RESILIENT
NORTHEASTERN NEW JERSEY

FLOOD RESILIENCE TOOLBOX

FLOOD RESILIENCE TOOLBOX

There are many possible solutions that can be implemented to address flooding. Resilient NENJ developed a toolbox that included physical and nature-based solutions, policy and governance solutions, and individual and community-based actions. Physical and nature-based solutions include infrastructure projects and things that change the built environment. 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 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

The toolbox also groups solutions into three approaches to resilience: **Protecting** from the water, **Adapting** to the water, and **Moving** away from the water. These approaches are described further in the following pages.

PROTECT FROM WATER

ADAPT TO PRESENCE OF WATER

MOVE AWAY FROM WATER

(RESILIENCE GOALS INFORM ADAPTATION STRATEGIES)

The toolbox is not intended to be inclusive of all possible solutions but was a helpful starting point to identify solutions and outline the decision-making process for selecting a specific solution for an area. The Action Plan built on examples from this toolbox, integrating community feedback, other engagement, and technical analyses. The decision tree on page 2 outlines an example process that could be used to select flood risk reduction solutions. Note that based on feedback, the Resilient NENJ Action Plan includes five types of solution categories rather than the three included herein, and also addresses other climate-related hazards (see the **Climate Hazards Assessment** and associated toolbox). The goals of the toolbox are to:

- Communicate the types and range of solutions possible, as well as when they might be appropriate and their limitations
- Provide a framing tool for both the technical team and stakeholders, to help us begin from similar places of understanding, about the technical considerations that often guide these types of decisions

DECISION TREE

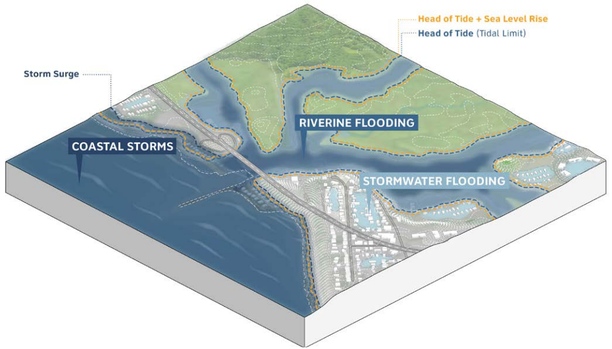
WHAT TYPE OF FLOOD HAZARD(S) IS THE SITE EXPOSED TO?

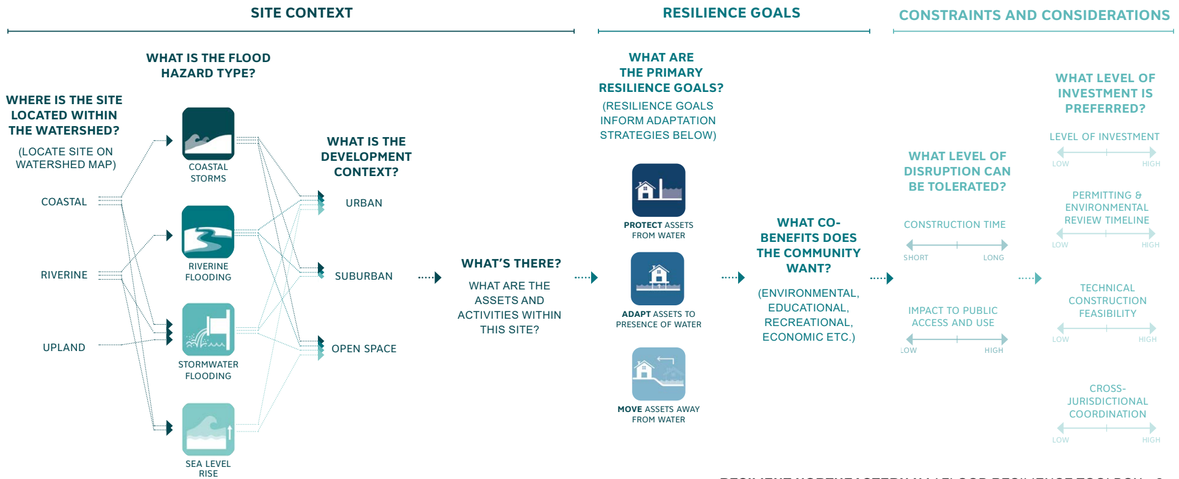
COASTAL STORMS

RIVERINE FLOODING

STORMWATER FLOODING

SEA LEVEL RISE



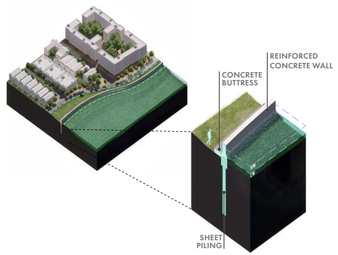


Physical and Nature Based Solutions

PROTECT FROM WATER

Solutions that protect from water keep flood waters out. They prevent water from flooding our neighborhoods with physical barriers. These solutions can be permanent, like a berm or levee, or can be deployed for specific flood events.

FLOODWALLS



Floodwalls are concrete structures designed to keep water out by physically blocking storm surges and floodwaters. Various types of floodwalls may be applicable to different areas and regions.

HAZARDS ADDRESSED

COASTAL, RIVERINE, STORM WATER, SEA LEVEL RISE

SCALE OF IMPLEMENTATION

LINEAR

CO-BENEFITS

ECONOMIC

LEVEL OF POTENTIAL DISRUPTION

CONSTRUCTION TIME

IMPACT TO PUBLIC ACCESS AND USE

APPLICABLE AREAS

COASTAL, RIVERINE, UPLAND, URBAN, SUBURBAN, OPEN SPACE

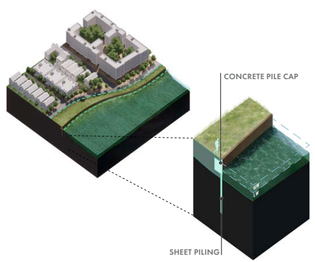
CONSTRAINTS AND CONSIDERATIONS

COSTS $ $$$

PERMITTING

CONSTRUCTABILITY

BULKHEADS



Bulkheads are concrete structures along shorelines of large bodies of water that protect from flooding, wave action and erosion. They can be integrated into recreational greenways and provide waterfront access to users.

HAZARDS ADDRESSED

COASTAL, RIVERINE, SEA LEVEL RISE

SCALE OF IMPLEMENTATION

LINEAR

CO-BENEFITS

ECONOMIC

LEVEL OF POTENTIAL DISRUPTION

CONSTRUCTION TIME

IMPACT TO PUBLIC ACCESS AND USE

APPLICABLE AREAS

COASTAL, RIVERINE, URBAN, SUBURBAN, OPEN SPACE

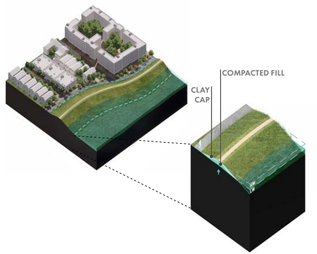
CONSTRAINTS AND CONSIDERATIONS

COSTS $ $$$

PERMITTING

CONSTRUCTABILITY

BERMS & LEVEES



Berms and levees are raised earthen structures erected to protect from flooding. They can be integrated with recreational boardwalks, walkways and bike paths. Their natural sloped sides can be populated with recreational features.

HAZARDS ADDRESSED

COASTAL, RIVERINE, STORM WATER, SEA LEVEL RISE

SCALE OF IMPLEMENTATION

LINEAR

CO-BENEFITS

ECONOMIC, RECREATIONAL

LEVEL OF POTENTIAL DISRUPTION

CONSTRUCTION TIME

IMPACT TO PUBLIC ACCESS AND USE

APPLICABLE AREAS

COASTAL, RIVERINE, UPLAND, SUBURBAN, OPEN SPACE

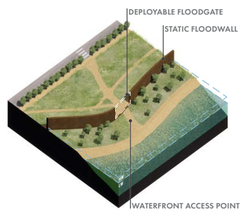
CONSTRAINTS AND CONSIDERATIONS

COSTS $ $$$

PERMITTING

CONSTRUCTABILITY

DEPLOYABLE FLOODGATES



Deployable floodgates are mobile elements, integrated into static flood barriers, that are closed during flood events to fill gaps in protective barriers and prevent floodwater intrusion.

HAZARDS ADDRESSED

COASTAL, RIVERINE, STORM WATER

SCALE OF IMPLEMENTATION

NETWORK

CO-BENEFITS

ECONOMIC

LEVEL OF POTENTIAL DISRUPTION

CONSTRUCTION TIME

IMPACT TO PUBLIC ACCESS AND USE

APPLICABLE AREAS

COASTAL, RIVERINE, UPLAND, URBAN, SUBURBAN, OPEN SPACE

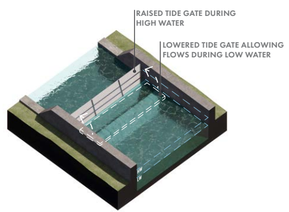
CONSTRAINTS AND CONSIDERATIONS

COSTS $ $$$

PERMITTING

CONSTRUCTABILITY

DEPLOYABLE TIDE GATES



Tide gates are deployed along drainage and waterways to keep out floodwaters during high tides. They control water levels within urban systems and areas, come in several forms and are usually self-regulating.

HAZARDS ADDRESSED

COASTAL, SEA LEVEL RISE

SCALE OF IMPLEMENTATION

NETWORK

CO-BENEFITS

ECONOMIC

LEVEL OF POTENTIAL DISRUPTION

CONSTRUCTION TIME

IMPACT TO PUBLIC ACCESS AND USE

APPLICABLE AREAS

COASTAL, URBAN, SUBURBAN, OPEN SPACE

CONSTRAINTS AND CONSIDERATIONS

COSTS $ $$$

PERMITTING

CONSTRUCTABILITY

PROTECT FROM WATER

BERM / DUNE SYSTEM

Dunes are landforms that occur with the sufficient transportation of sand or sediment and rely on the presence of a healthy and extensive root system from dune grasses and other vegetation to maintain their shape and help reduce flood risk associated with coastal storms. Dunes can act as a buffer, attenuating storm waves and reducing damage to communities.

HAZARDS ADDRESSED

COASTAL

SCALE OF IMPLEMENTATION

LINEAR

CO-BENEFITS

EDUCATIONAL, ECOLOGICAL

APPLICABLE AREAS

COASTAL, OPEN SPACE

LEVEL OF POTENTIAL DISRUPTION

CONSTRUCTION TIME

IMPACT TO PUBLIC ACCESS AND USE

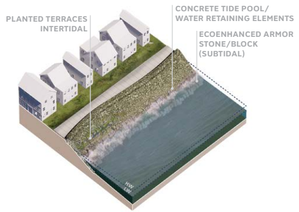
CONSTRAINTS AND CONSIDERATIONS

COSTS $ $$$

PERMITTING $ $$$

CONSTRUCTABILITY

REVETMENTS



Revetments are hard sloping structures, typically constructed using natural stone, or concrete blocks designed to reduce shoreline erosion by absorbing wave energy and minimizing wave run-up.

HAZARDS ADDRESSED

COASTAL

SCALE OF IMPLEMENTATION

LINEAR

CO-BENEFITS

ECONOMIC

APPLICABLE AREAS

COASTAL

LEVEL OF POTENTIAL DISRUPTION

CONSTRUCTION TIME

IMPACT TO PUBLIC ACCESS AND USE

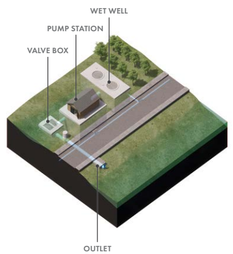
CONSTRAINTS AND CONSIDERATIONS

COSTS $ $$$

PERMITTING $ $$$

CONSTRUCTABILITY

CONSTRUCT PUMPING STATIONS



Pumping is a crucial method to convey water out of areas vulnerable to inundation, where natural and gravity fed drainage is insufficient or not possible.

HAZARDS ADDRESSED

COASTAL, RIVERINE, STORM WATER

SCALE OF IMPLEMENTATION

SITE

CO-BENEFITS

ECONOMIC

APPLICABLE AREAS

COASTAL, RIVERINE, URBAN, SUBURBAN

LEVEL OF POTENTIAL DISRUPTION

CONSTRUCTION TIME

IMPACT TO PUBLIC ACCESS AND USE

CONSTRAINTS AND CONSIDERATIONS

COSTS $ $$$

PERMITTING $ $$$

CONSTRUCTABILITY

ADAPT TO PRESENCE OF WATER

Solutions that adapt to the presence of water manage water or reduce the impacts of flooding to people and infrastructure. This can be through physical solutions such as floodproofing or through individual or community-based actions that improve capacity of people to deal with flooding.

COASTAL WETLAND PRESERVATION/ RESTORATION/ EXPANSION

Low-lying tidal wetlnd ecosystems are among the most vulnerable environments to sea level rise. The resilience of tidal wetlands to sea level rise depends on the potential for horizontal migration to upland areas and the vertical accretion rate of the wetland, which can be supported through restoration and expansion.

HAZARDS ADDRESSED

COASTAL, SEA LEVEL RISE

SCALE OF IMPLEMENTATION

LINEAR

CO-BENEFITS

EDUCATIONAL, RECREATIONAL, ECOLOGICAL

APPLICABLE AREAS

COASTAL, OPEN SPACE

LEVEL OF POTENTIAL DISRUPTION

CONSTRUCTION TIME

IMPACT TO PUBLIC ACCESS AND USE

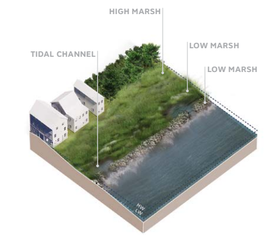
CONSTRAINTS AND CONSIDERATIONS

COSTS $ $$$

PERMITTING $ $$$

CONSTRUCTABILITY

LIVING SHORELINE



Shoreline stabilization approaches along estuarine coasts, bays, sheltered coastlines, and tributaries incorporate natural features, including vegetation or submerged aquatic vegetation alone, or hybrid systems in combination with harder shoreline structures for added stability such as stone, sand fill, rock sills and other structural and organic materials.

HAZARDS ADDRESSED

COASTAL

SCALE OF IMPLEMENTATION

LINEAR

CO-BENEFITS

EDUCATIONAL, ECOLOGICAL

APPLICABLE AREAS

COASTAL, OPEN SPACE

LEVEL OF POTENTIAL DISRUPTION

CONSTRUCTION TIME

IMPACT TO PUBLIC ACCESS AND USE

CONSTRAINTS AND CONSIDERATIONS

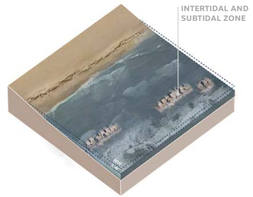
COSTS $ $$$

PERMITTING $ $$$

CONSTRUCTABILITY

ADAPT TO PRESENCE OF WATER

CONSTRUCTED REEFS/ BREAKWATERS



Constructed reefs are subtidal and sometimes intertidal submerged structures that promote marine life and break waves, limiting the wave energy reaching the shoreline. Breakwaters are partially or fully emergent structures that extend above mean high water. They are built with armor units to help attenuate storm waves to improve safety and prevent damage to buildings and infrastructure.

HAZARDS ADDRESSED

COASTAL

SCALE OF IMPLEMENTATION

LINEAR

CO-BENEFITS

RECREATIONAL, ECOLOGICAL

APPLICABLE AREAS

COASTAL

LEVEL OF POTENTIAL DISRUPTION

CONSTRUCTION TIME

IMPACT TO PUBLIC ACCESS AND USE

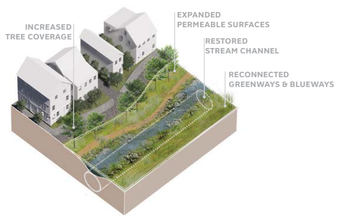
CONSTRAINTS AND CONSIDERATIONS

COSTS $ $$$

PERMITTING

CONSTRUCTABILITY

STREAM DAYLIGHTING & RESTORATION



Stream daylighting is the exposure of some or all of the flow of waterways covered in piped or culverts. Stream daylighting and restoration of natural drainage systems can help eliminate flooding issues by re-connecting piped stream channels with the floodplain and re-creating a functioning floodplain and riparian area.

HAZARDS ADDRESSED

RIVERINE, STORM WATER

SCALE OF IMPLEMENTATION

LINEAR

CO-BENEFITS

ECONOMIC, EDUCATIONAL, RECREATIONAL, ECOLOGICAL

APPLICABLE AREAS

RIVERINE, SUBURBAN

LEVEL OF POTENTIAL DISRUPTION

CONSTRUCTION TIME

IMPACT TO PUBLIC ACCESS AND USE

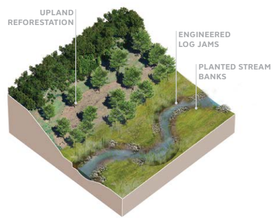
CONSTRAINTS AND CONSIDERATIONS

COSTS $ $$$

PERMITTING

CONSTRUCTABILITY

NATURAL CHANNEL DESIGN/STREAM RESTORATION



Streams that are artificially modified through straightened channels or altered stream banks result in instability where bed and bank erosion is a common consequence. Natural streams and floodplains provide stability to manage floodwaters safely, minimizing impacts to infrastructure.

HAZARDS ADDRESSED

RIVERINE

SCALE OF IMPLEMENTATION

LINEAR

CO-BENEFITS

ECONOMIC, EDUCATIONAL, RECREATIONAL, ECOLOGICAL

APPLICABLE AREAS

RIVERINE, OPEN SPACE

LEVEL OF POTENTIAL DISRUPTION

CONSTRUCTION TIME

IMPACT TO PUBLIC ACCESS AND USE

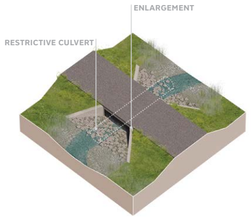
CONSTRAINTS AND CONSIDERATIONS

COSTS $ $$$

PERMITTING

CONSTRUCTABILITY

CULVERT MODIFICATION/ ENLARGEMENT



Enlargement of culverts that are not able to manage large flow surges during heavy rain events or spring thaw can help reduce likelihood of localized flooding upstream of the culverts, assuming additional floodwater doesn't exacerbate flooding issues downstream.

HAZARDS ADDRESSED

RIVERINE

SCALE OF IMPLEMENTATION

SITE

CO-BENEFITS

ECONOMIC

APPLICABLE AREAS

RIVERINE, URBAN, SUBURBAN

LEVEL OF POTENTIAL DISRUPTION

CONSTRUCTION TIME

IMPACT TO PUBLIC ACCESS AND USE

CONSTRAINTS AND CONSIDERATIONS

COSTS $ $$$

PERMITTING

CONSTRUCTABILITY

RAIN GARDEN

A rain garden collects rainwater runoff from impervious surfaces like roofs, streets, and paved surfaces, thereby reducing risk associated with rainfall flooding.

HAZARDS ADDRESSED

STORM WATER

SCALE OF IMPLEMENTATION

MULTIPLE SITES

CO-BENEFITS

EDUCATIONAL, ECOLOGICAL

APPLICABLE AREAS

UPLAND, URBAN, SUBURBAN

LEVEL OF POTENTIAL DISRUPTION

CONSTRUCTION TIME

IMPACT TO PUBLIC ACCESS AND USE

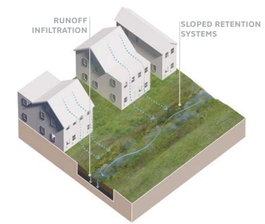
CONSTRAINTS AND CONSIDERATIONS

COSTS $ $$$

PERMITTING

CONSTRUCTABILITY

PLANTED SWALE



Planted swales are linear sloped conveyance and retention systems for stormwater runoff that can absorb low flows and help reduce flood risk associated rainfall flooding.

HAZARDS ADDRESSED

STORM WATER

SCALE OF IMPLEMENTATION

MULTIPLE SITES

CO-BENEFITS

EDUCATIONAL, ECOLOGICAL

APPLICABLE AREAS

UPLAND, SUBURBAN

LEVEL OF POTENTIAL DISRUPTION

CONSTRUCTION TIME

IMPACT TO PUBLIC ACCESS AND USE

CONSTRAINTS AND CONSIDERATIONS

COSTS $ $$$

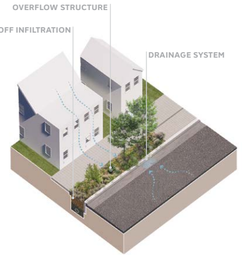
PERMITTING

CONSTRUCTABILITY

Physical and Nature Based Solutions

ADAPT TO PRESENCE OF WATER

RIGHT-OF-WAY BIOSWALE (URBAN)



Right-of-way bioswales are vegetated drainage courses located in sidewalks to capture, detain, and infiltrate runoff from streets, allowing any excess rain water to enter the piped stormwater system.

HAZARDS ADDRESSED

STORM WATER

SCALE OF IMPLEMENTATION

MULTIPLE SITES

CO-BENEFITS

EDUCATIONAL ECOLOGICAL

APPLICABLE AREAS

UPLAND URBAN SUBURBAN

LEVEL OF POTENTIAL DISRUPTION

CONSTRUCTION TIME

IMPACT TO PUBLIC ACCESS AND USE

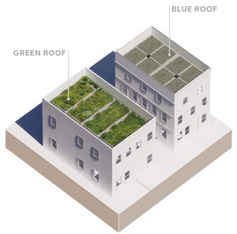
CONSTRAINTS AND CONSIDERATIONS

COSTS $ $$$

PERMITTING $ $$$

CONSTRUCTABILITY

GREEN ROOF & BLUE ROOF



A green roof is a layer of growing medium for vegetation installed over a waterproofing system, slowing down runoff by retaining rainwater and gradually releasing it back into the atmosphere through condensation and transpiration. Blue roofs provide temporary water storage systems that allow for the gradual release or evaporation of stored water.

HAZARDS ADDRESSED

STORM WATER

SCALE OF IMPLEMENTATION

MULTIPLE SITES

CO-BENEFITS

ECONOMIC EDUCATIONAL RECREATIONAL ECOLOGICAL

APPLICABLE AREAS

UPLAND URBAN SUBURBAN

LEVEL OF POTENTIAL DISRUPTION

CONSTRUCTION TIME

IMPACT TO PUBLIC ACCESS AND USE

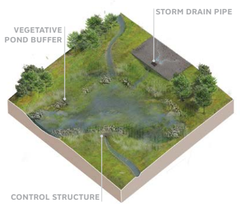
CONSTRAINTS AND CONSIDERATIONS

COSTS $ $$$

PERMITTING $ $$$

CONSTRUCTABILITY

RETENTION/WET PONDS (STORMWATER BASINS)



Retention ponds are artificial basins used to manage stormwater runoff and promote infiltration. Capturing runoff, they can reduce downstream or localized flooding and enable groundwater recharge.

HAZARDS ADDRESSED

STORM WATER

SCALE OF IMPLEMENTATION

MULTIPLE SITES

CO-BENEFITS

EDUCATIONAL ECOLOGICAL

APPLICABLE AREAS

UPLAND SUBURBAN

LEVEL OF POTENTIAL DISRUPTION

CONSTRUCTION TIME

IMPACT TO PUBLIC ACCESS AND USE

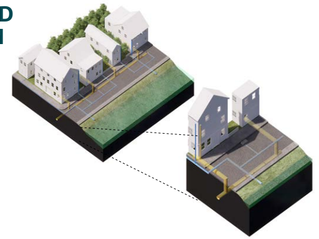
CONSTRAINTS AND CONSIDERATIONS

COSTS $ $$$

PERMITTING $ $$$

CONSTRUCTABILITY

IMPROVE & EXPAND DRAINAGE SYSTEM



Overwhelmed drainage systems are frequently the root cause of rainfall flooding. Combined sewer and stormwater systems also lead to environmental pollutants being released into waterways during rainfall events at CSO points. By separating and expanding the drainage capacity of these systems we can mitigate both stormwater flooding and CSO pollution.

HAZARDS ADDRESSED

STORM WATER

SCALE OF IMPLEMENTATION

NETWORK

CO-BENEFITS

ECONOMIC

APPLICABLE AREAS

UPLAND URBAN SUBURBAN

LEVEL OF POTENTIAL DISRUPTION

CONSTRUCTION TIME

IMPACT TO PUBLIC ACCESS AND USE

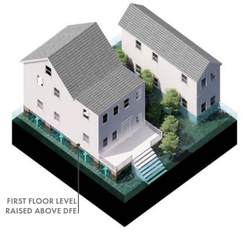
CONSTRAINTS AND CONSIDERATIONS

COSTS $ $$$

PERMITTING $ $$$

CONSTRUCTABILITY

ELEVATE STRUCTURES ABOVE DFE



Physically raising structures above flood levels protects these structures during flood events. Structures can be kept relatively intact during the raising process. Ground level can be used for storage, parking and other temporary uses.

HAZARDS ADDRESSED

COASTAL RIVERINE STORM WATER

SCALE OF IMPLEMENTATION

SITE

CO-BENEFITS

ECONOMIC

APPLICABLE AREAS

COASTAL RIVERINE UPLAND URBAN SUBURBAN

LEVEL OF POTENTIAL DISRUPTION

CONSTRUCTION TIME

IMPACT TO PUBLIC ACCESS AND USE

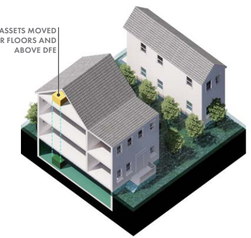
CONSTRAINTS AND CONSIDERATIONS

COSTS $ $$$

PERMITTING $ $$$

CONSTRUCTABILITY

RAISE CRITICAL SYSTEMS



Relocating critical systems to higher floors within structures reduces the impacts of flooding on critical services and reduces recovery times. This tool increases the resilience of essential services to homes and businesses.

HAZARDS ADDRESSED

COASTAL RIVERINE STORM WATER

SCALE OF IMPLEMENTATION

SITE

CO-BENEFITS

ECONOMIC

APPLICABLE AREAS

COASTAL RIVERINE UPLAND URBAN SUBURBAN

LEVEL OF POTENTIAL DISRUPTION

CONSTRUCTION TIME

IMPACT TO PUBLIC ACCESS AND USE

CONSTRAINTS AND CONSIDERATIONS

COSTS $ $$$

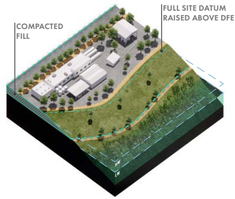
PERMITTING $ $$$

CONSTRUCTABILITY

Physical and Nature Based Solutions

ADAPT TO PRESENCE OF WATER

RAISE LAND



By physically raising land above flood levels a whole site can be protected from regular flooding. Raising land protects the full footprint of important sites like utilities and other public assets. This tool does displace risk to surrounding areas and is susceptible to subsidence. This should be applied only when there is enough space and risks to surrounding areas are considered.

HAZARDS ADDRESSED
COASTAL, RIVERINE, STORM WATER, SEA LEVEL RISE

SCALE OF IMPLEMENTATION
SITE

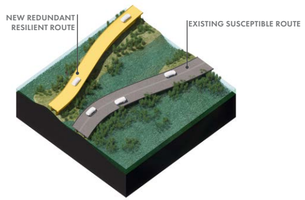
CO-BENEFITS
ECONOMIC, RECREATIONAL

APPLICABLE AREAS
COASTAL, RIVERINE, UPLAND, SUBURBAN, OPEN SPACE

LEVEL OF POTENTIAL DISRUPTION
CONSTRUCTION TIME
IMPACT TO PUBLIC ACCESS AND USE

CONSTRAINTS AND CONSIDERATIONS
COSTS $ $$$
PERMITTING
CONSTRUCTABILITY

CREATE REDUNDANT EMERGENCY ROUTES



By creating redundant routes, residents and emergency services can have mobility options when other, more susceptible routes are impassible. This tool applies to instances where critical emergency routes are often compromised by floodwaters.

HAZARDS ADDRESSED
COASTAL, RIVERINE, STORM WATER, SEA LEVEL RISE

SCALE OF IMPLEMENTATION
LINEAR

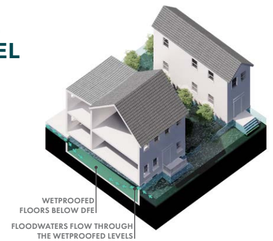
CO-BENEFITS
ECONOMIC

APPLICABLE AREAS
COASTAL, RIVERINE, UPLAND, URBAN, SUBURBAN, OPEN SPACE

LEVEL OF POTENTIAL DISRUPTION
CONSTRUCTION TIME
IMPACT TO PUBLIC ACCESS AND USE

CONSTRAINTS AND CONSIDERATIONS
COSTS $ $$$
PERMITTING
CONSTRUCTABILITY

WETPROOF LEVELS BELOW FLOOD LEVEL



Wetproofing of floors below grade involves sealing susceptible levels to water infiltration. This allows for flood water to move into and through these levels while limiting infiltration to the rest of the structure.

HAZARDS ADDRESSED
COASTAL, RIVERINE, STORM WATER

SCALE OF IMPLEMENTATION
SITE

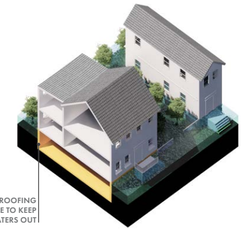
CO-BENEFITS
ECONOMIC

APPLICABLE AREAS
COASTAL, RIVERINE, UPLAND, URBAN, SUBURBAN

LEVEL OF POTENTIAL DISRUPTION
CONSTRUCTION TIME
IMPACT TO PUBLIC ACCESS AND USE

CONSTRAINTS AND CONSIDERATIONS
COSTS $ $$$
PERMITTING
CONSTRUCTABILITY

DRYPROOF LEVELS BELOW FLOOD LEVEL



Dryproofing below flood levels involves fully blocking out floodwaters with both permanent and deployable structures. This tool retains usability of floors below grade for permanent and temporary uses. Allows for assets and utilities to remain below DFE with a lessened chance of flooding.

HAZARDS ADDRESSED
COASTAL, RIVERINE, STORM WATER, SEA LEVEL RISE

SCALE OF IMPLEMENTATION
SITE

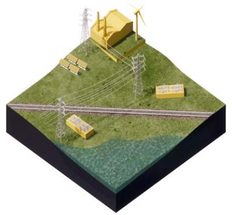
CO-BENEFITS
ECONOMIC

APPLICABLE AREAS
COASTAL, RIVERINE, UPLAND, URBAN, SUBURBAN

LEVEL OF POTENTIAL DISRUPTION
CONSTRUCTION TIME
IMPACT TO PUBLIC ACCESS AND USE

CONSTRAINTS AND CONSIDERATIONS
COSTS $ $$$
PERMITTING
CONSTRUCTABILITY

CREATE REDUNDANT SYSTEMS



Creating redundant systems is an essential element of resilience. For example, the reliable delivery of electricity is crucial for daily life and to post-disaster recovery. By creating decentralized and redundant energy generators and developing micro-grid systems we ensure the functioning and recovery of critical systems in case of failure within the wider network.

HAZARDS ADDRESSED
COASTAL, RIVERINE

SCALE OF IMPLEMENTATION
NETWORK

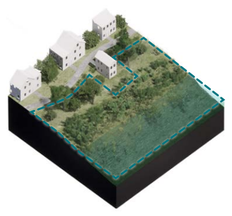
CO-BENEFITS
ECONOMIC

APPLICABLE AREAS
COASTAL, RIVERINE, UPLAND, URBAN, SUBURBAN

LEVEL OF POTENTIAL DISRUPTION
CONSTRUCTION TIME
IMPACT TO PUBLIC ACCESS AND USE

CONSTRAINTS AND CONSIDERATIONS
COSTS $ $$$
PERMITTING
CONSTRUCTABILITY

ACQUIRE LAND FOR PRESERVATION



By acquiring and consolidating land, particularly along coasts and shorlines, for preservation, natural edges can be restored and enhanced in order to add inundation and erosion protection as well as sea level rise and wave mitigation.

HAZARDS ADDRESSED
COASTAL, RIVERINE, SEA LEVEL RISE

SCALE OF IMPLEMENTATION
SITE, NETWORK

CO-BENEFITS
ECONOMIC, ECOLOGICAL

APPLICABLE AREAS
COASTAL, RIVERINE, UPLAND, URBAN, SUBURBAN

LEVEL OF POTENTIAL DISRUPTION
CONSTRUCTION TIME
IMPACT TO PUBLIC ACCESS AND USE

CONSTRAINTS AND CONSIDERATIONS
COSTS $ $$$
PERMITTING
CONSTRUCTABILITY

Individual and Community Based Actions | Policy and Governance

ADAPT TO PRESENCE OF WATER

RESILIENCE HUBS

Resilience Hubs are community serving facilities that support residents through coordination resource distribution and services before, during, and/or after a natural hazard event.

Hubs can be used year-round as neighborhood centers and are intended to be supported by local government by led and managed by community members, community-based organization and/or faith-based groups

EMERGENCY PREPAREDNESS

NJ Health New Jersey Department of Health

Prepare and Maintain an Emergency Kit

Prepare y mantenga al día Equipo para Emergencias

CERT COMMUNITY EMERGENCY RESPONSE TEAM

Emergency preparedness efforts include the dissemination of emergency alerts and guidance to residents and community leaders and supporting community-based emergency preparedness programs through partnerships with community organizations and faith-based institutions.

Outreach in multiple languages and through trusted local leaders is key.

More info from the New Jersey Department of Health's Office of Disaster Resilience

https://www.state.nj.us/health/er/

BUSINESS & INDUSTRY EMERGENCY PREPAREDNESS

STAY OPEN OFB-EZ FOR BUSINESS

THE EASY WAY TO PREPARE YOUR BUSINESS FOR THE UNEXPECTED.

Outreach and technical assistance to businesses and industries is another key element of emergency preparedness. This includes providing resources and guidance on developing emergency plans and how to navigate recovery programs.

More info from the New Jersey Office of Emergency Management

http://ready.nj.gov/plan-prepare/business-industry.shtml

COMMUNITY PLANNING

One way to build adaptive capacity is to work in close collaboration with neighborhood residents and community-based organizations to identify community needs and develop strategies for improving access to necessary resources. This could include improving access to open space, improving community mobility and connectivity, or addressing food deserts—all things that help a community adapt to changing climate hazards and thrive every day.

COMMUNITY STEWARDSHIP OF GREEN SPACES

Community co-creation and stewardship of green spaces is a way to partner with community-based organizations to maintain green spaces that support community resilience while supporting education, job training, and providing volunteer opportunities.

Ex. United Parks for One in Newark

WORKFORCE DEVELOPMENT

NEWARK GREEN WORKS

Creating a Clean, Green Newark!

Job training programs focused on green infrastructure or other resiliency projects help direct investment in infrastructure projects to community and develop the necessary workforce to implement planned projects.

Example: Newark Green Works.

More info from New Jersey Water Works: **https://www.jerseywaterworks.org/wp-content/uploads/2020/11/Newark-Local-Hire-Report-November-2020.pdf**

PUBLIC-PRIVATE PARTNERSHIPS FOR RESILIENCY INFRASTRUCTURE

Partnerships with developers can be used to incorporate resiliency improvements, such as barriers like berms or floodwalls, or on-site stormwater improvements, into redevelopment plans.

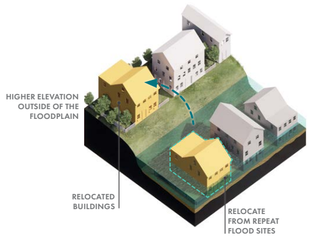
Ex. Crescent Park Redevelopment in Jersey City

Physical and Nature Based Solutions

MOVE AWAY FROM WATER

Moving away from the water includes relocation or setting back from flood areas. This approach keeps people and infrastructure out of areas of high flood risk. The NJDEP Blue Acres program is an example program that allows communities to buyout homes in high risk areas. Discussions about moving away from water can be challenging because of how this can disrupt communities. Resilient NENJ has heard from residents that they value keeping their communities intact.

RELOCATE STRUCTURES



Relocating structures, homes, or businesses may be the best solution for properties that have experienced increased and/or repeat flooding.

HAZARDS ADDRESSED

COASTAL · RIVERINE · STORM WATER · SEA LEVEL RISE

SCALE OF IMPLEMENTATION

LINEAR · SITE · MULTIPLE SITES · NETWORK

CO-BENEFITS

ECONOMIC

APPLICABLE AREAS

COASTAL · RIVERINE · UPLAND · URBAN · SUBURBAN

LEVEL OF POTENTIAL DISRUPTION

CONSTRUCTION TIME

IMPACT TO PUBLIC ACCESS AND USE

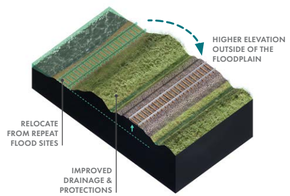
CONSTRAINTS AND CONSIDERATIONS

COSTS $ $$$

PERMITTING

CONSTRUCTABILITY

RELOCATE CRITICAL ASSETS & INFRASTRUCTURE



Relocating critical assets such as key infrastructure, community and emergency services, and parks and walkways, will lessen destruction and disruptions from extreme weather events.

HAZARDS ADDRESSED

COASTAL · RIVERINE · STORM WATER · SEA LEVEL RISE

SCALE OF IMPLEMENTATION

LINEAR · SITE · MULTIPLE SITES · NETWORK

CO-BENEFITS

ECONOMIC

APPLICABLE AREAS

COASTAL · RIVERINE · UPLAND · URBAN · SUBURBAN

LEVEL OF POTENTIAL DISRUPTION

CONSTRUCTION TIME

IMPACT TO PUBLIC ACCESS AND USE

CONSTRAINTS AND CONSIDERATIONS

COSTS $ $$$

PERMITTING

CONSTRUCTABILITY

Policy and Governance

GOVERNANCE AND POLICY ROLES

FEDERAL AGENCIES & PROGRAMS

FEMA	• Creates maps of current flood risk and sets national floodplain construction standards • Administers the National Flood Insurance Program (NFIP), through which people in participating municipalities can purchase flood insurance. Reduced rates are available for municipalities that adopt higher construction standards through the Community Rating System (CRS). • Provides hazard mitigation and disaster recovery funding to governments, businesses, and individuals. To be eligible for hazard mitigation funds, states and local entities must have developed a Hazard Mitigation Plan (HMP).
US Army Corps of Engineers	• Conducts flood risk reduction studies • Implements flood risk reduction projects • Coordinates with NJ Department of Environmental Protection (NJDEP) on hazard mitigation and disaster recovery funding efforts
NOAA	• Manages the federal Coastal Zone Management Program

STATE AGENCIES & PROGRAMS

NJDEP	• Coordinates federal, state and local floodplain management programs. These include statewide floodplain management standards and model local ordinances • Leading developing of statement climate resilience planning initiatives, including NJPACT and Resilient NJ. • Relatedly, oversees the Site Remediation Program and sets requirements for combined sewer systems / LTCPs.
NJDCA	• Enforces construction codes • Administers CBDG funds received by the State for Superstorm Sandy assistance
NJBPU	• Regulates utilities, including water supply and wastewater management
NJOEM	• Coordinates with FEMA on hazard mitigation, preparedness, response, and disaster recovery funding

COUNTY, REGIONAL, AND LOCAL AGENCIES & PROGRAMS

Hudson County, Essex County	• Responsible for managing county roads, infrastructure, parks • Can adopt site plan and subdivision standards as development impacts their assets • Maintain County Hazard Mitigation Plans
LTCP stakeholders (JCMUA, PVSC etc.)	• Responsible for wastewater conveyance and treatment and development of Long-Term Control Plans to mitigate impacts on water quality • Advanced internal planning for climate risks and implementation of flood mitigation projects
Jersey City, Newark, Hoboken, Bayonne	• As a home rule state, land use, zoning, development regulation rest in local decision makers • Required to have Flood Damage Prevention Ordinances and Municipal Separate Storm System (MS4) “Stormwater Management” plans • Must adopt a Master Plan that meets statewide requirements • Develop hazard mitigation plans and capital improvement programs to address infrastructure and flood protection needs • Submit grant applications to support funding • Raise funding through property taxes, municipal bonds, and improvements associated with redevelopment projects

Policy and Governance

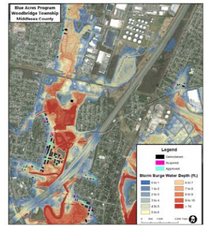
GOVERNANCE AND POLICY TOOLS

POTENTIAL ACTIONS

Strategy	Examples	Hazards Addressed	Co-Benefits
Increasing floodplain construction standards	• Higher freeboard • Disclosure laws for sale of land in the floodplain • Require dry access • Non-conversion agreements • Prohibit new critical facilities in high hazard areas	All	• Flood insurance savings
Increasing standards for on-site stormwater management	• Maximum lot coverage standards • Prohibit encroachments on drainage ways	Stormwater	• Water quality improvements • Creation of community green space
Land use planning and zoning	• Plan for growth in areas of lower risk and reduce growth in high hazard areas • Improve access to resources and necessities • Remove zoning barriers to resilient design • Set elevation requirements of buildings, yards, and esplanades • Erosion prevention requirements • Setbacks	All	• Economic development • Quality of life • Environmental benefits
Incorporating resiliency in Capital Infrastructure Planning	• Align Capital Infrastructure Plan with land use plans and hazard mitigation plans • Create resiliency design standards • Prioritize investments based on risk reduction	All	• Improved efficiency of capital spending
Adapting governance structures to advance resiliency	• Resilience District to fund, implement, and maintain community-scale resiliency infrastructure • Task forces and working groups across agencies and jurisdictions to advance	All	• Improved governance and accountability

CASE STUDY: WATSON-CRAMPTON NEIGHBORHOOD (WOODBRIDGE, NJ)

Approx. 150 homes have been bought out so far through this program.

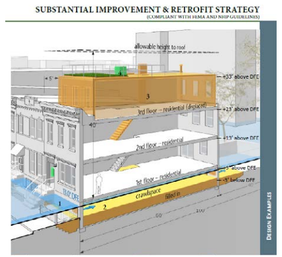


- After Hurricane Sandy, Woodbridge worked with the New Jersey Blue Acres Program (managed by NJDEP) for funding for voluntary buy-outs of homes severely damaged by Sandy.
- Woodbridge rezoned the area to an Open Space Conservation / Resiliency zone, which:
  - Prohibits new development
  - Renovation, reconstruction, sale, or change in tenancy require properties to be elevated one foot above federal requirements
- Woodbridge is working with Rutgers University to plan for the restoration of bought-out properties to serve as a flood buffer.
- Due to these efforts, Woodbridge has been designated a class 6 community through the Community Rating System, which allows residents to earn discount on flood insurance premiums.
- Woodbridge worked closely with residents and the Land Conservancy of New Jersey to educate residents about the program.

CASE STUDY: FLOOD OVERLAY ZONE (JERSEY CITY)

- The **Jersey City Flood Overlay Zone Ordinance** applies to all properties located in the current 1% annual chance floodplain.
- Includes requirements for **green infrastructure** and resilient site design depending on location in the AE or VE zone (VE zone is portion of floodplain where there are wave hazards).
- Strategies such as vegetated walls, green roof, permeable pavement, bioretention, WaterSense fixtures, etc., can be used to meet these requirements.

CASE STUDY: RESILIENT BUILDING DESIGN GUIDELINES (HOBOKEN)



- Provides an overview of the laws and regulations that apply to construction in the floodplain.
- Provides guidance on strategies to reduce flood insurance premiums.
- Recommendation for how to design buildings to be resilient as well enhance the character of a dense, urban city with pedestrian-friendly streets.

A split stoop allows matches frontage, while allowing access to dwelling above DFE.

Credit: Anne Hutchinson