpose coastal flood barrier
- Tide / Surge Gate
- Culvert modification
- Construct new pump station / retrofit existing pump station

CRITICAL UTILITIES

- Power Generation & Substations
- Wastewater Treatment
- Oil & Gas Storage
- Warehouse

BASEMAP

- Water bodies
- Future Sandy (2070), 24-hour 100-year storm with 10% rainfall increase (2070)
- Existing Wetlands
- Municipal Boundary

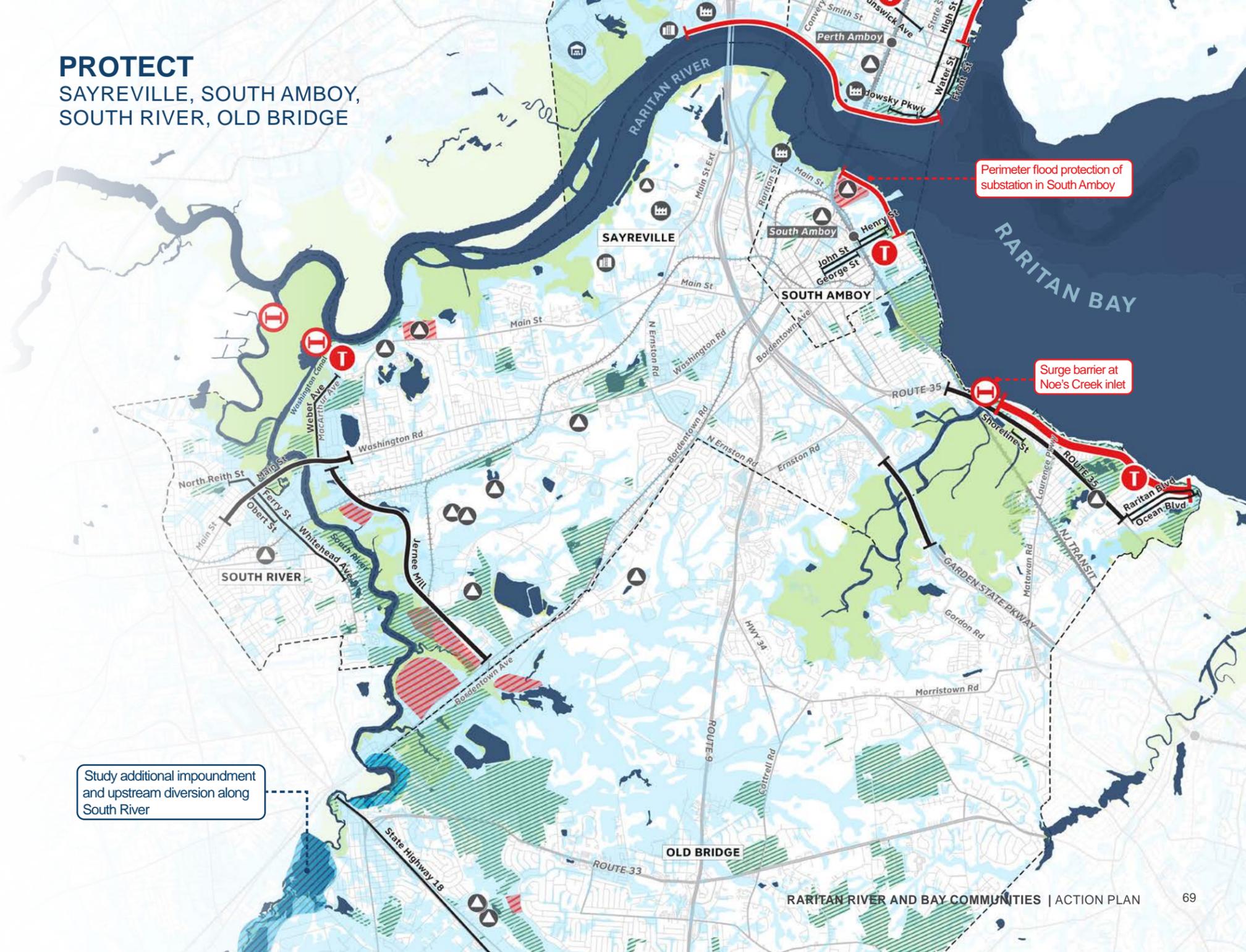


Tide gate and coastal protection of Noe's Creek

Multi-purpose coastal flood barrier with multi-use paths along the waterfront for public access

Site or building-level adaptation of critical facilities and industrial areas

PROTECT SAYREVILLE, SOUTH AMBOY, SOUTH RIVER, OLD BRIDGE



Perimeter flood protection of substation in South Amboy

Surge barrier at Noe's Creek inlet

Study additional impoundment and upstream diversion along South River

SCENARIO 2: RESTORE NATURAL SYSTEMS AND MINIMIZE EXPOSURE

This scenario focuses on minimizing exposure to flood risk through reducing the amount of development within the floodplain and restoring natural ecosystems and processes. Strategies seek to work with and augment existing networks of open spaces, wetlands, and streams to manage stormwater and provide buffers, and there is a greater reliance on acquisitions and reducing density in flood-prone areas. Specific strategies include restoring riparian zones to provide additional space for stormwater management, restoring tidal wetlands to improve stormwater management and buffer coastal flooding, and relocation of vulnerable uses to minimize exposure.

Example strategies under this scenario include:

- Restoration of tidal wetlands to buffer coastal flooding and providing space for marsh migration
- Restoration and expansion of riparian zones for flood storage
- Relocation of vulnerable land uses out of flood-prone areas

Community Feedback

Community members expressed a great deal of interest in preservation of open space, ecosystem improvements, and increased implementation of green infrastructure across the region. In some areas, however, the project team heard a general concern that Scenario 2's focus on restoration of natural systems, strategic acquisition of homes, and redevelopment of industrial sites may not be feasible given the existing interests of property owners and ongoing development trends. The

project team also heard concern that green infrastructure alone would not adequately reduce the high degree of risk posed by severe flooding of comparable magnitude to some of the most recent events.

Example Strategies by Sub-Watershed

Arthur Kill Waterfront

- Implementation of tide gate at and daylighting of Noe's Creek
- Technical assistance and targeted outreach to industrial property owners to promote building flood risk mitigation.
- Incorporation of brownfield and wetland restoration in low-lying industrial areas.

Woodbridge Creek

- Riparian zone restoration along Heards Brook Creek to create additional capacity for flood storage
- Additional targeted buyouts in Watson Crampton neighborhood

Raritan Riverfront and Bay

- Wetland restoration in Sayreville along Raritan River
- Right-of-way flood storage along rail easements that are no longer active
- Beach replenishment in Perth Amboy to protect

waterfront park and recreational assets

South River/ Washington Canal

- Additional buyouts in low-lying areas of South River, including industrial and commercial properties at risk
- Riparian zone and wetlands restoration along South River

Cheesequake/ Laurence Harbor

- Beach replenishment to protect recreational asset and dune restoration to reduce wave impacts in Laurence Harbor
- Wetland restoration in Cheesequake Park to serve as buffer from coastal storms and generate additional stormwater capacity

Rahway River and Tributaries

- Identification of brownfield sites suitable for wetland restoration
- Riparian zone restoration and stream bank stabilization along South Branch of Rahway River to create additional capacity for flood storage and minimize erosion

Examples of Strategies in Scenario 2

Wetland Restoration



Restoration of tidal wetlands and riparian zones help buffer coastal flooding and provide space for marsh migration and coastal habitats.



CHEVRON WETLAND RESTORATION
Perth Amboy, NJ

Stream Restoration / Riparian Zone Expansion



Restoration and expansion of riparian zones, such as stream daylighting or construction of wet ponds, can help increase flood storage capacity on publicly owned open spaces and parks.



NOE'S CREEK PARK RETENTION POND
Carteret, NJ

Relocation



Relocation of vulnerable land uses out of flood-prone areas can redirect growth to reduce flood exposure and preserve open space.



WATSON CRAMPTON BUYOUT AND RESTORATION PROJECT
Woodbridge, NJ

RESTORE

CARTERET, PERTH AMBOY, WOODBRIDGE

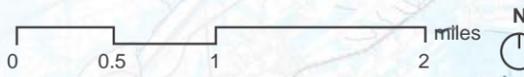
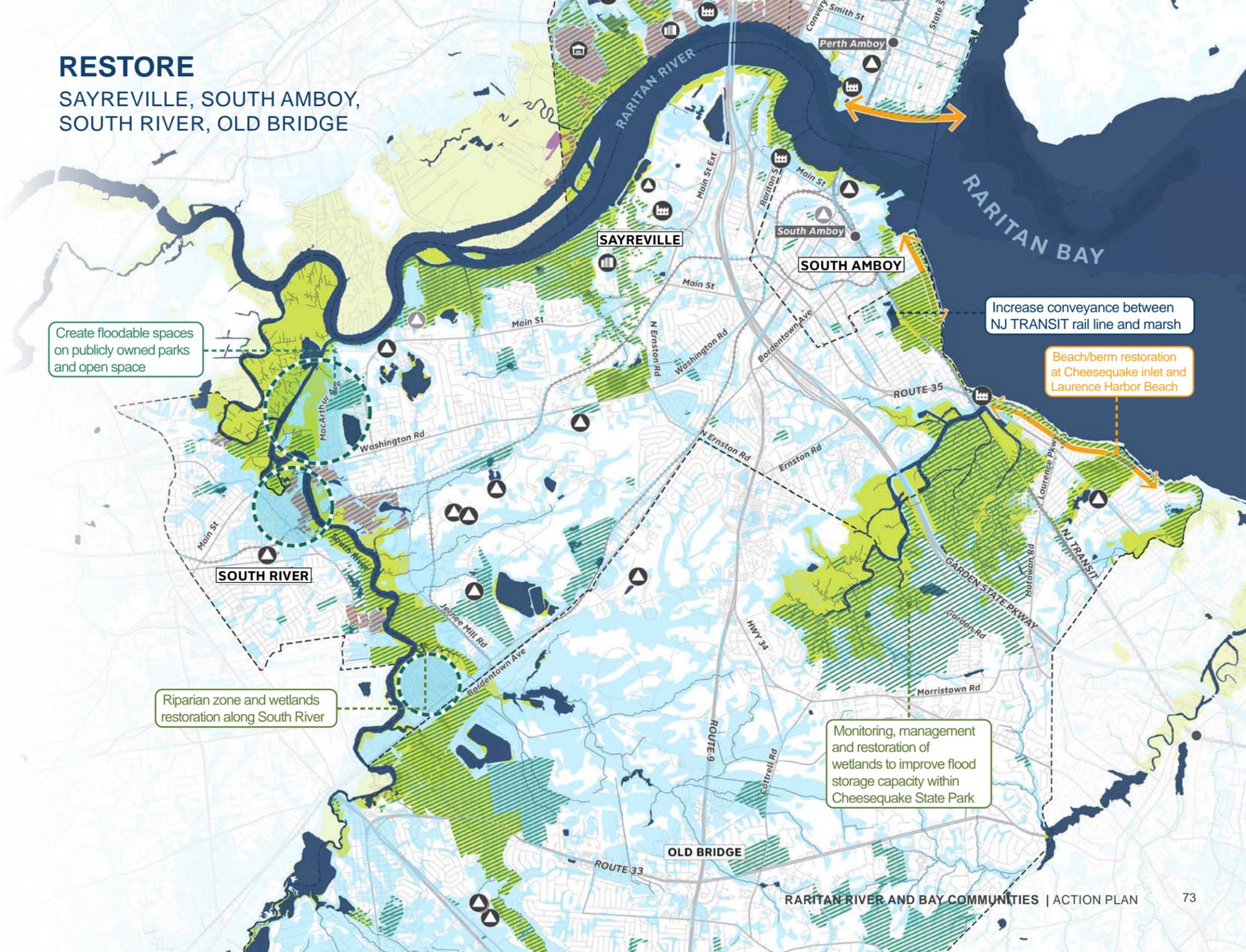
- LEGEND**
- STRATEGIES (RESTORE)**
- Restore wetlands and riparian zones
 - Create floodable spaces on publicly owned lands
 - Incorporate brownfield and wetland restoration in low-lying industrial areas
 - Acquire land through strategic buyouts for flood management
 - Restore or daylight riparian zones
 - Replenish and restore beaches
 - Right-of-way flood storage along rail easement
 - Building or site-scale flood mitigation
 - Tide/Surge Gate
 - Pump Station
- CRITICAL FACILITIES**
- Power Generation & Substations
 - Wastewater Treatment
 - Oil & Gas Storage
 - Warehouse
- BASEMAP**
- Water bodies
 - Future Sandy (2070), 24-hour 100-year storm with 10% rainfall increase (2070)
 - Existing Wetlands
 - Municipal Boundary



RESTORE

SAYREVILLE, SOUTH AMBOY, SOUTH RIVER, OLD BRIDGE

- Create floodable spaces on publicly owned parks and open space
- Riparian zone and wetlands restoration along South River
- Increase conveyance between NJ TRANSIT rail line and marsh
- Beach/berm restoration at Cheesequake inlet and Laurence Harbor Beach
- Monitoring, management and restoration of wetlands to improve flood storage capacity within Cheesequake State Park



SCENARIO 3: TRANSITION TO SMART GROWTH FOR A NEW ECONOMY

This scenario focuses on how redevelopment and growth can be directed in a way that reduces flood risk and helps shape a more sustainable future. It draws on flood risk reduction strategies included in the other two scenarios—incorporating protective features into redevelopment in some areas and focusing protection in densely built-up areas, while also reducing density in areas that are less densely populated and with fewer options for protection. Additionally, this scenario seeks to transition industrial uses away from oil and gas, strengthen developed areas outside of the floodplain, and enhance the resiliency of mobility systems.

Example strategies under this scenario include:

- Transitioning industrial uses away from oil and gas and towards new resilient economic drivers
- Strengthening and enabling growth in well-connected developed areas outside of the floodplain
- Enhancing resiliency of mobility systems

Community Feedback

This scenario was generally the most positively received by community members and other stakeholders, as it combines elements of Scenarios 1 and 2. Members of the community also appreciated that it provides opportunities for integrating resiliency improvements into other goals, such as improving public waterfront access or developing the waterfront.

Example Strategies by Sub-Watershed

Arthur Kill Waterfront

- Increased flood storage capacity on publicly owned lands through hybrid and structural solutions
- Installation of berm/floodwall with multi-use paths along the waterfront for public access
- Transition of oil and gas facilities to renewable energy sources
- Redevelopment of industrial areas with new forms of industry and mixed-use centers

Woodbridge Creek

- Encouragement of mixed-use development outside floodplain near transit
- Additional buyouts and extension of open space network in Watson Crampton neighborhood
- Riparian zone restoration along Heards Brook Creek to create additional capacity for flood storage

Raritan Riverfront and Bay

- Redevelopment of decommissioned power plant in Sayreville as green energy campus, with wetland restoration
- Increased storm sewer capacity in Perth Amboy and incorporation of underground water storage in open spaces

- Encouragement of mixed-use development outside floodplain near transit

South River/ Washington Canal

- Elevation of critical roadways
- Additional buyouts in low-lying areas of South River and Sayreville
- Incentivized relocation away from extremely flood-prone areas including Winding Woods

Cheesequake/ Laurence Harbor

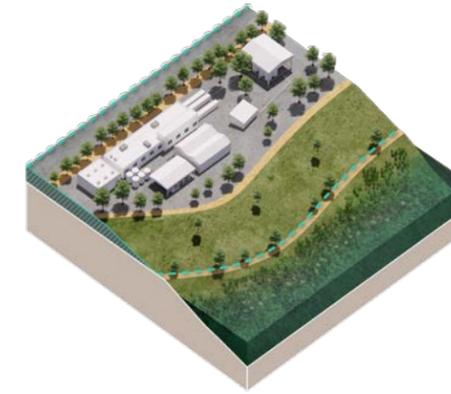
- Elevation of critical systems to protect South Amboy Pump Station
- Beach restoration and setback of new beachfront development
- Increased flood storage capacity within Cheesequake State Park through restoring wetlands and improving flow across infrastructure impediments

Rahway River and Tributaries

- Strategic land acquisition in flood prone areas
- Redevelopment of oil and gas terminals as mixed-use centers
- Encouragement of mixed-use development outside floodplain near transit

Examples of Strategies in Scenario 3

Resilient Redevelopment



Redevelopment of vulnerable waterfront legacy industrial areas into light industry or mixed-use residential should incorporate resilience standards.



PROPOSED FERRY TERMINAL
South Amboy, NJ

Strengthen Low Risk Centers

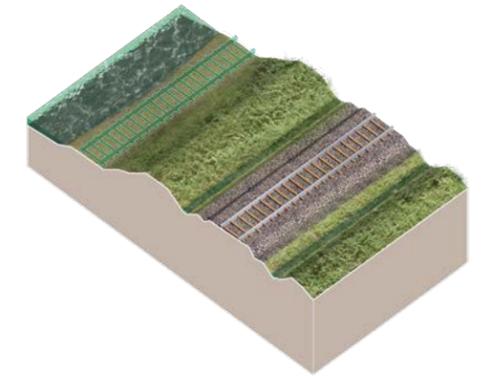


Enabling growth and additional density in well-connected areas outside of the floodplain can also support transit-oriented development.



AVENUE & GREEN TRANSIT-ORIENTED DEVELOPMENT
Woodbridge, NJ

Resilient Transportation Infrastructure



Mobility systems should be designed to be resilient to future flooding, taking into account sea level rise and future precipitation.



NJ TRANSIT RARITAN BRIDGE REPLACEMENT
Middlesex County, NJ

TRANSITION CARTERET, PERTH AMBOY, WOODBIDGE

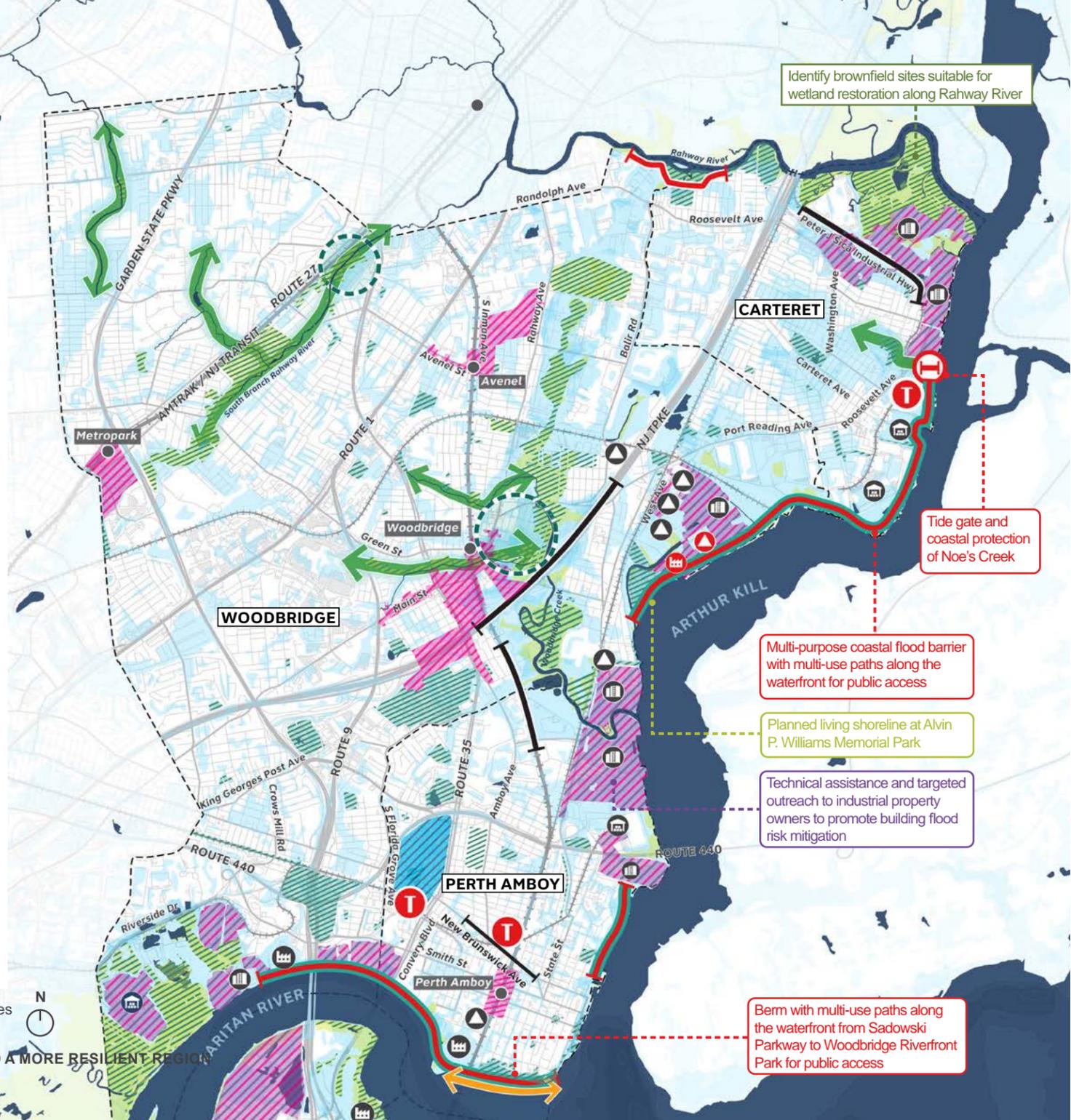
LEGEND

TRANSITION STRATEGIES

-  Strengthen lower-risk developed centers near transit
-  Resilient redevelopment
-  Site or building level adaptation of critical facilities
-  Restore wetlands and riparian zones
-  Create floodable spaces on publicly owned lands
-  Transition industrial uses to open recreation or wetlands
-  Multi-purpose coastal flood barrier with bike & pedestrian paths
-  Enhance resiliency of mobility systems
-  Acquire land through strategic buyouts for flood management
-  Restore or daylight riparian zones
-  Replenish and restore beaches
-  Tide/Surge Gate
-  Pump Station

CRITICAL FACILITIES

-  Power Generation & Substations
-  Wastewater Treatment
-  Oil & Gas Storage
-  Warehouse



TRANSITION SAYREVILLE, SOUTH AMBOY, SOUTH RIVER, OLD BRIDGE



SCENARIO EVALUATION

To determine a preferred scenario, the project team evaluated the scenarios within each sub-watershed according to a set of criteria designed to capture the benefits and drawbacks of each. The project team developed these evaluation criteria based on NJDEP's guidance with refinement from the Steering Committee and public feedback.

The scenarios also received feedback from stakeholders during Steering Committee meetings and feedback from the community during virtual public meetings. These two components—community/stakeholder feedback and evaluation criteria—allowed the project team to select an actionable scenario that is feasible, appropriate for the region, and supported by the public and key stakeholders.

The evaluation criteria covered the following topics:

- **Design Life / Adaptability:** Strategies should be designed to be adaptable to accommodate changing future risk and community preferences.
- **Cost and Feasibility:** Cost is a major factor that needs to be considered as projects with too high of a price tag relative to benefits are difficult to fund and implement. Scenarios must also be feasible given the permitting and regulatory environment and community's support, among other considerations.

- **Risk Reduction / Effectiveness:** Projects need to effectively reduce the risk of all types of future flooding and effectively protect community assets.
- **Environment:** Protection of the environment and improvement of natural systems is vital to the region and projects must not have negative environmental impacts.
- **Community and Health:** Preserving existing community values and places is essential. Projects should expand community benefits and go beyond just reducing flood impacts to provide additional benefits.
- **Partnership and Equity:** Strategies must consider all members of the region, especially socially vulnerable populations. Community leaders and members should be involved in decision-making and past inequities should be considered in all strategies.

Evaluation Criteria

Feedback from the Community

How Feedback is Incorporated in the Preferred Scenario

Design Life / Adaptability



DESIGN LIFE / ADAPTABILITY

Community members and stakeholders expressed concern about how current problems will only get worse with climate change.

- The preferred scenario includes a of mix of short-, medium-, and long-term strategies to address near-term risks while also planning for long-term potential impacts of climate change.

Cost and Feasibility



COST AND FEASIBILITY

Community members and stakeholders were concerned about costs, including where project funding comes from and how will it be secured.

Community members and stakeholders expressed a desire to see action quickly; in other words, that it is important that recommended actions be feasible.

- The preferred scenario focuses on feasible and cost-effective strategies to reduce risk. Some infrastructure elements from the protect scenario were determined to be too costly and challenging to implement, and thus were not incorporated into the preferred scenario.

Risk Reduction / Effectiveness



RISK REDUCTION / EFFECTIVENESS

Community members and stakeholders expressed concerns about how effective certain strategies would be given the unique conditions of the region.

Community members and stakeholders expressed concern over how new development could impact flooding.

- To effectively reduce flood risk, the preferred scenario includes action on both policy and governance, as well as outreach, capacity building, and the construction of physical and nature-based infrastructure.
- The preferred scenario includes recommendations for how development ordinances and zoning can be used to promote more resilient forms of and locations for development.

Environment



ENVIRONMENT

Access to the waterfront, increased park, open space, and recreation opportunities are priorities for many community members and stakeholders.

- The preferred scenario includes ways in which flood mitigation projects, such as coastal protection, stormwater management, and riparian zone restoration, can be used to increase waterfront access and improve open space amenities.

Community and Health Benefits



COMMUNITY AND HEALTH BENEFITS

Community members and stakeholders expressed concern over public health impacts of flooding on contaminated sites.

Community members and stakeholders expressed concern over public health impacts of Additional Climate Hazards , such as extreme heat.

- The preferred scenario includes specific, prioritized recommendations for remediation of brownfields and other contaminated sites.
- The preferred scenario includes strategies to reduce the health impacts of Additional Climate Hazards , including extreme heat.

Partnership and Equity



PARTNERSHIP AND EQUITY

Residents expressed a desire to be involved in the creation of the Action Plan.

Community members and stakeholders expressed that all members of the region should be able to see themselves represented in this plan.

Community members and stakeholders expressed a need for the project team to build on work already being done in the region and to leverage existing community networks and organizations.

- The preferred scenario includes actions to broaden outreach, education, and capacity building.
- The preferred scenario includes recommendations for how community organizations and non-governmental organizations can support the region's resilience.
- The preferred scenario leverages ongoing and planned projects to efficiently build resilience.

EVALUATION CRITERIA AND COMMUNITY FEEDBACK

In order to be consistent with other regions participating in RNJ, the project team also evaluated the scenarios using standardized evaluation criteria developed by NJDEP. Criteria developed by NJDEP align well with those refined to meet the needs of the RRBC region. Evaluation of the scenarios through NJDEP's methodology is documented in *Appendix E*.

Throughout the community engagement process, the project team received feedback relating to each of the evaluation criteria, summarized in the table below. The preferred scenario, described in detail in the next section, aims to address this feedback and related concerns.

Building on the community engagement and outreach activities described in the *Vision and Priorities* report, additional engagement took place between February and June 2022. The goal of these engagement efforts was to seek feedback on the scenarios described above and to refine the preferred scenario through the lens of the evaluation criteria. Specific engagement and outreach activities the project team conducted included:

- Community Meeting #3 in May: a virtual community meeting held to gather feedback on the preferred scenario
- Presentation to the South River Environmental Committee: a presentation on the three scenarios and preliminary preferred scenario
- YMCA Old Bridge Workshop: an in-person workshop with community members and Old Bridge Township on scenario alternatives and feedback to inform the preferred scenario

- Presentation to Weather Club at McGinnis Middle School in Perth Amboy: a presentation to middle school students in Perth Amboy, introducing them to the project, flood risk, and potential ways to address flooding
- Presentation to the Gateway Neighborhood Association: a presentation to a local neighborhood association on the project to gather residents' input
- Healthy Kids Day with the YMCAs: engagement with community youth on climate change and flooding with activities and shared information on the project
- Tabling, handing out flyers, and leading activities demonstrating impacts of flooding and climate change for kids at numerous events, including South River Day

In undertaking the evaluation and engagement process, the project team determined that the preferred scenario must combine elements of each of the three preliminary scenarios. Given the great diversity of types of flooding, land use and density, feasible strategies, and community priorities across RRBC, selected elements from each scenario must be applicable to the region at large. Therefore, the preferred scenario combines key elements of Scenarios 1, 2, and 3 in different geographies and at varying scales to recommend concrete strategies and actions designed to address existing flood and other climate risks while bolstering long-term resilience throughout the region.

“We cannot think of flood risk in isolation, the action plan needs to go beyond flooding too. Projects that have other community benefits, like access to green and open space, but also don't compromise economic development are a priority.”

— PUBLIC MEETING 2



“All communities should work together and analyze how their development goals impact the coastlines of other communities.”

— SOUTH AMBOY RESIDENT



“Major goal is to make the waterfront more accessible and help it become a destination.”

— OLD BRIDGE RESIDENT



“We need to prepare for more frequent rainfall events as well, not just 100-year storms. We need to think of community's needs now and plan for the future.”

— STEERING COMMITTEE MEMBER



CITY OF WATER DAY
Project staff hosting a promotional table to discuss flood risk with attendees and organizers of Perth Amboy's City of Water Day, July 16, 2022.



WORKSHOP AT OLD BRIDGE YMCA
Community members, steering committee members, and project staff gathered in person to discuss flood risk and risk reduction strategies.



WEATHER CLUB AT MCGINNIS MIDDLE SCHOOL
Educating middle school students on flood risk and climate change and hearing how they would like to address flooding issues in their community.



HEALTHY KIDS DAY
Healthy Kids Day, organized by the Raritan Bay YMCA, provided an opportunity to hand out flyers and share project details with the local community.