Guidance for New York Rising Community Reconstruction Plans

A Planning Toolkit for CR Planning Committees

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Introduction

Hurricane Irene and Tropical Storm Lee (2011) and Hurricane Sandy (2012) demonstrated the severe effects of changing weather patterns – loss of life, displacement, damage to property and infrastructure, loss of essential services, and disruption of daily routines.

Through the New York Rising Community Reconstruction Program, New York State is assisting communities to rebuild better and safer based on community-driven plans that consider current damage, future threats to community assets, and the community's economic future. In keeping with the National Disaster Recovery Framework, CRZ Plans will consider the needs, risks, and opportunities related to assets in the following categories of recovery support functions: Community Planning and Capacity Building, Economic Development, Health and Social Services, Housing, Infrastructure, and Natural and Cultural Resources.

By completing a successful Plan, each participating community will position itself to obtain funding to implement that Plan to improve the community's future.

Through the planning process, communities will:

- Assess the community's vulnerabilities to future natural disasters and its needs for economic development;
- Identify where funds should be used to repair or reconstruct critical facilities and essential public assets damaged or destroyed by these storms; and
- Identify projects that will increase resilience while also protecting vulnerable populations and promoting sound economic development.

Planning to become more resilient is based on understanding and managing risk to a community. An evaluation of the factors that produce risk – hazard, exposure, and vulnerability – will help communities develop effective reconstruction strategies which will guide project and investment decisions, redirect land use, and gradually transition at-risk assets from high risk conditions to an acceptable lower level of risk.

To promote economic development in the community, each community will be able to apply lessons learned and best practices in other communities across the country and around the world. A successful plan will focus on those investments that produce the greatest economic benefits while improving the resilience of the community in the face of future threats.

To help communities develop their plans, New York State will provide communities with the following:

- Consultants to help develop plans;
- Assistance from experts and facilitators during the planning process;
- Workshops and webinars to help prepare the community and planning committee members to develop plans;
- A website containing information related to plan development and implementation, as well as other useful resources;
- A regional context to develop large scale infrastructure projects and address State, regional, and county assets;
- Identification of risk assessment areas; and
- A risk assessment tool to allow communities to quantify relative risk and test management measures.

Preparation of a NY Rising Community Reconstruction Plan

OVERVIEW

Though scientists cannot predict meteorological events with certainty, it is likely that the storms of 2011 and 2012 are the first of an era in which coastal storms may be more intense and more frequent. As a result, communities must identify approaches to community reconstruction and development that will reduce future costly damages to their social, economic, and environmental assets.

The State has invited communities hardest hit by Hurricane Sandy, Hurricane Irene, and Tropical Storm Lee to prepare NY Rising Community Reconstruction Plans. For details on how to access information and assistance related to community reconstruction planning, consult the website found at:

http://nysandyhelp.ny.gov/community-reconstruction-program

This guide explains the seven steps a community must take to develop a plan that will guide their rebuilding, resilience and economic development and position the community to receive implementation funds.

As set forth in the timeline in Figure 1, the planning process is expected to take eight months. The deadline for submission of completed plans will be posted by the State before the commencement of the planning process.

PREPARATION OF A COMMUNITY RECONSTRUCTION PLAN

Step One: Organize for Action
- Appoint a Plan Development Committee
- Select a Consultant
- Establish Goals
- Conduct Public Outreach
- Review Risk Assessment Areas
- Identify Geographic Scope of Reconstruction Plan

Step Two: Inventory Assets
- Conduct Inventory of Assets

Step Three: Assess Risk
- Assessing Risk
- Using the Risk Assessment Tool to Quantify Risk

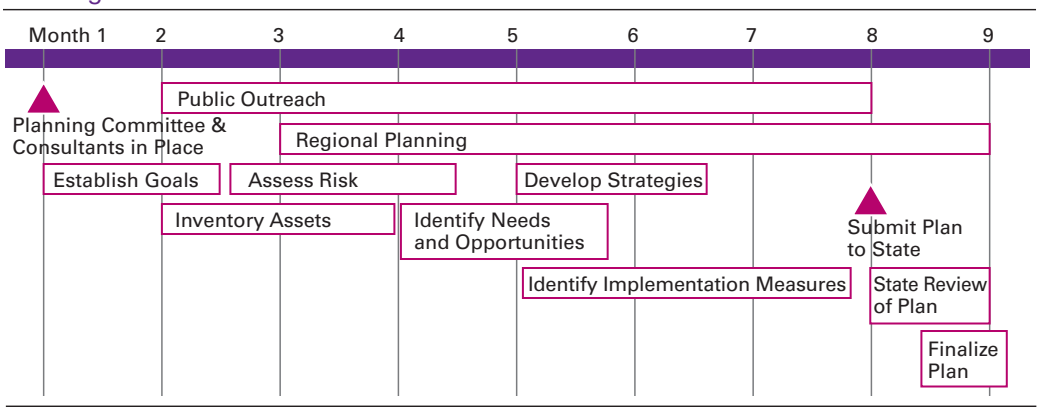
Step Four: Determine Needs and Opportunities
- Analyze Asset Needs and Opportunities

Step Five: Engage in Regional Planning Process

Step Six: Develop Strategies for Investment and Action
- Develop Strategies
- Identify Projects Needed to Implement Strategies
- Identify Management Measures Needed to Implement Strategies

Step Seven: Complete the Community Reconstruction Plan
- Develop Detailed Implementation Schedule
- Submit Community Reconstruction Plan

Figure 1
Planning Timeline



CHARACTERISTICS OF A SUCCESSFUL CR PLAN

To qualify for grants to implement the CR Plan, the plan must include the following:

- **Assessment of risk to key assets and systems.** As the bedrock of the plan, an inventory of the vulnerabilities of key assets and systems is necessary to prioritize various projects and actions.
- **Projects and actions to restore and increase the resilience of key assets.** The CR Plan should address both the restoration of key assets and actions that will make them more resilient to future threats. Examples of such projects and actions include restoration or mitigation of natural infrastructure (e.g. wetlands, oyster reefs, dunes, and other green infrastructure), changes in land use regulations (e.g. changes in use, increased setbacks, and transfer of density) to encourage sound development, and investments in transportation or other improvements in community systems to prepare for future threats.
- **Protection of vulnerable populations.** The CR Planning Committee should develop new measures to protect vulnerable persons (people with disabilities, low and very-low income populations, elderly, young children, homeless and people at risk of becoming homeless) through housing decisions and other services. For example, site new facilities in lower risk areas, require backup power systems for critical facilities such as nursing homes and hospitals, and improve communications systems to ensure that vulnerable persons are not left without aid. Some actions to address vulnerable populations could include amendments to municipal emergency management procedures.
- **Projects with economic growth co-benefits.** Projects that will improve the future of the local economy may also enhance the resilience of the community. For example, investments in new transportation infrastructure may facilitate the growth of Main Street business corridors; and investments in new recreational assets (e.g. new green space that serves as a buffer against coastal flooding) may protect against storm damage or serve as redundant protection in critical areas, while also drawing tourists or facilitating the growth of new businesses.
- **Regional coordination.** To ensure that CR Plans are consistent with regional objectives and that a regional response to the challenges that cross political jurisdictions serve the community's long-term objectives, Long Island communities and communities in other areas identified by the State must participate in a regional planning process.
- **Detailed implementation agendas.** Each CR Plan must include a clear and detailed description of the tasks it will take to implement the plan. This includes assigning responsibility for specific actions to specific individuals or organizations, and establishing timelines for each action, as appropriate.

CONTENTS OF A NY RISING COMMUNITY RECONSTRUCTION PLAN

Planning for the future of a community after a major disaster must be driven by the community itself. Through a CR Plan, a community will express its strategies for rebuilding and replacing critical facilities, improving its resilience against future threats, capitalizing on its social and economic assets, and fostering economic growth. Development of a plan which contains the required elements will qualify a community to receive implementation grants and guide long term construction and use of local and other funds.

The CR Plan will result in a list of projects and actions needed for the community to recover and to reduce future hazard damages. The community will estimate costs and benefits of the proposed course of action, and set priorities for the projects that have the most significant recovery value.

The items that must be contained in a CR Plan are listed on the right. For a more detailed description, refer to Appendix 1.

Community Reconstruction Plan Contents

Transmittal Letter

Overview
- Geographic Scope of Plan
- Description of Storm Damage
- Critical Issues
- Community Vision
- Relationship to Regional Plans

Assessment of Risk and Needs
- Community Assets
- Assessment of Risk to Assets
- Assessment of Risk to Systems
- Assessment of Needs and Opportunities

Reconstruction Strategies
- Community Planning and Capacity Building
- Economic Development
- Health and Social Services
- Housing
- Infrastructure
- Natural and Cultural Resources

Implementation Schedule
- Schedule of Implementation Actions

Appendices
- List of CR Planning Committee Members
- Description of Public Engagement Process
- Description of Priority Projects and their Costs and Benefits
- Inventory of Assets

Step One: Organize for Action

APPOINT A PLANNING COMMITTEE

The first step for a participating community to complete is to establish a Planning Committee (Committee) that accurately reflects the community's diverse populations and represents both the needs of the community and its members' various talents. The Committees' co-chairs will be selected by the State in consultation with the communities.

The composition of the remaining members of the Committee will vary from one community to another, but will include a representative from (1) the town board, village board of trustees, or city, as applicable, (2) the county, (3) elected legislative representatives and (4) directors of established community organizations and businesses.

Examples of other types of people who may be on the Committee or who might advise the Committee include:

- Planning experts;
- Hazard mitigation experts;
- Local zoning experts;
- Economic development experts;
- Local Waterfront Revitalization Program manager;
- Representatives of commercial, environmental, housing, and human services organizations;
- Representatives of vulnerable populations such as people with disabilities, low and very-low income populations, the elderly, young children, homeless and people at risk of becoming homeless;
- Transportation experts;
- Public works experts familiar with water or sewer systems;
- Representatives of the parks department; and
- Emergency management personnel.

The size of the Committee must balance participant availability with the need for representation of diverse communities, interests, and areas of expertise. Generally, 9 to 15 people have been found to be a workable committee size.[1]

A member of the Committee will be designated to serve as a liaison between the Committee and the regional planning effort.

The members of the Committee will not be paid. They will be required to follow a detailed code of ethics that will govern their service on the Committee. The State will provide Committee members with access to online training which explains the code of ethics.

SELECT A CONSULTANT

The State will provide consultants to help facilitate the planning process in each participating community. The consultants will provide ongoing technical assistance and facilitate the Planning Committee's work in many ways to ensure timely and successful completion of the key steps toward a completed CR Plan. In addition, the State will retain a series of outside consultants and experts in a broad range of substantive areas to be "on call" to help Planning Committees in specific areas. For example, if a Planning Committee wishes to better understand its range of options to improve the waterfront protections in its community while improving its tourism economy, the Committee could call upon an environmental engineering firm to analyze the physical options for improvements and a firm with expertise in economic development strategies to analyze the best approaches to building public recreational or other facilities on the water. Such firms will be available and engaged from the start without requiring each Committee to conduct its own separate RFP/RFI/RFQ process.

The State will be available throughout the process to answer questions and assist Planning Committees in navigating the best use of such outside consultants in their work.

ESTABLISH A VISION

The Committee should establish a vision which may be expressed in short, medium and long-term goals to be achieved through the implementation of the plan. The vision and goals should reflect community objectives and revitalization strategies as well as the priorities of the Regional Economic Development Council. The overall aim should be to address damage caused by Sandy, Irene and Lee; capitalize on social and economic assets to improve the local economy; and rebuild a more resilient community to reduce future risk. Medium and long-term goals should incorporate medium and long-term risks, especially those identified by State and federal agencies (see below). Goals should focus on:

- Opportunities for reconstruction and resilience projects with potential for economic growth;
- Buildings, infrastructure, or services that must be built, rebuilt, or relocated to sustain service in response to future hazards;
- Development and implementation of long-term, cost-effective and environmentally-sound mitigation projects to make the community more resilient in the future;
- Protecting vulnerable populations from future hazards, and improving emergency response protocols for elderly and special needs populations where necessary;
- Reduction of risk to assets from frequent natural disasters through relocation, elevation, or safer reconstruction;
- Expanding the availability of affordable housing types to better accommodate post-storm and post-buyout housing demands; and
- Resilience awareness and education.

CONDUCT PUBLIC OUTREACH

Broad public outreach is an important component of successful planning. The Committee should develop a public outreach plan. Public input will help shape and enrich the CR Plan itself. Outreach will also serve to educate and inform residents and stakeholders on storm and climate change risks, potential mitigation projects and management measures, and will build support for implementing strategies.

The Committee should offer opportunities for public input and comment at key milestones in the planning process. The Committee could organize an open house, hold workshops and public information sessions, and participate in other meetings to solicit public input.

The State has developed a website to post progress, meeting schedules and agendas (http://nysandy-help.ny.gov/community-reconstruction-program), and outreach materials to retain public interest and involvement. Members of the community may also use the website to comment on issues they believe should be addressed by the Plan. Open access to the planning process ensures inclusiveness, and increases understanding of and support for implementation actions.

Improving resilience is a long-term and ongoing process, therefore it is important to include provisions in the public outreach plan that ensure continued public outreach and opportunities for input throughout the planning and implementation phases of the CR Plan.

REVIEW RISK ASSESSMENT AREAS

Knowing which areas have been and will be affected by storms and other threats such as sea level rise are the first step understanding risk. To help understand the geographic distribution of coastal risk, the Department of State prepared coastal and riverine risk assessment maps with assistance from the National Oceanic and Atmospheric Administration Coastal Services Center (NOAA-CSC) and the Federal Emergency Management Agency (FEMA).

Coastal risk assessment areas have been identified for Nassau, Suffolk, and Westchester counties and the New York City boroughs. The Department of State can provide assistance to communities on the Hudson River (south of the Troy Dam) to help identify similar risk assessment areas. In the absence of available risk assessment maps, communities should consult floodplain maps and consider flood levels experienced in recent storms. Factors that may be helpful in identifying inland flood risk are listed in Appendix 2.

The coastal risk assessment areas, which can be viewed online, depict the full spectrum of coastal risk, from relatively frequent events to infrequent large storms or future changes in water levels.

Risk assessment mapping uses the best currently available science and data sources to identify areas at risk from flooding, erosion, and storm surge as well as potential effects from sea level rise. As Hurricane Sandy demonstrated, areas well inland can be affected, so risk assessment mapping included sources such as the FEMA 0.2% annual risk ("500-year") flood zone and the National Hurricane Center's Sea, Lake, and Overland Surges from Hurricanes (SLOSH) zones. The mapping also assumes a 3-ft rise in sea level by 2100.

The online maps identify three risk areas based on aggregated information for multiple coastal hazards:

- **Extreme Risk Areas:** Areas currently at risk of frequent inundation, vulnerable to erosion in the next 40 years, or likely to be inundated in the future due to sea level rise.
- **High Risk Areas:** Areas outside the Extreme Risk Area that are currently at infrequent risk of inundation or at future risk from sea level rise.
- **Moderate Risk Areas:** Areas outside the Extreme and High Risk Areas but currently at moderate risk of inundation from infrequent events or at risk in the future from sea level rise.

Risk assessment maps are intended for planning purposes only. These maps can be used in conjunction with other planning tools, maps, and resources to advance reconstruction plans. They should not be confused with, and may not be substituted for, any existing regulatory maps or associated boundaries.

Data sets used to create the extreme, high, and moderate risk areas on the risk assessment maps are identified on the NY Rising Community Reconstruction Plan website.

On the following page is an example of a risk assessment map showing areas of Extreme, High, and Moderate risk. The image is of the Shirley Mastic area in the Town of Brookhaven, Suffolk County.

IDENTIFY GEOGRAPHIC SCOPE OF COMMUNITY RECONSTRUCTION PLAN

The Committee should identify the geographic scope of the Community Reconstruction Plan. Properly scoping the CR Plan includes meeting federal guidelines for the use of reconstruction funds. Those guidelines, and State assistance in interpreting those guidelines for local communities, will be available to Planning Committees throughout the planning process. CR Plans are designed to address the damage caused by Sandy, Irene, and Lee, and communities seeking to implement projects not directly impacted by those storms will need to demonstrate how such projects mitigate the risk of such damage occurring in the future.

Assets are likely to be most at risk to future storms in the extreme, high, and moderate risk areas of the community, but reviewing current and previous damage may indicate that other areas should be included. For communities without risk assessment maps, the areas where assets are likely to be most at risk should include the 100-year flood plain and potential inundation areas associated with an upstream dam. Past experience with damage caused by storms should also be considered.

A community may define the geographic scope of the plan to include the areas where assets are most at risk, where reconstruction or future construction should be encouraged, and where key investments to improve the local economy can be made. The identification of more resilient areas for future development can later be reinforced in municipal comprehensive plans and land use regulations.

Figure 2
Shirley Mastic area, Town of Brookhaven, Suffolk County

Produced by NY Department of State in partnership with NOAA Coastal Service Center

Step Two: Inventory Assets

OVERVIEW

One purpose of the CR Plan is to ensure both reconstructed assets and new construction post-storm are more resilient in the face of future storms. Communities have a variety of assets such as housing, transportation, schools, hospitals, treatment plants, parks, natural areas, and commercial areas.

The Committee should compile and review the inventory of assets. Federal, State, regional and county sources may be able to provide information, as well as local sources. The State will assist the Committee to produce this inventory with both data analysis and guidance.

Within the geographic scope of the plan identified, the Committee should determine the assets that have been affected by coastal or riverine hazards, and those assets which could be affected as shown on the risk assessment maps (or in non-coastal areas, assets located within the 100-year flood plain or dam inundation areas). The Committee may choose to limit the inventory of assets to those located within the Extreme and High Risk areas within the geographic scope of the CR Plan.

Special attention should be paid to assets whose loss or impairment would compromise any critical facilities or any essential cultural, social, economic or environmental functions of the community. (See Appendix 3 for FEMA's list of critical facilities.) Examples of the types of assets to include in the inventory are presented in Table 1.

Major energy and utility infrastructure that is outside the local government's management control need not be included in the inventory unless the Committee believes that it is essential to consider.

The Committee may choose to use the Asset Inventory worksheet, which is a component of the Risk Assessment Tool. The Risk Assessment Tool can be found on the community reconstruction zone website. A sample of the Asset Inventory worksheet is shown below. Use of the Asset Inventory worksheet is strongly recommended if the Committee chooses to use the Risk Assessment Tool, as these two are linked. The Risk Assessment Tool is described in Step Three.

Figure 3
Asset Inventory Worksheet

Asset Information							Landscape Attributes						
Asset Name	Address	Geographic Coordinates	Risk Area	Asset Class	Critical Facility	Community Value	**Erosion Rate:** Long-term average erosion rate ≥1 per year, or unknown	**Beach Width:** Waterline frequently at shore defense or upland vegetation	**Shore Defenses:** Absent, not constructed to anticipated conditions, below BFE, or deteriorating	**Protective Vegetation:** Dense, healthy vegetation, wetlands between asset and flood source absent	**Dunes or Bluffs:** Dunes absent, below BFE, discontinuous, eroding; Bluff slope unstable, partially vegetated	**Soils:** Asset located on a coastal barrier island or filled wetland	Additional Information

Table 1
Types of Assets

Asset Class	**Asset Examples**
A. Economic	Office buildings, business and industrial parks, manufacturing, warehouses, storage facilities, grocery, restaurants, banks, lodging, storefronts, downtown center, seasonal/tourism destinations
B. Health and Social Services	Schools, health care, day care, elder care, emergency operations, government and administrative services, media and communications, police, fire and rescue
C. Housing	Single-family and multi-family dwellings, supportive housing/group homes, senior housing and affordable housing
D. Infrastructure Systems	Pedestrian, bicycle and vehicular ways, transit, bridges, airports, rail, ports, ferries, gas stations, water supply, stormwater, wastewater, solid waste and recycling
E. Natural and Cultural Resources	Natural habitats, wetlands and marshes, recreation facilities, parks, public access, open spaces, agricultural areas, religious establishments, libraries, museums, historic landmarks, performing arts venues
F. Socially Vulnerable Populations	Assets predominantly providing services for people with disabilities, low and very-low income populations, the elderly, young children, homeless and people at risk of becoming homeless

CONDUCT INVENTORY

Information about assets located in the Extreme and High Risk areas should be recorded in the asset inventory. Assets may be recorded individually (e.g. Wright Airport), or assets in close proximity with similar characteristics and risk factors may be identified as a group (e.g. Garner Industrial Park). For example, several multi-family buildings in the same neighborhood with similar risk factors could be grouped as one asset. Grouping assets of a similar type and with similar exposure conditions helps simplify the risk assessment process.

The following types of information should be gathered and entered in the inventory in order to assess the risk to each asset:

Asset Name: The name of the facility or a descriptive name that will serve as a unique identifier. For example, "St. Jude's Medical Center," "Elmwood Multi-Family Dwellings #1," or "Owens Athletic Complex."

Address: The street address for the asset. If it is a group of assets, provide a general description of the boundaries of the asset.

Geographic Coordinates: The Committee may provide the asset's geographic coordinates to be used in mapping the asset. Multiple coordinates may be needed to map a group of assets.

Risk Area: If a coastal risk assessment map is available, identify the risk assessment area in which the asset is located, selecting Extreme or High. If the Committee chooses to inventory assets in other parts of the community, select Moderate or N/A (not located in a risk area).

If a coastal risk assessment map is not available, the community should indicate the relative level of risk to flooding as Extreme (10-year floodplain or areas known to be frequently inundated) or High (100-year floodplain). If the Committee chooses to inventory assets in other parts of the community, select Moderate (500-year floodplain) or N/A (not located in 100- or 500-year floodplain).

Asset Class: The asset class best describing the asset as listed in Table 1. If using the provided spreadsheet, select the appropriate asset class, represented by letters A – F, from the dropdown menu. If an asset has a mixed function, such as an apartment building with many senior citizen residents, list it in the asset class which is most important in terms of measuring and addressing risk – which in this example might be Class F – Socially Vulnerable Populations. Another example would be a gasoline station, which is an important source of fuel for residential or commercial generators but is primarily used to support transportation. As a result, it could be listed as Class D – Infrastructure Systems.

Critical Facility: Select "Yes" or "No" to indicate whether the asset is a critical facility. Critical facilities are essential to the health and welfare of the whole population and are especially important following hazard events. For example, critical facilities may include emergency service facilities such as hospitals and other medical facilities, police and fire stations, emergency operations centers, public works facilities, evacuation shelters, schools, and other uses that house special needs populations. A list of critical facilities is included in Appendix 3.

Community Value: The value of the asset to the community expressed as high, medium, or low. The community can determine value in many ways. For example, high value may be placed on critical facilities, high property tax revenue generators, or large employers.

Landscape Attributes

Features of the landscape that lie between the asset and the source of flood waters may reduce the potential for flooding and erosion. Use the drop-down menu to answer the following questions regarding that landscape:

- **Erosion Rate:** Is the long-term average shoreline erosion rate one foot per year or more, or unknown?
- **Beach Width:** Is the water line frequently in contact with a shore defense structure or upland vegetation?
- **Shore Defenses:** Are shore defenses (e.g. seawalls, bulkheads, levees, revetments, and groins) absent, not constructed to anticipated storm or sea level rise conditions, or deteriorating?
- **Protective Vegetation:** Are protective vegetation (i.e. dense shrubbery or forested land cover at least 300 feet in depth), well-established or restored wetlands, or other intervening structures between the asset and the flood source absent?
- **Dunes or Bluffs:** Are dunes absent or below base flood elevation (BFE), or eroding, discontinuous or have little vegetation? Are bluff slopes unstable or partially vegetated?
- **Soils:** Is the asset located on a coastal barrier island or built on a filled wetland?

Additional Information

The inventory worksheet has a final column in which the Committee can include other information of note. For example, it could be noted whether the asset is a wooden or concrete structure; how long the asset is likely to be impaired by storm effects based on similar past experiences; the age of the asset; and features of the asset that are at risk (e.g. electrical system). Other information, if needed, might include: ownership of the asset; whether it is occupied by vulnerable populations; damage it may have experienced in a storm; or details on the items in a group of assets. This additional information may help the community determine the vulnerability of the asset, cost factors, and help with the selection of management measures.

Step Three: Assess Risk

OVERVIEW

Risk is the chance that an asset will be damaged or destroyed. Assessing the risk to assets will help the Committee understand and prioritize projects and measures to protect assets at risk and ensure appropriate long-term economic growth. Three factors contribute to overall risk for each asset:

- The likelihood and magnitude of future storm events. This is a measure of *hazard*.
- The moderating effect of topographic and shoreline features. This is a measure of *exposure*.
- The level of impairment or consequences that assets may experience from a storm event. The ability of the asset to resist damage from a storm is a measure of *vulnerability*.

The Committee can assess risk by using guidance in this document and Appendix 2. The Committee may also use the Risk Assessment Tool to generate a Risk Score representing the relative risk to assets in the community. The Risk Assessment Tool is not designed for inland communities.

The next section explains how risk is assessed, followed by a section explaining how to use the Risk Assessment Tool to quantify risk.

ASSESSING RISK

To assess risk to an asset, the Committee should consider the three factors contributing to risk. Using those risk factors and past experience, it will estimate the potential consequences an asset faces from future storms.

Hazard

For a CR Plan, hazards are storms that are typical for the region, not unlikely or unpredictable events. Evaluating risk from a range of storm events, from frequent, low intensity events to infrequent, high intensity events, will help distinguish assets that are most at risk in the near term from those that are at risk over the long term.

The Committee must identify what is likely to cause harm and the frequency with which it will occur. Examples of the most common risks include hurricanes, coastal flooding, flooding in a 100-year floodplain, sea level rise, or dam or levee failure. As a rule of thumb, an asset located in an extreme risk area experiences hazards more frequently and with greater impact than if it were located in a high or moderate risk area; and an asset located in a wave impact zone (the V zone) is more at risk than if it were located in other parts of a 100-year floodplain or in a 500-year floodplain.

Exposure

Exposure is an expression of the local topographic and shoreline conditions that tend to increase or decrease the effects of coastal hazards on assets. If assets are more exposed (e.g., situated on low-lying floodplains, directly exposed to the probable storm surge, or otherwise unprotected), they are more likely to suffer storm effects than similar assets located at a higher elevation, on a rocky shoreline behind multiple rows of continuous dunes.[2] Landscape features are more important when an asset is near the flood source (e.g., as the distance between the assets and the flood source increases, the shoreline conditions become less important and the site conditions become more important).

Table 2 provides some guidance on assessing the amount of risk to an asset in a coastal area based on its landscape attributes. The examples below explain how a variety of landscape attributes determine exposure.

- Vegetation can reduce flood and erosion impacts. Density of vegetation can significantly influence wind speeds, as well as water flow velocity.

Table 2
Effect of Landscape Attributes on the Exposure of Assets

Landscape Attribute	Least Exposed	Most Exposed
Erosion Rate	Shoreline is accreting or minor erosion	Average annual shoreline erosion is 1 foot per year or more
Beach Width	The waterline is not in contact with shore defenses or upland vegetation or only in contact temporarily during storms	The waterline is in frequent or daily contact with shore defenses or upland vegetation
Shore Defenses	Constructed to anticipated conditions including storms and sea level rise and well maintained	Not constructed to anticipated conditions including storms and sea level rise or poorly maintained
Protective Vegetation	Healthy, dense upland or wetland vegetation, near the asset	Vegetation is sparse or distant from the asset
Dunes or Bluffs	Dunes are broad, above Base Flood Elevation, vegetated and have space to retreat. Bluff slope is stable and vegetated	Dunes are narrow and unvegetated, eroded (scarped), discontinuous, below Base Flood Elevation, or constrained by adjacent structures. Bluff slope is unstable and partially vegetated
Soils	Soils are stable and/or rocky	Sites of former wetlands that have been filled, or unconsolidated sand and fine sediment, or sandy coastal barriers

- Shoreline composition and topography close to the coast affects exposure. Wide beaches, cobble, bluffs, or shallow water reduce waves and surge. Narrow, steep beaches and low land behind a beach without dunes are often at higher risk.
- Assets built on filled wetlands may experience increased flooding and erosion damages. Filling wetlands may cause wetland degradation or loss, resulting in diminished services such as providing critical habitat, flood and erosion control, and water quality protection.
- The presence of structural defenses such as bulkheads, seawalls, breakwaters and revetments may reduce the effects of incoming surge and wave energy on an asset if they are well maintained and above BFE. However, if the waterline is already at the seawall or bulkhead, assets are at increased risk to wave overtopping effects.
- Assets facing open waters or embayments subject to significant storm surge are more likely to be inundated. The orientation of the shoreline to probable storm surge direction affects which areas experience direct wave attack or increased erosion.
- Storm effects may be exacerbated on shorelines with high erosion rates. Development situated on an eroding beach may be at greater risk from wave impacts and storm surge. Development situated on a stable beach or one growing with new sediment deposits may be less prone to severe storm effects.
- Dunes located between the asset and the shoreline can absorb incoming wave energy. Dunes that are higher, wider, and well vegetated are more effective than dunes with heights below the BFE, which are discontinuous, or have little vegetation.
- Exposure is also affected by the distance of the risk area from the flooding water bodies. For example, landscape features near the shoreline are more important for extreme risk areas and are a smaller factor in the moderate risk area.

Vulnerability

As used in this guidance, vulnerability is an expression of the capacity of an asset to return to service after a storm, taking into account its material strength relative to the coastal hazard as well its regenerative capacity. If an asset quickly recovers without

Table 3
Vulnerability Based on Impact on Service or Function of Community Assets

Impact	Insignificant 1	Minor 2	Moderate 3	Significant 4	**Major 5**
A. Economic Assets	Limited interruption in service or short term reduced service	Service loss for up to 1 week or longer term reduced service	Service loss for more than 1 week up to 1 month or longer term reduced service	Service loss for more than 1 month or permanent reduced capacity	Permanent loss of service of the economic asset
B. Health and Social Services Assets	Limited interruption in service or short term reduced service; Services under more than usual stress but manageable	Service loss for up to 1 week or longer term reduced service; Services under more than usual stress on several fronts	Service loss for more than 1 week up to 1 month or longer term reduced service; Services under severe pressure	Service loss for more than 1 month or permanent reduced capacity	Permanent loss of service of any one of the essential services listed
C. Housing Assets	Limited inconvenience	Out of use for up to 1 week	Out of use for more than 1 week up to 1 month	Out of use for up to 6 months [OR] permanent loss of 15% or less of housing in a group asset	Out of use for more than 6 months [OR] permanent loss of more than 15% of housing in a group asset
D. Infrastructure Systems Assets	Limited interruption in service or short term reduced service	Service loss for up to 1 week or longer term reduced service	Service loss for more than 1 week up to 1 month or longer term reduced service	Service loss for more than 1 month or permanent reduced capacity	Permanent loss of service of any one of the facilities listed
E. Natural and Cultural Resources Assets	Limited interruption in service or short term reduced service [OR] Limited loss of access, habitat, or use	Service loss for up to 1 week or longer term reduced service; Minimal natural habitat impacts, temporary loss of public access, temporary loss of open space/tourism assets	Service loss for more than 1 week up to 1 month [OR] Moderate impacts on natural habitats, sustained loss of public access, long term loss of private open space	Service loss greater than 1 month [OR] Permanently diminished capacity of natural resource; substantial damages of important natural habitats	Permanent loss of service of the cultural asset [OR] complete loss of important natural habitats
F. Assets Providing Services for Socially Vulnerable Populations	Limited service interruption	Service interruption for up to 1 week	Service interruption of more than 1 week up to 1 month	Permanent service interruption of more than 1 and less than 6 months	Service interruption of 6 or more months

external assistance it has low vulnerability. Local knowledge of how assets were affected in the past will help estimate future effects.[3] Table 3 provides some guidance on assessing vulnerability. Look for weaknesses or vulnerabilities that can make an asset more susceptible to damage, requiring longer periods to restore its function. For example:

- Elevation above BFE has a direct influence on which assets experience direct wave action, storm surge, and flooding. Assets below BFE are highly vulnerable to flooding impacts;
- Well-constructed and reinforced structures can resist storm damage better than poorly constructed or unreinforced structures;
- Natural features may be impacted by saltwater inundation, changing the vegetation or landform and affecting native species;

- Sewer treatment facilities that are inundated may cease operation for long periods because equipment was exposed to storm waters;
- Unsecured oil storage tanks could spill and render an asset unusable until cleanup efforts are completed; and
- Flooded access roads or other affects on adjacent areas could limit access to the asset.

Consider also the aspects of the asset that may make it less vulnerable. For example:

- Measures may be underway that would minimize future vulnerability, such as elevation or dune nourishment; and
- Measures may be in place to reduce damages, such as flood-proofing or levees.

Assets protected by shore defenses including seawalls, bulkheads, and levees are still at risk, as demonstrated by Hurricane Katrina and the Midwestern floods of 2011. As a result, assets behind shore defenses should include an estimate of residual risk. It may be advisable to estimate the vulnerability of such protected assets twice: once assuming the protection works, and once assuming the protection fails or is overtopped, to help understand this residual risk. (See information included with the Risk Assessment Tool.)

Risk

The Committee should analyze the assets listed in the inventory and how they were impacted by previous hazard events. The Committee should seek input from local experts, resource managers, and community members. Based on the discussion and a review of the characteristics recorded in the inventory, the Committee should estimate how likely it is that the asset will be negatively affected by hazard events.

For areas affected by sea level rise, it is important to recognize that flooding associated with the current 1% annual risk event (100-year storm) will occur much more frequently in the future. For example, one assessment estimates the current water levels in New York City associated with a 1 in 100-year storm will occur about once in 35 to once in 15 years towards the end of the century.[4]

USING THE RISK ASSESSMENT TOOL TO QUANTIFY RISK

The NYS Department of State developed a tool to help coastal communities assess and quantify the risk to their assets and to test whether various projects and management measures will reduce the risk to those assets. The Risk Assessment Tool is available at http://nysandyhelp.ny.gov/community-reconstruction-zones.

For each asset the three factors contributing to overall risk – hazard, exposure, and vulnerability – are scored and combined to produce a final Risk Score, representing the overall level of risk. Assets with high Risk Scores are not likely to be resilient to future storm events.

The Risk Assessment Tool is in the form of a spreadsheet with formulas built into it to calculate an overall Risk Score for each asset.

The asset information and landscape attribute information will automatically be entered into the Risk Assessment Tool spreadsheet if the Committee used the Asset Inventory worksheet. The landscape attribute score will be automatically calculated based on the landscape attribute information.

Detailed information about how each score is calculated is included with the Risk Assessment Tool.

Hazard Score

The Risk Assessment Tool will ***automatically*** assign a Hazard Score of 3 for each asset based on a 100-year storm event occurring within the next 100 years.[5] Information as to how to calculate the hazard score for a 500-year storm event is included with the Risk Assessment Tool.

Exposure Score

The Exposure Score, which will be ***automatically calculated,*** takes into consideration the risk area in which the asset is located and local landscape

Figure 4
Risk Assessment Tool

Asset Information					Landscape Attributes						Risk Assessment			
Asset	Risk Area	Asset Class	Critical Facility	Com-munity Value	**Erosion Rate:** Long-term average erosion rate ≥1 per year, or unknown	**Beach Width:** Waterline frequently at shore defense or upland vegetation	**Shore Defenses:** Absent, not constructed to anticipated conditions, below BFE, or deteriorating	**Protective Vegetation:** Dense, healthy vegetation, wetlands between asset and flood source absent	**Dunes or Bluffs:** Dunes absent, below BFE, discontinuous, eroding; Bluff slope unstable, partially vegetated	**Soils:** Asset located on a coastal barrier island or filled wetland	Hazard Score	Exposure Score	Vulner-ability Score	Risk Score

attributes that influence the potential for storm impacts, such as the local erosion rate, beach width, presence and condition of natural protective features and engineered shore defenses. The Committee will provide this information in the landscape attribute portion of the asset inventory worksheet.

The Exposure Score reflects how the variability of landscape features moderate damages to assets. Assets that are closer and more exposed to hazards are at greater risk than those that are less exposed.

To aid in understanding the basis of the results, the factors used to calculate the Exposure Score are included with the Risk Assessment Tool.

Vulnerability Score

The Vulnerability Score reflects the level of impairment, or consequences that assets may experience from a hazard event, and reflects the ability of the asset to resist damage from the hazard. In the case of vulnerable populations, it reflects the difficulties of relocating or evacuating vulnerable people in an asset as their percent of occupation increases. The Committee will need to assign a vulnerability score for each asset ranging from 1 to 5 using Table 3 as a reference. Local knowledge of how assets were affected in the past will help in estimating future effects.[6]

Risk Score

In the Risk Assessment Tool a Risk Score will *automatically* be calculated when all the necessary factors have been entered on the table. The formula to calculate risk is:

Hazard × Exposure × Vulnerability = Risk[7,8]

The tool will generate a Risk Score representing the relative risk of the assets in the community to one another. Risk Scores will range from 1.5 (negligible) to 75 (severe).

Risk Scores rely on past experience as predictor of future risk and include some subjective analysis. They should not be compared from one community to the next.

Using the Risk Score

An asset with a high Risk Score should be addressed to the extent possible in the CR Plan, either through avoiding the risk (relocation), reducing the exposure, or by making the asset less vulnerable to future hazard events (e.g. elevation, flood-proofing, and changing the landscape features).

- High Risk Scores indicate high exposure and high vulnerability, suggesting actions are needed.
- High scores for either exposure or vulnerability indicate response measures may be needed for the high factor.

- Consistently high exposure scores for assets in a geographic area indicate that new measures, including relocation, within this area should be carefully considered. When it is not practical or feasible to relocate, defensive measures may be necessary.

The Committee can use the Risk Score as one factor in determining the strategies it will include in the CR Plan, the actions it will take, and the projects it will propose to restore and protect its assets and ensure appropriate long-term economic growth.

The Risk Assessment Tool can also be used to test different sets of management measures. The change in the Risk Score is an indication of whether a particular set of management measures would be beneficial, and how one set of measures would compare to other sets. Descriptions of how to use the tool to test management measures are provided in Appendix 6: Using the Risk Assessment tool to Test Management Measures; Appendix 7: Scenario Planning; and Appendix 8: Interpreting Risk Scores.

Step Four: Determine Needs and Opportunities

OVERVIEW

After conducting an inventory of assets, assessing risk to those assets, and hearing from the public, the Committee should assess the community's needs and opportunities for economic development and growth. These needs may relate to repairing or replacing assets that were damaged by Hurricane Sandy, Hurricane Irene, or Tropical Storm Lee; to lost economic opportunities attributed to damages or to energy and funds redirected toward recovery; to rebuilding or expanding the local economy; to making existing assets more resilient; or to needs already existing when the storm hit.

Needs may range from immediate (e.g., restore the function of sewer pumping stations, housing for displaced residents), to short term (e.g., repair beach access, repair commercial infrastructure), to mid-term (e.g., elevate or relocate buildings that are in extreme risk area, expand housing opportunities for vulnerable populations in less risky areas), and to long-term (e.g., relocate critical functions outside of extreme and high risk areas, redirect economic growth to safer areas).

While economic development strategies differ by community and circumstance, they often include a number of key elements. Though no guarantee of

Figure 5
Weld County, CO publicly-listed demographic data

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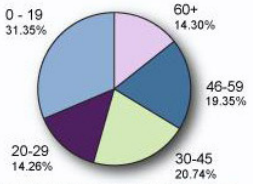
- Overview
- Demographics & Statistics
- Labor Force
- Major Employers
- Educational Institutes
- Utilities & Transportation
- Government
- Taxes
- Map of Weld County Communities

Weld County Demographics & Statistics

Weld County offers a diverse population. Its workforce in the range of 20 to 60 years of age is 137,394 people which is 54% of the total population. There is a large manual labor force, a large number of people in the trades and a well-educated sector due to the number of higher education institutes in the area.



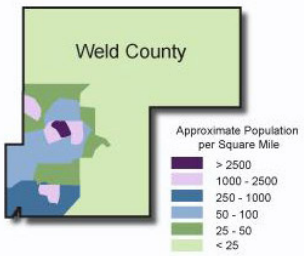
Weld County Population by Age Range
Source: 2010 U.S. Census

Download the Upstate Colorado Demographic Profile Document

Weld County Communities

Name	Population	Name	Population
Ault	1,519	Keenesburg	1,127
Berthoud*	5,105	Kersey	1,454
Brighton*	33,352	LaSalle	1,955
Dacono	4,152	Lochbuie	4,726
Eaton	4,365	Longmont*	86,270
Erie	18.135	Mead	3,405
Evans	18,537	Milliken	5,610
Firestone	10,147	Northglenn*	35,789
Fort Lupton	7,377	Nunn	416
Frederick	8,679	Pierce	834
Garden City	234	Platteville	2,485
Gilcrest	1,034	Raymer	96
Greeley	92,889	Severance	3,165
Grover	137	Thornton*	118,772
Hudson	2,356	Windsor	18,644
Johnstown*	9,887		

Source: US Census 2010 ** multi-county community*



Weld County Quick Facts

Total Population	252,825
Number of Households	89,349
Median Income	$54,578

success, communities that rely on these elements in their planning process are more likely to identify an economic development strategy that accounts for the community's needs and takes advantage of its opportunities.

Such elements include:

- **Conducting a thorough analysis of the micro- and macro-economic conditions in the community.** Understanding how a community fits in with its neighbors and the larger region can help identify hidden opportunities. Lower labor costs, positioning along rail or road networks, and/or assessments of current business's growth prospects can help a community understand where to position development finances. For example, Weld County, Colorado, maintains up-to-date comparative labor, demographic, employer, education, and taxation statistics on its community website, showcasing its low property tax rate and the businesses within its six major industries (see figure 5).
- **Identifying the community's core strengths.** In some communities, these strengths are clusters of similar economic activity – for instance, Silicon Valley and Atlantic City both feature economic development plans that foster stronger ties between the businesses that anchor their economies. Other communities identify their strengths in human capital or unique geography – for instance, suburban Boston's Route 128 corridor plan focuses on easing travel congestion among a diverse set of communities and businesses.
- **Identifying projects that have greatest benefit for the cost.** For some communities, this requires accounting for the direct and indirect benefits of investing in public infrastructure compared against construction costs, financing methods, and operations and maintenance expenses. In others, it means using local resources and creative ideas to invest in new planning and financing techniques. In the wake of Hurricane Katrina, for example, New Orleans partnered with a non-profit that brought cutting-edge affordable housing construction to the Ninth Ward, an area devastated by flooding. With media celebrities supporting the idea and helping to raise funds, a strong outreach program to former residents of the neighborhood, and the use of new materials and architectural techniques, the neighborhood now includes affordable and more resilient housing.
- **Involving the community in the strategy development process.** Civic engagement ensures that economic development plans benefit all members of the community. Even when there is broad consensus on the strategy generating extensive feedback from residents on how to tailor each project can have economic and social benefits. Cedar Rapids, Iowa, held three major open houses in the six months following a major flood in 2008 (see Appendix 10 for details), allowing it to identify multiple components of a re-development plan and ensuring that disaster mitigation engineering also created public spaces for recreation and new businesses.
- **Planning for long-term benefits.** Identifying what benefits and costs will continue to accrue after a project is complete is important to

Make It Right affordable housing, Ninth Ward, New Orleans

understanding the true value of a project. For example, San Antonio's River Walk development plan was first defined in the 1920s (see Appendix 10 for details). Over the course of the next eight decades, businesses took advantage of the social and cultural attractiveness of this new public space to build an engine of economic growth that contributes billions of dollars every year to San Antonio's economy.

Using these recommended best practices – and other case studies available – will allow the Committee to better understand their economic opportunities and needs. Strategies to address those needs will be presented in the CR Plan according to federal recovery area. Therefore, it is suggested the community organize its assessment of need by the same categories: Community Planning and Capacity Building, Economic Development, Health and Social Services, Housing, Infrastructure, and Natural and Cultural Resources.

ANALYZE ASSET NEEDS AND OPPORTUNITIES

Each community's needs for recovery and sound economic development are different, but there is a common set of expectations for the return of functional systems - a baseline for community recovery. As FEMA noted in *Lessons in Community Recovery*[9], communities are more successful when they blend traditional stabilization and repair actions with a holistic, long-range, forward-looking view of recovery. This approach addresses changed circumstances, takes advantage of opportunities, and enables the community to move beyond the status quo.

Community Planning and Capacity Building

This recovery function addresses the community's ability both to implement storm recovery activities and to plan how to mitigate the effects of future storms. To develop appropriate strategies and management measures, the Committee should review the systems in place that react to such events by considering the following:

Figure 6

Both San Antonio, TX and Cedar Rapids, IA, took advantage of post-disaster relief funding to enhance their economic development and build greater resilience within their communities (see Appendix 10 for more details). Their efforts included:

- Making economic development and disaster resiliency equally important in the planning process;
- Generating strong community feedback and incorporating citizens into the plan;
- Building on the foundations of existing local economic strength;
- Creatively leveraging federal and state funding to maximize impact; and
- Designing resilience features that increased nearby property values.

- Is there a need for public education regarding resiliency and how to prepare for future storms?
- Do current laws, regulations, and special purpose plans integrate socioeconomic, demographic, risk assessment, and consideration of vulnerable populations?
- Do existing building code, land use regulations, and design guidelines reflect current advisory base flood elevation maps or recent experience with the effect of storms on assets in the community?
- Have the costs and benefits of management or regulatory approaches in extreme and high risk areas been considered?

Economic Development

The primary economic concern after a disaster is returning economic and business activities (including agricultural) to a state of health and developing new economic opportunities that result in a sustainable and economically strong community. Doing so while incorporating resilience measures that strengthen the community's ability to withstand

future disasters allows communities to accomplish two tasks at once. While the solutions will be tailored to the particular circumstances of each committee, general principles of how best to accomplish such work are included in Figure 6.

To help identify appropriate strategies and management measures, the Committee should review the assets that were inventoried as Class A on Table 1. The Committee should analyze economic development needs by considering the following, among other questions:

- What do commercial, industrial, or agricultural uses damaged by the storm need in order to reopen in their current location, to relocate to a less hazardous area, and/or to mitigate against future storm damage?
- Are there economic assets in the community that were weakened or destroyed that should be strengthened and mitigated?
- Are the economic development plans in place prior to the storm still appropriate to pursue? If changes are appropriate, which make the most sense?
- How can disaster resilience work be incorporated into economic development plans?
- Is there a need for business initiatives to encourage expansion of the workforce, and likewise, is there a need for workforce development programs to build needed skills?
- Is there a need for support services for local businesses and entrepreneurs to thrive in the post-storm economy?
- Do businesses need to be encouraged to develop business continuity of operations plans that will help them recover more quickly from storm damage?
- Which public investments would most effectively produce both economic growth and greater resiliency against the threat of future natural disasters?
- What new businesses or investments would positively contribute to the character of the community, particularly in the Main Street commercial district or recreational areas?
- How can the community balance the economic potential of shoreline businesses with the potential risk to people and property located in those areas?
- How can tourism-related activities be expanded in the community?

Health and Social Services

After a disaster, one of the more immediate considerations is whether public health, health care facilities, and essential social service needs have been restored. To help develop appropriate strategies and management measures, the Committee should review the assets that were inventoried as Class B and/or Class F (Socially Vulnerable Populations) on Table 1 and consider the following:

- Can basic care be accessed at a level equal to that which existed prior to the storm? Is that level of care sufficient for all community members?
- What is needed to restore the capacity and increase the resilience of essential health and social services to meet ongoing and emerging post-disaster community needs?
- What needs to be done to promote the resilience, health and well-being of affected individuals and communities?
- Is the community meeting the behavioral health needs of affected individuals, response and recovery workers, and the community?
- How can the community promote self-sufficiency and continuity of the health and well-being of affected individuals; particularly the needs of children, seniors, people living with disabilities whose members may have additional functional needs, people from diverse origins, people with limited English proficiency, and underserved populations?

- Are efforts still needed to protect the health of the population and recovery workers from the longer-term effects of a post-disaster environment? Is public health messaging accurate, appropriate and accessible in multiple languages and formats?

Housing

A housing needs assessment is the foundation on which to build strategies that will help achieve local housing goals and ancillary activities, and should encompass the entire housing stock of the community with emphasis on that housing stock considered most at risk. An example of a housing needs assessment is provided on the New York Rising Community Reconstruction Program website.

The Committee should request assistance from county governments, regional planning associations, local housing agencies and firms that analyze local socio-economic conditions to prepare an assessment of community housing needs including:

- A thorough description of recent storm damage to the housing stock of the community and a discussion of any socio-economic events that may affect the community's housing stock during the next 3 – 5 years, such as regional economic trends or institutional investments.
- The current housing conditions in the area, including housing affordability, homeownership rates, building conditions, vacancy rates, and other relevant residential needs.
- The type and location of housing needs in the community based on current and expected housing availability, an analysis of the local economy (e.g., estimated job losses and/or job gains), information about population trends in the community using Census data, current year estimates and five year projections and other relevant data such as household size, housing tenure and age of housing. Housing needs that should be addressed include: interim and permanent; owner occupied and rental; single family and multifamily; housing for the elderly; special needs populations and supportive housing; and public, HUD-assisted, affordable, and market rate. The needs assessment should be evidence-based. The Committee should reference pertinent sections of local master plans, consolidated plans and other community development or strategic plans that support the proposed housing efforts presented in the CR Plan.

The Committee should consider the following questions:

- Are there currently sufficient housing units available for people who want to rent or own based upon community income levels?
- Where rental housing is being used for disaster recovery housing needs, how does that impact the availability of housing for longer terms?
- Do homeowners in some areas need to be incentivized to elevate or retrofit homes in order to be more resilient in future storms?
- Are building code requirements sufficient to protect the investments in new and rebuilt homes or buildings, and in the process, help home owners and owners of rental properties avoid high flood insurance costs?
- How may the loss of historic buildings and resources be minimized?
- Do emergency preparedness plans need to be updated to ensure vulnerable populations are safely evacuated from their homes?

Infrastructure

Investments in infrastructure can be effective both in rebuilding capabilities lost during the storm and in providing economic development, particularly with job creation. A 2009 Congressional research report estimated that more than 10,000 jobs are created for every $1 billion spent on construction in New York[10].

However, re-building infrastructure with increased resilience is critical for improving a community's capacity to respond to future disasters. Resilient systems have a number of common features,

including having spare capacity or redundancy; ensuring flexibility and responsiveness; managing for safe failure (building resistance to domino effects); rapid rebounding; and having the capacity to recover quickly and evolve over time – to thrive, not just survive major disruptions. Identifying the right infrastructure to build – and designing it properly – is an opportunity for the Committee to generate significant economic development, invest in and upgrade its buildings, roads, and other structures, and enhance the community's resilience to future disasters.

There are many types of essential services that fall under the infrastructure category. Examples include water, wastewater, dams, flood control, communications, roads, bridges, bus stops, train stations, public safety, emergency services, government facilities, sanitation and public recreation. To help identify appropriate strategies and management measures, the Committee should review the assets that were inventoried as Class D on Table 1 and consider the following:

- Is there a need for infrastructure repair, redevelopment and/or relocation within the community? This may include roads, bridges, water, sewer, health and safety, and communications infrastructure damaged or destroyed by flooding.
- How may infrastructure be rebuilt or reinforced in a manner that will reduce vulnerability to future disasters impacts and to expedite recovery?
- Which investments in infrastructure would most effectively stimulate and support economic growth and promote resiliency?
- How can the community best leverage available assistance from the various sources of funding for infrastructure development or mitigation?
- Is the pre-storm capacity of all infrastructure systems adequately matched to the community's current and projected demand on its built and virtual environment?

Natural and Cultural Resources

Natural infrastructure has been increasingly recognized and promoted among hazard and climate planners and managers. A growing body of evidence indicates the value of coastal ecosystems in wave attenuation, deflection, and erosion reduction. These systems can also retain stormwater during rain events, preventing surface flooding.

In addition to mitigating coastal risks, natural infrastructure systems offer significant co-benefits. Wetlands help cleanse urban stormwater of contaminants before it enters waterways, improving overall water quality. Shoreline green space provides habitat for wildlife, opportunities for fishing and recreation, and improved quality of life for urban residents. It also provides cooling effects, helping to combat the urban heat island effect. Many green infrastructure techniques intended to retain and absorb stormwater at the surface have the benefit of reducing the strain on storm sewer capacity by reducing the volume of stormwater that enters the piped system.

From an economic standpoint, natural solutions require lower maintenance and management costs when compared to traditional built infrastructure. The Committee should explore natural infrastructure systems and adopt measures that promote the use of green infrastructure.

To help develop appropriate strategies and management measures related to natural infrastructure and natural and cultural resources, the Committee should review the assets that were inventoried as Class E assets in Table 1 and consider the following:

- What damage did the assets sustain from the storm, including damages to services provided by natural resources?
- What needs must be addressed for those assets or services to be preserved, conserved, rehabilitated or restored consistent with post-disaster community priorities and in compliance with environmental and other laws?

- How can those assets be rebuilt or restored to reduce vulnerability to hazards and foster resiliency in future storms?
- What steps are needed to bring damaged public recreational infrastructure back to full operation for use by residents and tourists?
- How can natural systems (e.g. barrier beaches, dune systems, tidal wetlands, oyster reefs, natural berms and levees, and living shorelines) be restored or expanded to best withstand inundation from future storms and provide greater protection to assets?
- Are changes in land use or stormwater regulations needed to protect and enhance tidal wetlands or other natural infrastructure?
- Does critical hard infrastructure (e.g. bulkheads, riprap shoreline, levees, and seawalls) need to be repaired or improved, or would new infrastructure be advisable?

Step Five: Engage in Regional Planning Process

In developing a CR Plan, the Committee will find that some challenges cut across political jurisdictions and need to be considered on a regional basis. The importance of addressing specific issues as a region is already reflected in many non-Sandy-related efforts on Long Island, such as the strategic economic development plan developed by the Long Island Regional Economic Development Council; the Long Island 2035 Regional Visioning Initiative prepared by a group of Long Island organizations; the transit-oriented development plan being developed by the NYS Equitable TOD Collaborative; and the sustainability plan being developed by the Long Island Cleaner, Greener Consortium. It is hoped that the energy and enthusiasm brought to those regional efforts will be repeated in a new regional effort that responds to Hurricane Sandy.

Creating a Regional Process for Reconstruction Planning

Coordination of CR Plans with regional objectives requires the establishment of a regional planning process where communities share important information, receive technical expertise, and reinforce each other's solutions. To make this possible, the State will organize a new regional planning process that will bring together federal, state, regional, and county partners with local representatives participating in the CR Planning Committees.

The Long Island Regional Economic Development Council (LIREDC) will be asked to convene and oversee the regional planning process on Long Island. The LIREDC will appoint outside experts in each of the key sectors identified as part of the federal recovery framework to assist the LIREDC to develop, through a process that includes the participating community CR Planning Committees, a regional plan that covers each sector. The regional reconstruction plan that results from this process will, if successful, reflect the best of the CR plans from Long Island and ensure that each CR Planning Committee develops a Plan that is consistent with that for the region as a whole. A successful regional plan will also tackle regional vulnerabilities and seizes regional opportunities at a county or regional level.

Communities affected by Hurricane Irene and Tropical Storm Lee will coordinate through county planning departments to ensure that local reconstruction plans are supported by county and regional plans. The Southern Tier Regional Economic Development Council (STREDC), Mid-Hudson Regional Economic Development Council (MHREDC), and Mohawk Valley Regional Economic Council (MVREDC) will also be consulted to determine how local plans fit into the regions' strategic plans.

Coordinating Information and Providing Technical Assistance

Federal, State, regional, and county organizations have the ability to provide information and data resources to municipalities preparing CR Plans to ensure that regional issues are adequately addressed. Such services will be essential to the preparation of community plans, especially in light of the limited capacity many communities have to undertake such planning. The State will work to obtain such broad-based collaboration across jurisdictions.

Local, State, federal and international experts will participate in meetings and workshops as needed to share their expertise regarding the use of various management techniques that could be used locally, including hard structures, green infrastructure, and natural processes.

Integrating Regional Objectives

CR Planning Committee liaisons will play a crucial role in introducing a regional perspective into CR Plans. Conversely, they will bring local concerns to the table as innovative regional strategies and plans are developed. Working with other participants in the regional planning process, committee liaisons will seek advice and input on crafting policies, programs, and actions that will complement the policies, programs and actions of adjacent communities.

The State and its partners will sponsor meetings and workshops to discuss the challenges the region faces in preparing and responding to future storms. These discussions will help to inform each community's CR Plan.

To PATH Trains

Step Six: Develop Strategies for Investment and Action

OVERVIEW

Once the Committee has completed the inventory of community assets, conducted a risk assessment, and assessed its needs and opportunities, it must develop strategies to achieve rebuilding, resilience, and economic growth. These strategies will be implemented through the projects and programs that the community carries out and the actions it takes to restore and protect assets.

When developing strategies, the Committee should consider the risk assessment, the combined benefits of a project or action, cost and availability of resources, value to the community, timing in coordination with other construction or capital improvements, and availability of funding.

When identifying the optimal set of management measures, programs, and projects, the Committee should consider the following:

- Did the asset suffer damage from a recent storm and is in need of funding to restore its services or function?
- Would the project or management measure reduce the risk to development in an extreme or high risk area?
- Would the project restore a critical facility and/or a facility that supports health and safety?[11]
- Does the community have the resources to implement chosen management measures, or will it in the future? Are resources available from the county, State, or federal government or private entities?
- Would the project or program protect a large number of community residents or a large part of a vulnerable population (e.g. low income, minority, elderly)?
- How effective would a specific project or program be in implementing a strategy?
- Are the management measures technically feasible and in compliance with federal, State and local laws and regulations?
- What value does the community place on the asset, either socially or culturally (e.g. preservation of historic property or community character)?
- Would the project or management measures protect assets from future storm events and return co-benefits such as environmental protection or economic development?
- Would the project or management measure provide environmental benefits (e.g. restoration of natural coastal processes, expansion of tidal wetlands, improved public and environmental services, and direct reductions in storm impacts) or would it create environmental problems?
- What are the consequences if the proposed measure fails (e.g. increased flooding and increased service costs) or if the community fails to implement the action or project?
- Would the project result in increased economic opportunity within the community, in particular for low to moderate-income residents?
- Would the management measures strengthen social assets that establish well-functioning social interactions (e.g. public safety and community engagement).
- Would the management approaches be acceptable to the community (e.g. result in blocked views, limited access to resources, or higher taxes or fees)?

When Developing Strategies Consider:

- Risk Assessment
- Combined Benefits
- Critical Facilities
- Value to the Community
- Timing in Coordination with Other Improvements
- Life-Cycle Costs
- Availability of Funds

DEVELOP STRATEGIES

Present Strategies by Recovery Function

The strategies in the Community Reconstructrion Plan should be presented by recovery function (Community Planning and Capacity Building, Economic Development, Health and Social Services, Housing, Infrastructure, and Natural and Cultural Resources) and should include innovative projects, programs, and actions needed to carry out those strategies.

Community Planning and Capacity Building: These strategies should present ways the community will restore or enhance its ability to organize, plan, manage, and implement recovery. Examples of items which may be addressed include:

- Revision of municipal laws and regulations to improve emergency preparedness, management, or response protocols;
- Improvements to communication systems and protocols during a disaster to ensure that residents secure necessary assistance or information;
- Use of development tools to optimize land use patterns to meet the needs of vulnerable populations and future growth demands;
- Opportunities to collaborate with adjacent communities on management or development of shared resources;
- Development of a land use inventory as a basis for comprehensive land use planning; and
- Establishment of resiliency as an objective in existing planning and approval processes in local government.

Economic Strategies: These strategies should present ways the community will return economic and business activities to a state of health, and to develop new economic opportunities. Examples of items that may be addressed include:

- Projects and policies that will facilitate the return to productivity of commercial, industrial or agricultural uses;
- Projects and policies that help implement the Regional Economic Development Council strategic plan;
- Support services for local businesses and entrepreneurs;
- Workforce development programs to build needed skills;
- Adoption of storm mitigation measures to reduce the risk of doing business in the community;
- Public investment in infrastructure to serve commercial and industrial areas;
- Public-private partnerships to recruit business; and
- Strategies that can be implemented through both public and private actions.

Health and Social Services Strategies: These strategies should address how the community will restore and improve essential health and social services, particularly those that serve vulnerable populations. Examples of items which may be addressed include:

- Restoration of access to basic care to pre-storm levels or better;
- Making essential health and social services more resilient;
- Programs that promote the health and well-being of residents;
- Behavioral health services for individuals,

response and recovery workers, and the community affected by Hurricane Sandy, Hurricane Irene or Tropical Storm Lee;

- Funding sources for development and implementation of resilience measures to reduce public health impacts from contaminated sites at risk from storm damage; and
- Public education efforts about possible longer-term effects from storm damage, such as mold and contaminated soils.

Housing Strategies: A housing strategy should include:

- How community stakeholders, public/private partnerships, and collaborative ventures will meet the demand for affordable housing through the projects and programs that have been proposed;
- How the community will promote the availability of affordable housing to people impacted by the storm;
- Identification of non-CDBG programs that are available for public and private housing providers to address post-disaster housing needs, in the context of supply, affordability and accessibility; and
- How the community will encourage the provision of disaster-resistant housing for all income groups.

Infrastructure Strategies: These strategies should express how a community will restore, repair, and manage essential services the local government provides through its infrastructure in the community. Examples of items which may be addressed include:

- New investments in infrastructure that would most effectively improve services to the community, resilience, and economic growth;
- Projects and policies that would restore or improve pre-storm sewer and water systems;
- Projects and policies that would reduce the vulnerability of infrastructure to future storms;
- Removal of solid waste and storm debris;
- Relocation of public facilities over time to areas of lower risk; and
- Restoration of public recreation facilities.

Natural and Cultural Resource Strategies: These strategies will address management of natural and cultural resources from a risk reduction and economic development perspective. Examples of items that may be addressed include:

- Restoration, conservation, or rehabilitation of natural resources;
- Resilient repair or relocation of historic structures currently in extreme or high risk areas;
- Restoration and expansion of wetlands, natural areas, and dunes to reduce surge impact;
- Cultivation of a living shoreline or oyster reef;
- Improved maintenance of stormwater facilities, including retention basins; and
- Study whether hard infrastructure along the shoreline should be repaired, removed, or built up.

Describe Timelines

Within each recovery function the Committee should address the timing of the strategies – what needs to be undertaken immediately, which should be done in the mid-term, and what needs to be done in the long term in anticipation of changing weather patterns and sea level rise. For example, an ideal time to consider relocation or upgrades to reduce future storm damage would be when a facility is being reconstructed or expanded following a major storm.

Develop Strategies for Each Risk Area

Strategies should also recognize the geographic location or risk area where the project or action is intended to occur. Some factors to consider when developing strategies for various risk areas include:

- In extreme risk areas fixed development and infrastructure will continue to be exposed to chronic and/or severe damages unless they are elevated, protected or relocated. Not all

structures can easily be relocated so other risk reduction measures should be taken.

- Water dependent uses such as maritime commerce and commercial fishing require locations adjacent to the water in order to function. Assets that must be located near the shoreline should be designed to withstand extreme events, with provisions for adaptation to water level change during their functional life.
- In high risk areas increased costs for maintenance, emergency services, temporary services, restoration and recovery from storms and sea level rise are likely, so the cost of fortifying assets may outweigh the benefits.
- Rebuilding or reconstructing to more resilient standards in high risk areas may help reduce wind and flood effects to acceptable levels.
- Some uses may be candidates for relocation if they need substantial maintenance.

IDENTIFY PROJECTS NEEDED TO IMPLEMENT STRATEGIES

The CR Plans should include a description and prioritization of projects as they are identified in the planning process. These projects may be put forward because they would: replace damaged structures or address immediate exposure to risk; respond to current and future housing needs; help restore or grow businesses; or because they best implement the type of management measure needed to support the rest of the strategy. For example, projects might include the restoration of wetlands on parcels acquired by the community; the relocation of a senior citizen center; the installation of a parking structure that reduces risk in a commercial area; the repair of sewer pipes; the elevation of a fire house in a high risk areas; or the construction of new affordable housing to meet the needs of displaced residents.

Most projects, programs, and many management measures (e.g. zoning changes, stormwater regulations) will not be implemented without adequate resources. This could mean the community might need to apply for additional outside funds to take immediate action or identify other resources to adapt assets over the course of time. The Committee should identify potential financing problems if State, regional, or local resource gaps are apparent.

IDENTIFY MANAGEMENT MEASURES NEEDED TO IMPLEMENT STRATEGIES

Implementing a strategy may require a mix of projects and actions. The applicability of each type of management measure varies according to the nature of the risk, the entities involved, resources available, implementation sequence, and timing of hazard events. As a result, a CR Plan depends on careful consideration of what is at risk, what resources are available, and the capacity to implement various management measures.

Six classes of management measures have been identified that can reduce the exposure and vulnerability of assets to storm impacts. Some of the management measures will have a more immediate effect on risk and resilience than others, such as the first three classes of measures. Others will be more effective when used in combination with other measures, such as increased information.

Many individual approaches within these classes are available, as presented in Appendix 4, which includes a discussion of each class of management measure, as well as their benefits, costs, consequences, and effectiveness.

Strategies should be developed for each type of asset within a recovery support function. Consult Appendix 1 to see how to present these strategies in the Plan.

Class 1: Conserve, Restore, and Enhance Natural Protective Features

Use the landscape to promote safety and livability and to reduce costs. Preserve and expand natural protective features such as floodplains, wetlands, marshes, dunes, beaches, coastal barriers, and bluffs

for their capacity to reduce storm impacts and for their other environmental services. Approaches may include: maintain floodplains and flood storage capacity; conserve wetlands; restore natural sediment transport processes; and transfer development rights.

Class 2: Resilient Construction

Proper construction techniques are required to provide an adequate level of safety for structures and occupants. In New York, many buildings were constructed prior to the most current building codes going into effect. If they were substantially damaged or destroyed and will be rebuilt, they must comply with current New York codes and as a result will be more resilient in the face of future storms. Municipalities may adopt more restrictive code standards. Resilient construction retrofitting may be helpful where existing development cannot be relocated or otherwise adapted, even if it was not damaged in recent storms. For example, for more resilient structures, elevate buildings and increase height (freeboard) requirements in flood zones.

Class 3: Structural Defenses

Structural defenses are engineered or non-engineered constructions designed to resist environmental forces such as storm surge. On some heavily developed shorelines, structural defenses may be the only means of providing a measure of safety from flooding and erosion. Examples include areas where critical public facilities are at risk and cannot be relocated, or where a shoreline location is required for water dependent uses. Levees, bulkheads, revetments, groins, seawalls, jetties, and beach construction (fill or "nourishment") are examples of structural measures. Structural defenses may also be employed as a temporary measure in a planned transition to enable new design, relocation or other resilience measures to be implemented over time. In the event of failure or overtopping, structural defenses may exacerbate damages if redundant measures have not been employed. Structural measures may result in unwanted environmental impacts. For example, structural measures may include levees, jetties, groins, seawalls/bulkheads/revetments, and beach and dune construction.

Class 4: Land Use Planning and Regulation

Reduce storm and climate change impacts through effective land use management can increase resilience. Incorporating sustainable measures and environmental services of natural protective features in land use plans can enhance community value, making communities more attractive and safer while lowering costs. Carrying out land use management through adaptation over time can facilitate community health. Planning, zoning, subdivision, site plan requirements, and natural resource regulations are tools to accomplish land use adaptation. More specific information on measures that use local land use authority is provided in Appendix 4. For example, change zoning to allow multi-family housing in more residential areas or floor area ratio bonuses for green commercial buildings, and wetlands regulations.

Class 5: Market-Based Methods

Market methods work if the full, long term costs of land use are incorporated into prices, taxes, and fees, to the greatest possible extent. The market can reduce vulnerability by incorporating the cost of risk into the carrying cost of land. Tax incentives or disincentives, approval requirements, and user fees can help factor the cost of impacts into location decisions. Owners and developers can then make rational decisions about the value of locations relative to the cost of their use. For example, communities may redirect local development subsidies, capture costs through local tax districts, and acquire existing at-risk sites or structures.

Class 6: Increased Awareness and Information

Decisions are based on available information. Making better information available on coastal hazards, sustainable uses and ecosystem services can help improve decisions. Providing sound information on storms and erosion, environmental services, risk to development and community costs can help

decision makers in both the public and private sector. Supporting resilience with good information, education and outreach can also increase resilience. For example, conduct comprehensive education and outreach programs and encourage business recovery plans.

COSTS AND BENEFITS

Cost-benefit analyses help the Committee make decisions on which actions to take to implement the plan and how to prioritize those actions for implementation. The Committee should include a description of costs and benefits in the strategies section of the Community Reconstruction Plan. Additional information about how to do a cost-benefit analysis will be provided during the planning process.

The Committee should consider the benefits of a course of action and then compare those benefits with the costs of those actions. In terms of the CR Plan:

- Actions are the projects, programs and management measures that are being proposed to implement the strategies;
- Benefits are how the actions are predicted to increase public safety, provide economic opportunity, improve public and environmental services, reduce storm impacts, and should include ancillary benefits that may occur; and
- Costs are the expenses related to the projects, programs, and management measures being proposed, including the cost of developing the action, implementing it, and its life-cycle costs.

An analysis of costs and benefits should consider both the financial and the socio-economic impacts of an action. A cost-benefit analysis should place the action in context:

- Will an action to improve safety help vulnerable populations?
- Will funding an economic project create 10 jobs or 100 jobs?
- Will the extension of infrastructure benefit 6 properties or 60, impacting 12 or 200 people?

The Committee's analysis of costs and benefits should result in identification of individual or group actions best able to implement a strategy, and identification of the comprehensive set of actions best able to achieve the greatest benefits to the community at the least cost.

Step Seven: Complete the CR Plan

DEVELOP A DETAILED IMPLEMENTATION SCHEDULE

The detailed implementation schedule which the Committee will develop should ensure tangible progress in implementing reconstruction strategies. In the implementation schedule, the Committee will identify strategies to pursue, the actions to implement the strategies, the timeline for completing each action, and who will be responsible for taking each action. For example, responsibility could be attributed to a Committee member; town official; representative of the county, state, or local government; business; or non-profit agency.

Strategies should be broken down into discrete actions such as "work with engineer to develop pre-construction plans," and "develop zoning amendments." This will allow multiple people to work simultaneously on different actions to advance the single larger strategy.

An implementation schedule should include specific target dates for initiating and completing each action. Setting target dates, adjusting them when necessary and reporting on progress will enable the Committee to meet their benchmarks in implementing their reconstruction plan. In setting dates, Committees should consider what strategies are the best to tackle right away and the immediate actions needed to implement the strategies. Long-term strategies should include clear criteria for when implementation will occur. For example, "relocate sewer plant in 2040 at end of its period of probable usefulness."

SUBMIT THE CR PLAN

The Committee must submit the CR Plan to the State in a form consistent with the outline contained in Appendix 1. The planning process is expected to take 8 months and a deadline will be posted by the State prior to the commencement of the planning process.

The plan will be reviewed by the State to confirm it meets the characteristics of a successful CR Plan and contains the required information.

APPENDICES

APPENDIX 1: EXPANDED OUTLINE OF COMMUNITY RECONSTRUCTION PLAN CONTENTS

The Committee should complete the NY Rising Community Reconstruction Plan and ensure it contains the information and is presented in the order, as follows:

Transmittal Letter

The purpose of the transmittal letter is to identify the community which is submitting the Community Reconstruction Plan, highlight its priorities, and identify the person submitting it on behalf of the Committee, and contact information for that person.

Section I: Overview

A. ***Geographic Scope of Plan*** – As discussed in Step 1, identify the geographic area in which the community's efforts are focused. If not inclusive of an entire town or village, it should be explained at a level of detail sufficient for a reader to understand the plan area. Include a map to indicate the area of focus, identifying the name of the municipality and bordering municipalities.

B. ***Description of Storm Damages*** – Provide a description of the damage caused by Hurricane Sandy, Hurricane Irene, and/or Tropical Storm Lee. For example, list the percentage of housing units destroyed or damaged, damage or service outages affecting major public or governmental facilities, and impacts on businesses.

C. ***Critical Issues*** – Briefly describe the critical issues facing the community. These can be described in more detail in the assessment of risks and needs.

D. ***Community Vision*** - Establish a vision which may be expressed through short, medium and long-term goals to be achieved through the implementation of the plan, as explained in Step 1. Goals should reflect community objectives and revitalization strategies, as well as the priorities of the Regional Economic Development Council. They should address damage caused by Sandy, Irene and/or Lee; the community's hopes to capitalize on social and economic assets; and how the community intends to become more resilient to reduce future risk.

E. ***Relationship to Regional Plans*** - Describe how the plan incorporates regional perspectives in the way it addresses shared challenges and issues. These shared challenges and issues will be identified in Step 5.

Section II: Assessment Of Risk And Needs

A. ***Description of Community Assets and Assessment of Risk***– Present the following information by risk assessment area (Extreme, High, Moderate, or N/A):

   i. **Description of Assets** – Describe assets that have been affected by coastal hazards and those assets which could be affected as shown by the risk assessment maps, as discussed in Step 2. Be sure to include critical facilities (see Appendix 3) and assets whose loss or impairment would compromise any essential cultural, social, economic, or environmental functions of the community. Additional details from the asset inventory will be included in the appendices to the plan.

   ii. **Assessment of Risk to Assets** – Describe the level of risk facing the assets described in the previous paragraph using local knowledge of how assets have been affected in the past; an examination of the exposure of the

asset to storm surges and coastal flooding (Exposure); and the asset's ability to resist damage or return to service quickly due to its location, elevation, flood-proofing, or other factors (Vulnerability). Step 3 provides a discussion on how to assess risk.

iii. **Assessment of Risk to Systems** – One of the characteristics of a successful reconstruction plan is the assessment of risk to key systems, as well as assets. Examples of systems that may be addressed in the risk assessment are the healthcare system, coastal ecosystems, tourism networks, health care and social services delivery, regulation of land use, the provision of water and wastewater, emergency and other communication systems, and data systems. For example: were they able to continue operating as intended during or after recent storm events; did operational or enforcement gaps prior to the storm event lessen their effectiveness in reducing risk (e.g. overly permissive zoning regulations, minimal building enforcement, slow emergency response times, or failure to back up data off site).

B. ***Assessments of Needs and Opportunities*** – Describe the needs and opportunities to be addressed by strategies in the Community Reconstruction Plan. The needs and opportunities presented in the plan provide a basis for the strategies, projects, programs, policies, and actions that will be proposed. Such needs and opportunities might arise due to the following: damages caused by Hurricane Sandy, Hurricane Irene, or Tropical Storm Lee; ongoing risk faced by assets; lost economic opportunities attributed to damages or to energies and funds redirected toward recovery; rebuilding or expanding the local economy; making existing assets more resilient; or needs already existing when the storm hit. Step 4 addresses determination of needs and opportunities.

Present the information by recovery support functions, which include Community Planning and Capacity Building, Economic Development, Health and Social Services, Housing, Infrastructure, and Natural and Cultural Resources. The assessment of needs and opportunities relating to housing must address, at a minimum, the items listed under "housing" in Step 4.

Section III: Reconstruction Strategies And Implementation Actions

A. ***Strategies*** - Communities are more successful when they blend traditional stabilization and repair actions with a holistic, long-range, forward-looking view of recovery and economic development and growth. This section, which reflects information developed during Step 6, should present the strategies for how best to use community assets, capitalize on opportunities, and resolve critical issues. Strategies should be presented by recovery support function.

B. ***Projects and Management Measures*** - Identify the management measures or projects which will be taken to implement each strategy. Present specific actions to be taken to implement the management measures and target dates for those actions. Management measures were discussed in Step 6 and in more detail in Appendix 4.

C. ***Operational Arrangements*** - Describe the operational arrangements needed for timely implementation of the Community Reconstruction Plan and public engagement.

D. ***Presentation*** - When presenting the strategies in each recovery support function, the Community Reconstruction Plan should:

i. State the strategy;

ii. Indicate how the strategy addresses risk and satisfies needs;

iii. Describe how, if relevant, the strategy will help vulnerable populations;

iv. Describe the management measures policies, programs, and actions that will be needed to implement the strategy;

v. Provide a brief description of the projects proposed to implement the strategy and the estimated cost of the project;

vi. Describe the timeframes for actions implementing the strategy, providing target dates for initiating or completing the actions where known or describing general timeframes for action (i.e. immediate, mid-term, or long term);

vii. Identify who will be responsible for taking each action; and

viii. Indicate the risk areas where the strategy will be applied.

Section IV: Schedule For Implementation

Implementation Schedule– As discussed in Step 7, this section presents the implementation schedule to be followed to ensure tangible progress on the Community Reconstruction Plan. The intent is for the schedule to be presented as a table or spreadsheet that makes it easy for the viewer to see which implementation actions are planned during a specific timeframe. The schedule should identify the strategy, actions, target dates, and responsible parties.

Section V: Appendices

A. ***Members of the Community Reconstruction Planning Committee*** – Include a list of Community Reconstruction Planning Committee Co-Chairs and other members of the Committee.

B. ***Public Engagement*** - Describe the public and stakeholder engagement process used to inform and shape the reconstruction plan. It should describe how residents, public and private agencies, community organizations, and local businesses provided direction to the Committee through meetings, social media and other means; and how the public was able to react to draft documents of the Committee.

C. ***Description of Priority Projects*** – Identify and rank the projects needed to implement the Community Reconstruction Plan. Include for each project the following information:

i. A description of the project;

ii. The name of the proposed project sponsor(s);

iii. An estimate of the cost of implementing the project;

iv. The benefit or co-benefits to be derived from the project; and

v. A cost-benefit analysis of undertaking the project. Additional information on how to determine and describe cost-benefits will be provided during the planning process.

D. ***Inventory of Assets*** – Include a complete inventory of community assets, listing the asset name, risk area, asset class, and whether it is a critical facility.

APPENDIX 2: FLOODING RISK FACTORS FOR INLAND COMMUNITIES

Listed below are many of the factors affecting an asset's risk to flooding in inland communities.

Defensive Measures

The presence of protective defenses can significantly reduce flood damages to the built environment, provided those defenses are well designed, well maintained, and are not overtopped by extreme events or are undermined or otherwise destabilized. The more certain defensive measures are to meet these three conditions, the less risk to the protected assets. The less certain these three conditions are, the more likely assets will be at risk if a flood occurs.

Elevation

Elevation of an asset above flood waters is one of the most significant methods of securing the built environment. Base flood elevation (BFE) is the still water level estimated for a 100-year flood (a flood which has a 1% chance of occurring in any year). It should be noted that some environmental assets require periodic flooding and therefore the evaluation of risk for those assets should be favorable if they are more likely to experience the type of flooding they need.

Freeboard

Freeboard is the height of the habitable portion of a building or other construction above the design flood elevation. The more freeboard available above the design flood elevation, the better protection provided from flood damage.

Impervious Surfaces

Impervious surfaces are unable to absorb precipitation; therefore they shed water to adjacent property or to storm water collection systems and may contribute to flooding in streams and lakes. Areas with less impervious surfaces have greater flood storage capacity and can released stormwater more safely over time.

Points of Confluence/Stream Junctions

Flood waters discharging into joining streams may exceed bank capacity at the point of confluence if bank overflow is possible. These points of confluence may be poor candidates for development or require additional management measures such as flood defenses or increasing upstream storage capacity to prevent flooding.

Sediment Load

Presence of fine soils in stream beds may be an indication of unstable upstream banks associated with excessive flood discharge or poor bank management practices. Risk of flooding is lower where there is less silt deposited on a stream bed, which indicates stream banks that are less erosive.

Soil Permeability

Non-permeable soils shed storm water to adjacent areas where it will be collected in storm water systems and/or discharged into streams, increasing the likelihood for flooding. In general clay and rocky soils have less permeability, and sandy and loamy soils have greater permeability.

Storm Water Discharge

Percent of watershed area with storm water collection systems discharging into the hydrologic system.

Traditional storm water collection systems use gravity drainage with discharge into water bodies. Storm water discharge into streams and rivers increases flow rates, resulting in erosion and accelerating bank full conditions which can lead to flooding. The risk to assets is least if the overall storm water discharge rate in a watershed does not exceed the natural discharge rate because the stability of the stream system is maintained. An asset is at more risk when it is located near storm water discharge systems, which contribute extra water to streams and may increase downstream flooding.

Vegetated Stream Bank Buffers

Vegetated buffers protect stream banks from erosion, help reduce flood velocities and increase

absorption. The greater the width of a buffer, the greater the reduction in storm water runoff and flooding. Larger buffers are more effective than smaller ones. Assets are at higher risk where vegetated stream buffers are narrow or absent.

Watershed Flood Storage Capacity

A watershed with good flood storage capacity moderates flows to the stream network, resulting in less risk from flooding. Natural storage capacity occurs in wetlands and swamps, and manmade water storage systems include retention reservoirs, recharge basins, temporary storage pools, rain gardens and rain barrels.

Watershed Forest Land Cover

Trees substantially increase storm water storage capacity in a watershed, both by virtue of the leaf storage capacity and the increased capacity of soils near the root systems. The more trees within the watershed the more storm water can be stored and discharge to streams slowed. Risk from flooding is increased by the removal of trees from formerly forested land, which increases the rate of storm water discharge to streams.

Water Velocity

Water velocity is a contributing factor to flood damages in the built environment. During a flood the velocity of rivers and streams increases, placing nearby assets at higher risk. Even riskier is proximity to stream flood waters where the channel is constrained as the velocity of the water is further increased.

APPENDIX 3: FEMA DEFINITION OF CRITICAL FACILITIES

Extracted from ***Local Multi-Hazard Mitigation Guidance***, FEMA, July 1, 2008, pp. 42-43

Based on authority in FEMA Mitigation Planning Regulations, 44 CFR, Part 201.

Critical Facilities

- Are essential to the health and welfare of the whole population and are especially important following hazard events.
- For purposes of this mitigation planning guidance, critical facilities may include emergency service facilities such as hospitals and other medical facilities, jails and juvenile detention centers, police and fire stations, emergency operations centers, public works facilities, evacuation shelters, schools, and other uses that house special needs populations.

APPENDIX 4: SIX CLASSES OF MANAGEMENT MEASURES

Resilient communities tend to employ multiple, complementary measures to reduce risk, rather than relying on one means of protection. Six classes of management measures have been identified that can reduce the exposure and vulnerability of community assets to storm impacts. Within these classes, many individual measures may be available, not all of which are described in this guidance. The applicability of each measure varies according to the nature of the risk, actors involved, resources available, implementation sequence and timing of hazard events.

The risk assessment yields information about which community assets are at greatest risk to storm effects and where funds should be directed to assist New York State communities in rebuilding better and safer.

Review the six classes of management measures and examples of specific management approaches in the following tables:

Class 1: Conserve, Restore, and Enhance Natural Protective Features

Use the landscape to promote safety and livability and to reduce costs. Preserve and expand natural protective features such as floodplains, wetlands, marshes, dunes, beaches, coastal barriers, and bluffs for their capacity to reduce storm impacts and for their other environmental services. The benefits of natural protective features are maximized when their capacity to adapt to natural forces is uncompromised by encroaching development.

Discussion: Natural protective features reduce storm impacts and provide environmental services at minimal cost. Effective land use management preserves natural protective features. Natural sediment transport processes sustain them. Activities such as dredging, shoreline armoring and updrift structures like jetties and groins may cut off the sediment supply, accelerating erosion. In some areas of New York, excavation or construction within natural protective features is regulated.[12] Erosion and migration over time is normal for some coastal features. Structural measures to stabilize the shoreline may compromise natural protective features. If natural protective features are prevented from moving gradually to balance coastal energy and sediment supplies catastrophic failure may result. The protection offered by natural protective features can be overcome by major storms, thus they are not a guarantee against storm impacts.

If communities allow natural protective features to provide these environmental services they can avoid huge replacement costs while increasing public safety. Natural protective features also enhance community aesthetics, improve recreational fishing, attract tourists and increase real estate values. Natural protective features should be included as part of any community resilience strategy. Failure to adapt and conserve natural protective features will increase storm impacts or increase defensive costs, or both. Costs will include loss of environmental services. (See Figure 7)[13]

In certain circumstances, structural shore protection can be detrimental to natural wetlands through direct impacts and as a result of being trapped between shore defenses and the sea. Wetlands will be unable to migrate upland as waters rise, resulting in loss of these assets through inundation. As a result, valuable ecosystem services may be lost, including storm buffering, water filtration, carbon sequestration, sediment capturing capacity, essential habitat, unique natural communities and their associated commercial and recreational uses. Increases in contaminants and pathogens in coastal waters may occur and the ability of the ecological system to moderate species shifts, invasive species and pests may be reduced.

According to a study by the University of Vermont, wetlands provide an estimated $23.2 billion each year of storm surge and flood protection along our coastlines.

Source: Costanza, R. O. Perez-Maqueo, M. Martinez, P. Sutton, S. Anderson, and K. Mulder. 2008. "The Value of Coastal Wetlands for Hurricane Protection." AMBIO: A Journal of the Human Environment. June.

Figure 7

According to a report by the US EPA, assuming current land use and development policies continue over the next century, much of the coastline along New York City and Nassau County is "very likely" to require costly structural shore protection, and all but 5% of the remainder of the south shore is "likely" to require shore protection. The image below was included in the US EPA report. It shows anticipated structural protection along Long Island. Brown lines indicate where shore protection is almost certain. Red lines indicate where shore protection is likely. Dark green areas represent tidal wetlands.

The following table describes some management approaches to conserve natural protective features. For a discussion of land use regulations associated with natural protective features see Class 2. For more information about many of these strategies also see the *No Adverse Impact Handbook*[14], a toolkit for local governments interested in providing higher protection for their natural protective features.

Measure	Benefits, Costs, Consequences, Effectiveness
Maintain flood plains and flood storage capacity Maintain and enhance floodplains to increase flood capacity. Construct new development away from the most hazardous and sensitive part of the floodplain and coastal zone.	Benefits: Reduce hazard impacts, preserve open space, enhance recreational opportunities, public access, and public safety. Costs: Floodplain management costs vary depending on the approach taken, e.g., acquisition is the most costly, followed by easements, with regulation the lowest cost approach. The National Park Service and Urban Forestry Program are two federal programs that may share the costs of creating and connecting green spaces. Consequences: Failure to provide flood storage capacity increases water levels and storm impacts, reduces stormwater infiltration capacity, flood control, and environmental quality. Effectiveness: Floodplains and stream corridors are highly effective in providing both flood storage and recreational opportunities.
Wetland Conservation Protecting wetlands plays a large role in reducing flood hazards. Wetlands help control floods, provide recreational opportunities, improve water quality, and are essential for fish and other species.	Benefits: Preserve flood protection, natural resources and habitat, improve the environment, and promote public safety and livability. Enhancing State and federal wetlands protection improves performance and reduces future risk. Costs: Wetland conservation costs vary depending on the approach taken, e.g., acquisition is the most costly, followed by easements, with regulation the lowest cost approach. Replacement of essential wetland services is generally at high cost. (See Section 3 for a discussion of local wetlands regulations) Consequences: Failure to preserve wetlands increases flood vulnerability, reduces water quality, fish habitat, and recreational value. Potential negative impacts on air quality, tourism and real estate values. Effectiveness: Highly effective at providing environmental services. Coordination in a wetland systems approach through community or regional planning improves effectiveness.

Measure	Benefits, Costs, Consequences, Effectiveness
Tree Conservation And Vegetated Buffers[15] Protect and enhance vegetative buffers along coastal areas and adjacent to water bodies through land use planning, acquisition and restoration.	Benefits: Protect the banks of the water body from erosion, filter stormwater, provide habitat, protect against storm surge, and trap sediment that in turn may create wetlands. Help stabilize dunes, bluffs and shore banks by reducing the effects of wind, waves and runoff. Costs: Varies depending on the approach taken, e.g., acquisition is the most costly, followed by easements, plantings, with regulation the lowest cost approach. Consequences: Failure to establish coastal vegetative buffers can result in increased storm effects to development, infrastructure, recreation facilities, and critical habitat. Failure to conserve trees, shrubs, and natural vegetation reduces natural stability, increases runoff and accelerates erosion. Flooding and/or erosion may be exacerbated, particularly at steep bluffs. Bluff failure is increased by removal of vegetation. Effectiveness: Effective when used in conjunction with setbacks and regulations to prohibit structural defenses in the intertidal zone. Trees, shrubs and grasses must be protected and watered during the initial planting phase. Once established, they are highly effective in holding soil in place, preventing erosion, removing pollutants and reducing wind impacts. High winds or flood erosion may uproot trees, destabilizing soil. Shrubs and grasses may provide equal protection and are less costly to establish. Mixed native plantings that emulate natural diversity may be more stable.
Restore Natural Sediment Transport Processes Reduce erosion rates by conserving dunes and bluffs, stabilizing them with native vegetation. Restore sediment transport processes to reduce erosion. Reduce, shorten, taper or compensate for bulkheads, jetties and other shoreline structures that reduce sediment transport and sediment contributions to the nearshore, resulting in shoreline erosion. Manage dredging to avoid removing sediment from the nearshore transport system.	Benefits: Sediment is essential for maintaining natural protective features, and is normally provided by hydraulic transport, Aeolian transport (wind) and gradual nearshore erosion. Excess sediment contributions create shoals and deltas that may impair nearshore vegetation. In order to protect natural systems and reduce storm impacts, sediment transport must be maintained in balance with upland and underwater conditions. Costs: Limited cost for allowing existing structures to deteriorate. Small costs for removing small bulkheads. Substantial costs for removing or modifying engineered structures. Federal sources may subsidize costs. Consequences: Shorelines may be exposed to erosion if defensive structures are removed. Restored longshore sediment transport will reduce erosion rates on adjacent shorelines. Potential impacts to navigation uses from modified dredging practices. Effectiveness: Effective if employed on a regional basis. Restoration of nearshore wetlands and relocation of upland development or other management measures may be necessary where shore defenses are used to stabilize low lying floodplains. Not appropriate where water dependent uses or essential infrastructure require structural shoreline techniques.
Conservation of hazard areas or environmentally sensitive areas[16] Permanently protect high risk or environmentally sensitive areas to reduce impacts, preserve natural protective features and allow for inland migration of wetlands, marshes, and other natural flood management systems. Options for conservation include direct acquisition, easements, purchase or transfer of development rights, and land use controls.	Benefits: Permanently reduces or eliminates flood and erosion damage in high risk areas with the least impact. Facilitates other environmental services such as flood storage capacity, recreation, preserving ecologically important wetlands, forests, etc. Reduces obligations for high-cost services, infrastructure maintenance, protective measures and liability for damages. Costs: Costs vary based on the technique employed and local real estate values. Costs for long term conservation may include acquisition, monitoring and maintenance of preserved areas. Consequences: Failure to protect sensitive areas increases vulnerability, reduces protective functions, reduces the opportunity for wetland and marsh migration, diminishes environmental services, diminished air, water and landscape quality. Effectiveness: Highly effective on site. Community and regional effectiveness enhanced by a systems approach and regional prioritization. Requires site values assessment, coordinating funding sources and adaptation incentives. TDRs require a development receiving area and land use/land credit “bank” to buy and sell development rights. Possible owner or neighborhood objections.

Class 2: Resilient Construction

Proper construction techniques are required to provide an adequate level of safety for structures and occupants. Experience in Florida with improved construction codes following Hurricane Andrew demonstrates that cost effective building requirements can reduce losses in high risk areas. In New York, many buildings were constructed prior to current building codes going into effect. If they were substantially damaged or destroyed and are going to be rebuilt they must comply with current New York codes and will be more resilient in the face of future storms. Municipalities may adopt more restrictive code standards. Resilient construction retrofitting may be helpful where existing development cannot be relocated or otherwise adapted, even if it was not damaged in recent storms. Communities should identify at risk areas to determine where more resilient construction techniques should be required.

Discussion: Resilient construction is a means to improve safety through enhanced standards. For example, NFIP standards require elevation on pilings for homes in areas subject to coastal wave impacts (the "V-zone" on floodplain maps). Similar requirements might help secure other development at risk to storm surge or sea level rise, provided adequate local building code standards are enacted and enforced.

The *Whole Building Design Guide* describes options for buildings already built in flood plains: "Should buildings be sited in flood-prone locations, they should be elevated above expected flood levels to reduce the chances of flooding and to limit the potential damage to the building and its contents when it is flooded. Flood management techniques include elevating the building so that the lowest floor is above the flood level; dry flood-proofing, or making the building watertight to prevent water entry; wet flood-proofing, or making uninhabited or non-critical parts of the building resistant to water damage; relocation of the building; and the incorporation of levees and floodwalls into site design to keep water away from the building."[17]

In New York, the New York State Fire Prevention and Building Code establishes minimum standards for building construction and elevation, and New York City minimum standards are codified in the New York City Construction Codes. Local governments have the authority to enact enhanced or more restrictive building code standards to address local needs with approval by the New York State Fire Prevention and Building Code Council ("Code Council").

Measure	Benefits, Costs, Consequences, Effectiveness
Elevate Buildings Elevate structures to comply with building codes or raise them above a defined protective elevation to reduce flood or storm surge impacts.	Benefits: Minimizes risk and reduces damages to development and infrastructure. Provide capacity for extreme storms and future sea level rise. Costs: Relatively low for new construction, higher cost for elevating existing structures. Post-storm reconstruction may offer an opportunity to upgrade. Funding assistance for adaptations could help pay for elevating structures in appropriate circumstances. Consequences: Failure to elevate structures can increase damage and debris and lead to higher post-storm recovery costs. Effectiveness: Good on-site protection method. Consider additional freeboard and/or extend protective standards to additional areas where vulnerability exists if current standards are not adequate. Elevation can still leave buildings surrounded by floodwaters during a flood. If an NFIP insured structure is below the base flood elevation and is substantially damaged by a flood it must be brought up to current codes and zoning standards.
Additional Height (Freeboard) Requirements in Flood Zones Construction freeboard is extra clearance above minimum NFIP standards for areas where the base flood elevation (BFE) is determined, for new development and for existing structures that are being reconstructed or elevated. Two feet of freeboard above the BFE is required by the NYS code.	Benefits: Reduces vulnerability. Significantly lowers flood insurance rates. Communities that participate in the NFIP Community Rating System earn points toward reducing flood insurance rates. Costs: Adds a small percentage to construction costs. Consequences: Failure to incorporate freeboard requirements means that buildings may still be at risk to flooding from larger, more intense storms and the gradual increase in sea level. Effectiveness: Effective at reducing risk if extended to areas adjacent to flood zones where NFIP standards do not apply, where flooding above the 1% annual risk estimate is possible, or areas that will be affected by sea level rise and storms in the future.
Strengthen Building Codes: Set Reconstruction Standards to Reflect Future Hazards Strengthen building code standards to account for anticipated changes in sea level and other climate impacts. Standards that address sea level rise help minimize impacts over the expected life of the structure. Land use and site plan regulations and building codes should be seen as complementary tools.	Benefits: Building codes that are more restrictive than the Uniform Building Code may provide an additional level of protection against potential flood risks and other impacts of climate change. Costs: Municipal costs for adopting enhanced codes. May pose challenges for low-income households who cannot afford retrofitting. Communities should consider joining the NFIP Community Rating System to earn flood insurance discounts for implementing measures that exceed minimum NFIP standards. Consequences: Failure to incorporate resilience into structural design standards through adaptable infrastructure and building codes may result in increased costs to businesses, communities, and homeowners as flood and storm damages continue to escalate. Effectiveness: Strong enforcement of post-storm reconstruction standards is essential to the effectiveness.
Building Size and Height Restrictions Individuals that accept risk and choose to live in areas likely to experience hazard impacts should conform to local building regulations, such as building size and height. Structures should be designed to be easily movable (i.e. 1 story, simple construction) if and when relocation becomes necessary.	Benefits: Facilitates the relocation process by building structures that are easier to elevate and move. Costs: Administrative costs unchanged. Low costs to upgrade current standards. Consequences: Failure to accommodate development to assist future relocation efforts can result in the structure becoming damaged or permanently lost. Homeowners are responsible for covering damages. Effectiveness: Inadequate compliance is a major obstacle to effective building codes. Building codes are enforced by local building departments. Planning controls and building codes should be seen as complementary management tools.[18]

Class 3: Structural Defenses

Structural defenses are engineered or non-engineered constructions designed to resist environmental forces such as storm surge. On some heavily developed shorelines, structural defenses may be the only means of providing a measure of safety from flooding and erosion. Examples include areas where critical public facilities are at risk and cannot be relocated, or where a shoreline location is required for water dependent uses. Levees, bulkheads, revetments, groins, seawalls, jetties, and beach construction (fill or "nourishment") are examples of structural measures. Structural defenses may also be employed as a temporary measure in a planned transition to enable new design, relocation or other resilience measures to be implemented over time. Structural protection does not eliminate all flood, erosion and storm surge risk. The possibility of structural failure or large events that exceed the level of protection must be considered. In the event of failure or overtopping by flooding, structural defenses may exacerbate damages if redundant measures have not been employed.

Discussion: Structural defenses have been a standard response to coastal storm and erosion damage. The level of protection they offer is described as the design standard, e.g., a structure designed to protect against a one in 50-year frequency storm may be overtopped, damaged or fail in the event of a one in 100-year storm. Continuing maintenance is necessary to maintain the design level of protection. Nationally, increasing numbers of flood defenses are being overwhelmed by events due to failure caused by inadequate maintenance, changes in the environment or other factors. After the Hurricane Katrina disaster in New Orleans the National Academy of Engineering and the National Research Council found that "– because of the possibility of levee/floodwall overtopping – or more importantly, levee/floodwall failure – the risks of inundation and flooding never can be fully eliminated by protective structures no matter how large or sturdy those structures may be."[19] As a result of this experience, the National Academy recommended that protective structures should be backed by redundant measures such as flood proofing, elevation above potential flood levels, and resilient land use.

Large storms that result in structural failure or overtopping may result in damages that exceed the scale of the pre-structure risk exposure. Structural defenses can lead to a false sense of security, incentivizing development in high risk locations. Due to their tendency to increase development in floodplains and potential for failure, the Association of State Floodplain Managers recommends that levees be used only as a last resort, to provide a limited means of flood risk reduction for existing development.[20] Structures can cause significant detrimental environmental impacts. A National Research Council report on managing shore erosion on sheltered coasts recommended alternatives to traditional structures, finding "Strategies that address erosion, other than land use controls, can have cumulative impacts to sheltered coasts. These include permanent removal of sand from the littoral system, creating over steepened shore faces, loss of intertidal zones and habitat loss."[21] Regarding future increased risk from sea level rise, the National Research Council went on to say "Superimposed on the impacts of erosion and subsidence, the effects of rising sea level will exacerbate the loss of waterfront property and increase vulnerability to inundation hazards… Additionally, sea-level rise is chronic and progressive, requiring a response that is correspondingly progressive. Attempts to follow a 'hold the line' mitigation strategy against erosion and sea-level rise by coastal armoring will result in a steady escalation in both the costs of maintenance and the consequences of failure."[22] Lawsuits stemming from structural failure are increasing.[23] Structures are often favored by property owners as a means of perpetuating existing investments, but the negative aspects of structures suggest careful consideration of impacts, alternatives, and outcomes before they are employed.

Structural defenses have been the standard response to managing storm impacts for decades, partly due to assumptions that sea level and shoreline positions are relatively stable and can be addressed by static design. It is now known that sea level has

been gradually rising for centuries and the rate of sea level rise is increasing. Due to sediment transport there can also be wide variation in shoreline position. Stationary shore defense structures that trap sediment are likely to contribute to accelerated erosion on down drift beaches. Some shoreline erosion is essential to supply sediment that supports adjacent beaches. Shorelines change with sediment supply and weather patterns and in many places varies considerably from season to season. Shoreline retreat in response to erosion is normal for coastal areas of unconsolidated sediments. As a result, land use planning and nearshore development should account for and be resilient to these natural variations.

In some highly urbanized areas where essential public infrastructure is at risk and no alternative location or means of providing the necessary services are available, shore defense structures may be the only practical option available to avoid unacceptable damage. Consideration of structural protective measures should account for their limitations. Other alternatives that achieve safety, including but not limited to land use and resilient building construction techniques should be considered to augment structural protection. As a rule structural defenses do not increase the inherent resilience of development, natural resources, cultural resources or economic activities because they do not reduce risk inherent in the location. Instead structural measures act as a bulwark against the environment, requiring permanent maintenance to preserve the level of protection. The presence of shore defenses may encourage additional development in high risk areas, thus increasing damage if the protection is overwhelmed or fails during extreme events. The additional development could increase the need for protective measures, escalating the costs of defense. Constructed dunes and beaches act essentially as levees against waves and storm surge. They sacrifice sand to the beach during storms. While the extra sand supply compensates for erosion the protected development may be at risk to flooding from the opposite side in locations where a bay, tributary or low lying area backs the protected development.

In addition to the impacts cited in the discussion above, structural measures may result in unwanted environmental impacts. These may be direct impacts from excavation of construction of protective works, or indirect impacts from sediment displacement or changes in waves or currents. In some cases the installation of defensive structures has led to the propagation of additional structures on adjacent properties, responding to loss of sediment supply, flanking erosion or wave attack from the initial structure. Multiplication of individual structures can lead to excessive cumulative impacts in a bay or watershed.

If storm surge, sea level rise, precipitation or other factors exceed their design capacity, shore defenses may fail. As demonstrated by events in New Orleans in 2005 and in multiple levee failures in the Mid-West in 2011 the performance of structural defenses is not guaranteed. Many New Orleans homes destroyed by storm surge from Hurricane Katrina were built in areas thought safe with levee protection. In the event of failure, development that depended on those defenses may be destroyed unless secondary protective measures are employed. For example, development behind a constructed berm or levee should be elevated for security in the event the protective works fail. As a result, the construction of structural shore defenses does not remove the need for additional measures in support of community resilience. Evaluation of the costs of a protective strategy should include the necessary redundant measures and effectiveness of the combined system. Communities should always consider the potential for structural failure and evaluate potential impacts as a means of determining where additional measures are needed and which measures would be sufficient. Due to cost and performance limitations, use of structural defenses should be carefully evaluated along with other adaptation options. Where structural defenses are necessary they should be used in combination with non-structural measures to manage residual risk and environmental mitigation[24] to compensate for negative effects.

Measure	Benefits, Costs, Consequences, Effectiveness
Levees Levees are designed to contain and limit the penetration of flood water into developed areas. They protect development from coastal or riverine flooding up to a design magnitude, provided they are well designed and maintained. Levees are found along riverbanks. Beach and dune construction may be used in places where coastal natural protective features are insufficient protection from storms and erosion.	**Benefits:** Provides flood protection up to the design standard. May be used as a transitional measure until alternative adaptation is effective. May be necessary where essential public infrastructure is at risk. **Costs:** Substantial costs for construction. Ongoing monitoring and maintenance costs. Possible catastrophic costs in the event of failure unless redundant measures are used. **Consequences:** Levees confine the flow of water, resulting in higher and faster water flow. Structures may encourage more at-risk development. May result in severe environmental impacts if they reduce wetlands. They do not fully eliminate risk and can exacerbate damages when overwhelmed by larger events. **Effectiveness:** Effective up to their design standard but may not withstand larger events (such as extreme events or due to climate change). May trap flood water requiring pumping. Will not protect land subject to sea level rise inundation, if sea level rise is not factored into the design standard.
Jetties Jetties are structures extending perpendicular from the shoreline into the water at inlets. They are designed to protect navigation and keep sediment from filling in the channel. They are often paired on either side of an inlet.	**Benefits:** Stabilizes the inlet, protects access reduces channel dredging. **Costs:** High cost for stone, concrete or steel. Likely to cause erosion on down drift beaches by reducing sediment inflow. Jetties capture sediments by containing and redirecting longshore transport. May impair coastal barrier formation by eliminating natural shoaling processes that accumulate deposits where new barriers form. **Consequences:** Updrift sediment accumulation, downdrift erosion. Most jetties interfere with littoral transport to some extent. Bypassing accumulated sand across the inlet does not fully restore the natural processes. Jetties may increase bay flooding by enlarging the channel cross section through which flood waters can enter. **Effectiveness:** May be necessary for navigation channel access but they have little benefit for reducing storm surge or flooding. They generally result in downdrift erosion.
Groins Groins are structures extending perpendicular from land into the water, not at an inlet. Their purpose is to trap sand in an attempt to "stabilize" the beach. As a result of sediment trapping, the updrift side accretes sand while the downdrift side may experience accelerated erosion. A series of groins may be erected to stabilize a long shoreline. Some small groins have been built by private land owners.	**Benefits:** Groins can trap sediment on beaches where sand transport is predominantly in one direction. "T" head groins act as an artificial headland. Groins are intended to arrest shoreline erosion to protect upland development. **Costs:** Large cost for engineered stone construction. Moderate cost for wood or sheet pile structures. Accelerated erosion on downdrift beaches, interference with public beach access. May require a beach fill program for maintenance. **Consequences:** Groins can cause significant erosion on downdrift beaches, resulting in loss of those beaches, public access and natural habitat. Properties on downdrift beaches may lose value. Shoreline pedestrian access may be lost. **Effectiveness:** They are effective at stabilizing their location, and may help stabilize protective dunes. They may require continuing beach sand placement. They may allow sediment transport if tapered to match the bottom surface offshore, thus reducing down drift erosion.

Measure	Benefits, Costs, Consequences, Effectiveness
Seawalls/ Bulkheads/Revetments These structures are placed parallel to the shoreline at or above the water level. Seawalls are the heaviest structures and are designed to resist the full impact of waves. Bulkheads are designed to retain upland fill, generally not exposed to severe wave action. Revetments are stone or masonry units placed atop the nearshore upland on a slope, to reduce wave impacts and erosion. Seawalls are generally, larger steel or concrete engineered structures. Bulkheads may be of sheet piling, wood or vinyl. Revetments are stone, concrete or masonry units.	**Benefits:** Protection from waves or erosion for upland development. May provide some defense from storm surge. They maximize upland real estate, thus being preferred by property owners. **Costs:** High cost for seawalls, moderate costs for bulkheads and revetments. Natural retreat of the beach due to sediment transport and sea level rise will cause the beach to narrow or disappear completely where these structures are placed, thus eliminating public access along the shoreline and natural habitat. Additional, redundant measures are necessary to achieve community resilience. **Consequences:** Provide protection while well maintained and sufficient for storm events. Over time the structure may be undermined and destroyed, necessitating a larger structure and/or loss of upland use. May leave property, lives, and other development at greater risk from damage in the event of failure. Reflection of wave energy may accelerate erosion in front of or adjacent to bulkheads and seawalls. Wave overtopping can destroy all three. High impacts to nearshore habitat from construction, erosion, loss of area and lost capacity to migrate upland with sea level rise. Can destroy nearshore vegetation and allow overland stormwater drainage to flow into the water body with no vegetative filtration. Causes erosion to down drift beaches by removing sediment supply. These structures may disguise the risk of major storms to upland development by reducing visible, near term erosion. The result may be increased development in high risk locations. **Effectiveness:** Most effective as a temporary measure until alternative locations for development are found. Less effective as long-term solutions. Should not be used to protect minimally developed areas. They may be necessary for industrial uses that requires waterside access, or for essential public infrastructure that cannot be relocated. Frequently used to provide recreational boating access to upland property. They require large investments to maintain over the course of time.
Beach and Dune Construction (Fill) Addition of sediment (usually sand) to widen eroding beaches. Raises the beach to a designed profile. May include dunes as well as fill in the berm and nearshore. Regular placement of additional sediment, sometimes called “renourishment,” is required to maintain the desired profile. Requires a source of beach compatible sediment which may be from upland, from navigation dredging or from offshore dredging.	**Benefits:** Provides storm protection, compensates for erosion and may enhance beach recreation value. May improve property values or beach habitat. Negative impacts are small compared to other structures. **Costs:** $5 - $30/ cubic yard. Some impacts to excavation, dredging and placement sites due to mechanical disturbance, turbidity, sand compression or poor sand quality. Costs are generally shifted towards federal and State sources, creating incentives for localities to prefer this option. Localities may not be aware the temporary protection can increase eventual losses if development accompanies the placement. Local erosion tax districts may fund some costs. **Consequences:** Protection from low level storms and replaces eroding sediment to maintain shoreline location. Must be maintained in perpetuity for protection until extreme storms, sea level rise or financial shortfall forces other adaptation or retreat. Poorly executed or maintained projects can have negative environmental, economic, and social effects; including degradation of critical habitats, loss of public access and recreational value, loss of tourism and economic vitality. May encourage development in hazardous areas or discourage engagement in other adaptive measures. **Effectiveness:** Effectiveness of beach construction projects depends on the quality of sand placed, continued maintenance and storms below design protection level. Similar to natural protective features as long as the artificial beaches are maintained. Results can be inconsistent due to local conditions and weather events. May be appropriate for beaches in highly populated urban areas. A risky strategy unless accompanied by other resilience measures, adaptive planning and careful post-storm response.

Measure	Benefits, Costs, Consequences, Effectiveness
Living Shorelines Hybrid structures for managing shoreline erosion that combine both structural and living components. Examples include artificial oyster reefs, vegetated revetments and sill-protected marshes. The advantages of these methods are the ability to provide habitat similar to natural conditions while also mitigating erosion.	**Benefits:** Improved environmental performance in comparison with traditional hardened shore defenses. They may reduce maintenance costs in comparison with other structural shore defenses because there are few or no manufactured components (e.g. wood, concrete, steel, etc.) to break down. **Costs:** Costs are comparable to engineered structures designed for similar locations. Costs may be increased for additional care required for placement of structural members and for placement and care of living components. Cost advantages may be obtained from reduced maintenance, lower costs for organic materials in comparison with manufactured alternatives, or easier adaptation to environmental change. **Consequences:** Reduced shoreline erosion rates, enhanced natural habitat, improved visual quality, possible support for shoreline access. **Effectiveness:** With proper design, living shorelines techniques are as effective as traditional structural measures such as bulkheads, seawalls and revetments at reducing erosion. Living shorelines are generally most suitable for locations not exposed to direct wave attack. Optimal locations for implementing living shorelines techniques are relatively low energy environments with limited fetch across open water. Experience in New York waters is limited because living shorelines techniques were first commonly applied in more southerly regions such as Chesapeake Bay. As a result, close cooperation with regulators is needed to obtain environmental approvals. These techniques have been recommended by the National Academy of Science and appropriate designs for New York waters are under consideration.

Class 4: Land Use Planning and Regulation

Reduce storm and climate change impacts through effective land use management to increase resilience. Incorporate sustainable measures and environmental services of natural protective features in land use plans to enhance community value, making communities more attractive and safer while lowering costs. Carry out land use management through adaptation over time to facilitate community health. Planning, zoning, subdivision and site plan requirements, and natural resource regulations are tools to accomplish land use adaptation.

Discussion: Land use planning and management offer a means to minimize impacts by reducing the vulnerability of development and infrastructure to storm impacts. Land use planning is principally under the authority of local governments. When local governments manage development to achieve resilience they also reduce costs. Changes in land use can be implemented pre-development or over the course of time as opportunities arise. Monitoring, reporting and adaptive management should be used to update land use plans and regulations.

Resilient land use protects lives and community assets. Resilient land use techniques should be coordinated with capital development programs and other community plans to be cost effective and ensure public infrastructure does not stimulate development in high risk locations. See Class 5, Market-based methods, for a discussion of land acquisition through land trusts, property exchanges, partial easements, lease-back programs, transfer or purchase of development rights and other value exchanges. Appendix 5 describes some additional zoning and subdivision tools. Approaches could include clustering development through subdivision regulations, transfer or purchase of development rights, other equal value land exchanges, or land acquisition through land trusts, property exchanges, partial easements, or lease-back programs.

Communities can benefit from improved local land use standards by participating in the NFIP Community Rating System (CRS), by which they may qualify all flood insurance policy holders for reduced rates. CRS is a voluntary incentive

program "that recognizes and encourages community floodplain management activities that exceed the minimum NFIP requirements."[25] The types of provisions described in this section exceed the minimum requirements of the National Flood Insurance Program (NFIP), qualifying the community for "points" in the CRS and potentially lowering flood insurance costs for owners.

Local land use plans and regulations can be used to manage development in hazardous areas, control densities, incentivize retrofitting of existing structures, or control building occupancy in hazardous areas. Local governments are authorized to establish zoning districts and to regulate the use, construction, and alteration of buildings and land within those districts. Such districts may be unique for the purpose of addressing coastal hazards, or they may be designated as overlay districts that apply additional resilience requirements to at risk areas otherwise zoned for general purposes. Local subdivision regulations can be used to avoid the creation of lots that are unsafe due to proximity to flood or storm surge, or that will become unsafe in the foreseeable future.

"While the damage from natural disasters is typically structural, the solutions need not be. Much of the most effective mitigation consists of nonstructural measures directing land use away from hazardous areas or even seeking to influence human behavior."

Source: Schwab, J., K.C. Topping, C.C. Eadie, R.E. Deyle, and R.A. Smith. 1998. Planning for Post-Disaster Recovery and Reconstruction. Report no. 483/484. FEMA, American Planning Association, Chicago.

"...the United States can expect huge increases in disaster costs because of current land use practices, irrespective of any additional toll caused by climate change and attendant sea level rise."

Source: Roger Pielke, Jr. 2008. Proceedings from the 33rd Annual Natural Hazards Research and Applications Workshop, 2008.

Measure	Benefits, Costs, Consequences, Effectiveness
Local Waterfront Revitalization Program (LWRP) An LWRP is a locally prepared, land and water use plan and strategy for a community's natural, public, working, or developed waterfront through which critical issues are addressed.	**Benefits:** In partnership with the Department of State, a municipality develops community consensus regarding the future of its waterfront and refines State waterfront policies to reflect local conditions and circumstances. **Costs:** DOS provides technical assistance and funding through the Environmental Protection Fund to prepare LWRPs for plans and projects that expand public access, revitalize waterfront areas, restore habitats, and strengthen local economies. **Consequences:** Unlike comprehensive plans, LWRPs require implementation techniques to be in place before adoption. This avoids possible inconsistencies between plans and implementing land use regulations. **Effectiveness:** The Local Waterfront Revitalization Program also contains the organizational structure, local laws, projects, and on-going partnerships that implement the planning document. Once approved by the New York Secretary of State, the Local Program serves to coordinate federal and State actions needed to assist the community achieve its vision.

Measure	Benefits, Costs, Consequences, Effectiveness
Comprehensive Plan The Comprehensive Plan establishes a vision for the community's growth and development and provides policies, goals and recommendations for implementing that vision. The plan should include coastal hazard considerations, risk assessment, protection of coastal areas, protection of streams, rivers, lakes and wetlands, and the benefits that these natural resources provide to a community. The Comprehensive Plan should also incorporate a Local Waterfront Revitalization Plan (LWRP) if one has been developed for the municipality.	**Benefits:** All local land use regulations, including zoning, must be in conformance with the comprehensive plan.[26] By developing a consistent document that reflects the community's assets and involving residents and businesses in the creation and adoption of the plan, the entire community will benefit. **Costs:** Costs associated with comprehensive plans include the costs to develop or update the plan as well as the costs associated with implementing the plan. Communities may utilize staff or hire consultants to develop and implement the plan. The funds for these services may come from the municipal budget, grants, or in some cases from fees associated with development activities. **Consequences:** Long-term protection of the health, safety and welfare of the community's residents and its assets. **Effectiveness:** The courts have consistently upheld land use regulations that have been shown to conform to the comprehensive plan.
Zoning Adopt zoning measures to limit or control the type, density, size, location, and construction or reconstruction of structures in identified hazard areas. Use "dynamic" set-backs based on the annual shoreline erosion rate[27] in zoning regulations to safeguard natural protective features and green infrastructure, and to provide adequate room for future adaptation or relocation.[28] Use low impact development and smart growth techniques such as pile foundations, single story heights, low-impact streets, small building footprints, mixed land uses, clustering (away from sensitive areas), and designing walkable communities when developing or updating zoning regulations.[29]	**Benefits:** Avoid vulnerable development in hazardous areas; reduce community storm impacts, conserve natural protective features, control development densities to reduce impacts and facilitate recovery. Avoid increasing risk through compromising site requirements. Facilitate post-disaster reconstruction using safe techniques and locations. Setbacks can be used to avoid hazardous areas and create buffers to conserve natural protective features like wetlands, floodplains, and dunes. Infrastructure and service costs are reduced. Potential alternative use benefits, non-market benefits and community-wide real estate value benefits. **Costs:** Costs associated with zoning regulations include the costs to develop or update the zoning law as well as the costs associated with implementing the zoning law. Communities may utilize staff or hire consultants to develop and implement the law. The funds for these services may come from the municipal budget, grants, or in some cases from fees associated with development activities. **Consequences:** Without adequate zoning, development and redevelopment is likely to continue in ways that place people, property, and critical infrastructure at risk from storm damage. Without zoning communities lose the opportunity to address risk exposure and environmental impacts in site plan review. Large structures in at risk areas create damages, increase emergency costs, impact adjacent properties and are difficult to relocate or restore. Setbacks based on coastal erosion help secure community assets, reduce exposure to damages, and provide adaptive capacity for both human uses and environmental assets. Potential takings issues if the setback eliminates all development options. **Effectiveness:** Zoning is a versatile and effective tool for communities to manage hazard exposure. Floating zones[30] can be used effectively in the post-disaster period to control redevelopment in severely damaged areas, as the special conditions of this zone can then be put into effect. Tiered zoning, overlay zones, incentive zoning[31], maximum densities, limited build zones, and permanent no-build zones are additional techniques to address special conditions.[32,33] Zoning can be linked to other measures such as building codes. Regulations must be reviewed periodically to avoid becoming outdated and ineffective. Setback policies must be designed to ensure that new development is sustainable.

Measure	Benefits, Costs, Consequences, Effectiveness
Subdivision Regulations Use to ensure adequate setback from flood and erosion hazards, with provision to relocate on site if necessary. Minimize infrastructure maintenance and emergency response costs. Subdivision regulations govern the density, configuration, and layout of parcels and provide for sewers, drainage, parks, streets, sidewalks, lighting. Conserve natural protective features, green infrastructure, environmentally sensitive areas. Coordinate subdivision controls with zoning, building codes, and local comprehensive plans.	**Benefits:** Configure parcels to avoid floodplains, erosion prone areas or reduce the exposure of buildings to storm impacts. Clustering is one means of permitting development while preserving adequate setbacks and open space in new subdivisions. Subdivision regulations can be applied to avoid damage to natural protective features and properties. **Costs:** Costs associated with subdivision regulations include the costs to develop or update the subdivision law as well as the costs associated with implementing the subdivision law. Communities may utilize staff or hire consultants to develop and implement the law. The funds for these services may come from the municipal budget, grants, or in some cases from fees associated with development activities. **Consequences:** Failure to incorporate subdivision controls may result in small waterfront lots limiting opportunity to adapt to erosion or avoid storm impacts. **Effectiveness:** Highly effective measures to enhance disaster resilience. Prepare plans and incorporate subdivision controls before storm impacts to be ready to implement in the post-disaster period.
Site Plan Review Set preliminary requirements for area coverage, setbacks, conservation of natural features, and site access. Consider the design and location of structures, infrastructure, parking, and other improvements while respecting hazard exposure, storm water drainage, soil integrity, landscaping, and other issues that may affect disaster resilience.	**Benefits:** Provides an opportunity for planners to incorporate vulnerability, damage experience, future conditions and public service needs, and apply those requirements to development if adequate authority and regulations are provided. **Costs:** Costs associated with site plan regulations include the costs to develop or update the site plan law as well as the costs associated with implementing the law. Communities may utilize staff or hire consultants to develop and implement the law. The funds for these services may come from the municipal budget, grants, or in some cases from fees associated with development activities. **Consequences:** By using performance standards to evaluate site plans, considerations such as hazardous material safety, disaster resilience and secure storage of dangerous or polluting materials can be incorporated in development projects. **Effectiveness:** More detailed site plan review requirements provide a framework for developers, local planners and volunteer planning boards to include hazard considerations and natural resources in local development.
Local Natural Resource Regulations Consider adopting local laws or amending existing laws to regulate vegetated buffers, wetlands, and/or provide tree conservation. Strengthen local flood damage prevention laws to protect flood hazard areas, considering the No Adverse Impact program[34] and NYSDEC's model amendments for Flood Damage Prevention laws.[35] Local natural resource regulations can be adopted as stand-alone laws or incorporated as supplemental zoning regulations and environmental performance standards.	**Benefits:** Local regulations that protect wetlands buffers, trees and floodplains provide natural flood control, wildlife habitat, enhance recreation areas, prevent erosion, treat pollutants by natural processes, and promote public safety and livability. Planners can use landscaping requirements to preserve or enhance the "free" protection that natural features afford. **Costs:** Costs associated with local natural resource regulations include the costs to develop or update the local laws as well as the costs associated with implementing the laws. Communities may utilize staff or hire consultants to develop and implement the laws. The funds for these services may come from the municipal budget, grants, or in some cases from fees associated with development activities. **Consequences:** The minimum requirements that most municipalities adopt for flood damage prevention do not provide long-term protection for the community. Federal and State laws regulating wetlands and buffers cannot be enforced locally, leaving enforcement of these important areas up to regional government agency staff. **Effectiveness:** Local natural resource regulations provide a framework for developers, local planners and volunteer planning boards to include floodplain management and natural resource planning in local development. Local regulations can be enforced by the code enforcement officer, who knows the community and local conditions. Tree conservation ordinances must be built on a solid base of hazard identification and environmental research.

Measure	Benefits, Costs, Consequences, Effectiveness
Stormwater Management Manage post-construction stormwater to ensure that post-development runoff is no greater than pre-development runoff. Use "Green infrastructure" to increase stormwater infiltration rates and reduce the volume of runoff entering sewer systems, lakes, rivers, and streams. Onsite detention, recharge basins, buffer strips, prohibition of point and non-point source discharges into wetlands helps ensure environmental quality.	**Benefits:** Reduces storm water discharge and improves environmental quality. Reduce flooding; control floodwaters with natural or artificial ponds or wetlands. Improve human health and land value. **Costs:** Costs associated with local stormwater laws include the costs to develop or update the law as well as the costs associated with implementing the law. Communities may utilize staff or hire consultants to develop and implement the laws. The funds for these services may come from the municipal budget, grants, or in some cases from fees associated with development activities. Funding may be available through the EPA to implement cost-effective and sustainable stormwater management practices. **Consequences:** Failure to consider stormwater management during the recovery process may diminish water quality and increase runoff. **Effectiveness:** New York State requires that "green infrastructure" be included in the development of stormwater pollution prevention plans for certain projects. Incorporating the concept of "green infrastructure" into stormwater management practices is an effective approach at helping achieve community sustainability.
Infrastructure Planning and Development Foster community resilience by directing infrastructure and public facilities (roads, water supply) away from high risk areas.	**Benefits:** Fosters resilient development in more sustainable locations, away from high risk areas, and reduces future losses and maintenance costs. **Costs:** Similar to costs for at-risk infrastructure. Cost savings for reduced exposure and maintenance. Improved resilience (and reduced emergency service costs) for development in more secure areas. Reduces tax burden on community to service at risk assets. Possible reductions in flood insurance premiums. **Consequences:** Infrastructure improvements in high risk areas encourage development that will be exposed to coastal hazards, increasing risks to people and property as well as infrastructure. **Effectiveness:** Highly effective at facilitating development in safe locations. Infrastructure planning and development should be consistent with community plans, land use regulations and resilience strategies.

Class 5: Market-Based Methods

Market methods work if the full, long term costs of land use are incorporated into prices, taxes and fees, to the greatest possible extent. The market can reduce vulnerability by incorporating the cost of risk into the carrying cost of land. Tax incentives or disincentives, approval requirements, and user fees can help factor the cost of impacts into location decisions. Owners and developers could then make decisions about the value of locations relative to the cost of their use.

Discussion: As effects of coastal storms accelerate, public funds will be strained to maintain infrastructure, subsidize insurance, build shore defenses and compensate disaster losses. Local governments have several means for supporting the incorporation of risk into pricing for at risk areas, including locally funded infrastructure programs, land/property acquisition programs, parks and open space districts, purchase or transfer of development rights, and special tax districts for defensive measures that support primarily local interests. Local governments provide services and infrastructure that create development incentives. By redirecting spending towards safe areas local governments can encourage sustainable development.

Another option to reduce risk is by purchasing at risk undeveloped land or developed properties that are no longer habitable or whose owners prefer safer locations. Acquisitions facilitate beneficial outcomes for both owners and communities, enabling sustainable transition over time. The State of New York is offering public buy out of properties in flood-prone areas as part of efforts to help homeowners affected by Hurricane Sandy. The State is offering pre-disaster market prices to a limited number of homeowners who have suffered through multiple flooding

and want to move.

Open space acquisitions for high value natural resource conservation are well known, including partial acquisitions such as development rights or conservation easements. The National Park Service has employed creative acquisitions that allow owners to temporarily remain in homes or lease them back until a future date or specified condition. Acquisition may be used to create buffer zones or restore natural protective features. Additional community benefits such as water filtration, storm water management, public access and recreation or open space may be obtained through acquisition.

Measure	Benefits, Costs, Consequences, Effectiveness
Redirect Local Development Subsidies[36] Shift expenditures for development and infrastructure away from extreme hazard areas and apply resilient development standards for other at-risk areas. Direct infrastructure funds to sustainable locations. Create local tax districts to support infrastructure in extreme and high risk areas. Where feasible form local tax districts to support protective measures.	**Benefits:** Reduces public costs for development and infrastructure in hazardous areas and discourages unwise development, especially in areas subject to repetitive damages. Reduces incentives to develop at risk coastal flood plains. Uses public spending and services more efficiently. **Costs:** This shifts site related costs to primary beneficiaries. Can be implemented at little cost to a local government. **Consequences:** These measures tend to correlate costs with services received in areas of increased storm risk, improving the price connection between risk and use. Internalizing costs leads to risk informed decision making, more resilient development, and reduced storm damages. **Effectiveness:** Restrictions on local development subsidies .
Local Tax Districts Localities can form special tax districts to support certain infrastructure, facilities and erosion protection. Consider forming local tax districts for risk management.	**Benefits:** Local financing can correlate costs with at-risk areas. **Costs:** Building in risk-based costs with development results in these costs reflected in market rate of development. **Consequences:** Tends to discourage development in risky locations through higher costs due to direct assumption of costs associated with the storm impact management measures. Likely to reduce risky development and encourage safer location decisions. **Effectiveness:** Effective by associating risk with location price. Reduced at-risk development lowers storm damages for both the public and private sector.
Community Rating System[37] Local governments use the Community Rating System (CRS) to reduce flood insurance premiums for property owners. Local governments obtain CRS credits for resilience actions.	**Benefits:** Flood insurance premiums are reduced in communities that qualify under the FEMA Community Rating System. Actions taken to reduce flood impacts receive credit through the program. By accumulating enough credits, communities achieve thresholds to qualify for reduced rates. **Costs:** Minimal direct costs, as the program gives credits for flood resilience actions taken within the community. **Consequences:** Reduced flood insurance rates in CRS participating communities. Also, more affordable housing as a result of reduced insurance premiums. Maintenance of federal mortgage program eligibility by preserving participation in the National Flood Insurance Program. As FEMA updates flood plain mapping over time the areas subject to coverage will increase with sea level rise. In addition subsidies for non-conforming structures will be reduced. Both actions will result in escalating flood insurance rates absent other measures to reduce community risk, such as the CRS program. Failure to participate means communities will not receive credit and reduced premiums for actions taken to address flood risk. Communities with flood insurance will have only minimum FEMA standards which do not account for sea level rise, extreme storms, or flooding outside the regulated flood hazard areas. **Effectiveness:** Substantial reductions in premiums are available. Reduced flood risk is directly correlated with a financial benefit to owners.

Measure	Benefits, Costs, Consequences, Effectiveness
Acquisition of Existing, Vulnerable Sites or Structures In addition to the voluntary buyout program now being offered by the State, local governments may consider creating voluntary buy-out programs for at-risk or damaged properties. Convert acquired lands to alternate safe uses. Relocation of acquired structures to safe sites may be an option. This may prove an attractive option when other measures are not effective. Acquisition may include agreements to maintain occupancy for a specified time or until a future event, allowing owners to maintain present uses temporarily.	**Benefits:** Creates a safety valve for owners with no other option. Eliminates future damages on site. Beneficial alternate uses can be coordinated with other community objectives. Long term economic and environmental benefits and reduced negative impacts onsite and for others. Adaptable as conditions change over time. **Costs:** Substantial short term costs. May benefit from partnerships with land trusts Voluntary acquisition is generally more acceptable. **Consequences:** Failure to acquire development likely to be damaged may result in future high costs for protection, repetitive damages, emergency services and recovery. Damaged structures and debris affect other properties. **Effectiveness:** Effective at reducing future damages. Effectiveness is enhanced where acquisition helps preserve natural protective features. Effective in areas subject to storm surge, slope failure, or erosion. At risk buildings on slabs, masonry foundations, or too delicate to move may have limited options. Relocation is feasible for structures small enough to traverse streets. Pile foundations facilitate relocation.

Class 6: Increased Awareness and Information

Decisions are based on available information. Making better information available on coastal hazards, sustainable uses and ecosystem services would help improve decisions. Providing sound information on storms and erosion, environmental services, risk to development and community costs would help decision makers in both the public and private sector. Encourage resilient land use and development with better awareness of hazards and potential mitigation measures. Support resilience with good information, education and outreach.

Discussion: Improving decisions through better information is best achieved if the appropriate information is delivered effectively to decision makers. Informed decision making is desirable at all levels. An assessment of the decision making process could identify key points at which information on storm impacts and location vulnerability would be effective. Information products are most effective if developed in partnership with the receiving community. Basic principles emphasizing risk exposure and sustainable land, water and asset management would support resilient communities. Community vision, long range or life-cycle costs, scale, extent and frequency of impacts, future projections, community welfare, natural processes and periodic storms are example information needs.

Those who understand coastal hazards and the risks they pose to communities are more likely to take action to reduce their exposure and vulnerability. Better information is needed on sustainable uses of land and water assets, ecological services, and how alteration of the landscape influences the potential for damages. Create and utilize educational programs on risk and resilience, and confirm that information is incorporated into the land use and risk management decision making processes of individuals, local and regional decision makers. Coordinate education and outreach with other resilience strategies so residents and leaders understand and endorse the community vision, the spectrum of management measures, and their role in implementation.

Measure	Benefits, Costs, Consequences, Effectiveness
Comprehensive Education and Outreach Programs Provide public workshops, training, and information sessions to discuss hazard risks and community goals for redevelopment. Address lack of understanding or misunderstanding of programs such as the NFIP, Multi-Hazard Mitigation. Coordinate public outreach with resilience planning initiatives. Cultivate two-way communication and participation in planning.	**Benefits:** Obtain public support and 'buy-in' for resilience and planning. Foster public involvement and responsibility for protecting community assets. Adopt a plan based on locally preferred options. **Costs:** Methods range from free to expensive, depending on the size of the audience, scope of the information and medium used. Recent advances in social networking may offer cost effective platforms. **Consequences:** Failure to provide effective education and outreach reduces perception of: vulnerability, reasons for proactive measures, and effects on assets and the broader community. These weaknesses increase the potential for poor decisions, repetitive damage, loss of assets, and community costs. Lack of access to communication professionals might inhibit community involvement in planning. **Effectiveness:** Effective with strong leadership and facilitation. Ensure that all community stakeholders have a voice and an opportunity to participate in planning and adaptation. Seek to unify rather than divide the community on redevelopment and recovery actions.
Communicate Hazard and Climate Risks and Techniques to Reduce Risk Distribute information on storm and climate risks to officials, businesses and homeowners. Communicate clearly that preparing for hazard impacts is in the community's best interest and will help save lives and properties over time. Potential venues include websites, public access television, radio spots, news releases, newspaper and magazine articles, brochures and pamphlets. Describe risks and management techniques that individuals and businesses can adopt to reduce vulnerability and exposure to hazard impacts.	**Benefits:** Homeowners and businesses and community leaders learn to adapt to reduce impacts and avoid repetitive damages. Officials support community action. May support flood insurance discounts through the NFIP Community Rating System. Costs: Content development and publication costs. Coordinate messaging with other State and regional hazard management strategies. Incentives would encourage other proactive measures. **Consequences:** Failure to increase risk awareness among community members and local governments may result in increased impacts to individuals and escalating burdens on communities. Lack of awareness reduces the appreciation for exposure of essential socio-economic assets. A better societal understanding of vulnerability is helpful to identify adaptive measures and inform transition to community resilience. **Effectiveness:** Communication is most effective if developed with the receiving audience.
Business Recovery Plans[38] Provide guidance on post-storm business recovery planning, especially for small businesses (fewer than 10 employees). Recovery plans can help businesses resume functioning, or can provide business owners with a range of post-disaster alternatives and opportunities, such as business relocation, temporary assistance, or revising the business strategic plan. Local governments can support small business recovery by disseminating economic analysis on: disaster effects on the consumer base, relative demand for goods and services, how the disaster affects key suppliers and resources for assistance.	**Benefits:** Prepare business recovery plans to minimize economic disruption and/or identify business alternatives under a range of post-disaster scenarios. Costs: Small businesses typically lack the in-house expertise and capability to prepare business recovery plans on their own, and may not have the resources to hire contractors to provide assistance. Competing priorities, and lack of knowledge are reasons why many small businesses do not prepare contingency plans in advance of disaster events. **Consequences:** Failure to prepare business recovery plans can result in economic disruptions, with long-term impacts on other sectors of society. Losses may include investment, trade, supplier/consumer loyalty, revenue, payroll, and credit lines. Business owners may not fully realize their vulnerability or range of potential options after a disaster. Time and resources may be lost trying to resume business when operating conditions are unsound due to lack of demand for the goods or services, inability of employees to reach the workplace, loss of distribution system, or unreliable communications. **Effectiveness:** Effective business recovery plans incorporate vulnerability analysis and provide strategies and actions to reduce disaster impacts, ensure business survival and facilitate recovery.

Measure	Benefits, Costs, Consequences, Effectiveness
Recognize Local Adaptation Achievements Local achievements in implementing adaptation measures should be recognized and documented as successful case studies to guide and assist other localities. Boost recognition of local resilience and facilitate co-adopters by recognizing effective adaptation.	**Benefits:** Encourages other individuals and localities to take action and foster community well-being. Community success stories initiate thinking about adaptive strategies in other departments and communities. **Costs:** Minimum costs for public, commendations. Potential television, radio, newspaper and magazine reporting. Website announcements, blog, social media options. All parties who contributed to the success of implementing adaptation measures should share their experiences and lessons learned. **Consequences:** Failure to recognize local achievements and share strategies with other communities limits access to viable strategies and may discourage initiative. **Effectiveness:** Recognizing local achievements can be effective to cultivate public support for adaptation measures. It may stimulate evaluation of alternatives not previously considered.

APPENDIX 5: EXAMPLES OF ZONING AND SUBDIVISION TOOLS

Zoning Tools:

Tiered zoning
A graduated system of zoning requirements that are increasingly stringent with proximity to hazards.

Overlay zoning
A widely used means of protecting natural, historic, or scenic resources and of directing development to appropriate areas. Provisions of the overlay ordinance are applied in addition to the underlying zoning regulations.

Floating zones[39]
A zone that has no specific geographic designation but carries a descriptive designation that attaches to any parcel of land where ordinance conditions are met.

Incentive zoning[40]
Allows developers to exceed certain zoning restrictions, such as those governing density, floor-area ratios, or height, in return for providing amenities or making additional concessions. Such incentives may be offered for maintaining or enhancing the natural protective features of a site, for encouraging cluster development, or for providing additional safety features. Must be carefully administered so the zoning concession achieves the desired public benefit. Use clear guidelines and avoid subjective standards.

Maximum densities for development
These local codes set the development capacity for designated areas. Provisions to allow higher density development on a portion of a parcel of land in return for setting aside critical habitat, parts of the floodplain, natural protective features or open space can enhance resilience.

Site plan review
Set preliminary requirements for area coverage, setbacks, conservation of natural features, and site access. An opportunity to incorporate vulnerability, damage experience, future conditions and public service needs, and apply those requirements to development if adequate authority and regulations are provided. Consider the design and location of structures, infrastructure, parking, and other improvements while respecting hazard exposure, storm water drainage, soil integrity, landscaping, and other issues that may affect disaster resilience. Use site plans to evaluate conformance with performance standards, including hazardous material safety, to ensure disaster resilience and secure storage of dangerous or polluting materials.

Limited-build zones
Apply conditional uses that support goals of the comprehensive plan or LWRP (for instance, allowing only temporary, seasonal or water dependent uses).

Permanent no-build zones
Permanent development prohibition is viable for areas where flooding is so frequent or severe that any development would put people and property at significant risk. Options for such high risk areas include alternative flood resilient uses, acquisition, transfer of development rights, phased withdrawal, designation as parks, recreation areas, or open space.

Risk area zoning requirements
Examples include pile foundations, single story heights (to allow future relocation), low-impact streets, small building footprints, on-site stormwater management, mixed land uses, clustering (away from sensitive areas), and designing walkable communities.

Subdivision Regulations:

Risk assessment requirements for subdivision applications in at risk areas
Incorporate provisions in local subdivision regulations to account for long term risk. Minimum lot sizes in flood prone areas should include land of adequate size and elevation to keep structures out of the floodplain and secure from erosion and storm surge. This could be coordinated with flood

plain management and building code requirements. Provide adequate space for future adaptation in flood or erosion prone areas.

Cluster Development

Consider clustering to conserve natural protective features, green infrastructure and adaptive capacity, and to minimize community costs for infrastructure, emergency services and restoration.

APPENDIX 6: USING THE RISK ASSESSMENT TOOL TO TEST MANAGEMENT MEASURES

The likelihood that management measures will be successful can be tested using the Risk Assessment Tool. The relative Risk Score can help examine the effectiveness of proposed management measures. This is done by repeating the risk assessment with updated scores for Exposure or Vulnerability, depending on proposed projects and management measures. A proposed set of projects and management measures is more likely to be effective if it significantly improves the asset's risk score.

Select Management Measures to Test

The Committee should select one or more measures from the classes of measures, using approaches from Appendix 4, to test how the proposed measure may reduce risk. All sets of management measures reviewed in a test should be compatible. Test combinations of structural and non-structural measures to determine the most effective measures.

Test Each Set of Management Measures

To use the Risk Assessment Tool, test each set of management measures by defining a management measure for an asset (or groups of assets in a common geographic area) and revising the Exposure or Vulnerability scores in the risk calculation. Below are some examples of changes the Committee could test.

- Relocation of the asset to a lower risk area could be tested by manually changing the name of the risk area in the Risk Assessment Tool. This will change the Exposure Score and affect the overall Risk Score.
- The installation of soft infrastructure could be tested by manually changing the landscape attributes of an asset to one that reflects the management action, such as restored wetlands. This will change the Exposure Score and affect the overall Risk Score.
- Installation of a backup generator and dry flood-proofing of a commercial structure , or providing business assistance for developing recovery plans designed to protect important documents and provide alternative sources of goods are examples of actions that would lower the asset's vulnerability and restore their function quicker, though perhaps to varying degrees. Test the proposed measures by estimating how long the asset would be out of service if the improvements were in place, and select the appropriate Vulnerability score. A lower Vulnerability score will result in a lower overall Risk Score.

The Risk Assessment Tool may be used to test proposed assets as well. For example, it can be used to develop a Risk Score for a potential new affordable housing development in a high risk area with certain landscape attributes. The Committee could test:

- A change in zoning regulations to prohibit publicly sponsored affordable housing in extreme and high risk areas. By changing the risk area in which the affordable housing would be allowed this would change the Exposure Score and the overall Risk Score.
- Adoption of a local building code requirement that all multifamily housing structures be wet flood-proofed. Since the building would return to service sooner, the Vulnerability Score should be changed, resulting in a change to the overall Risk Score.

If existing plans describe hazard management actions or projects, they may be tested along with the management measures proposed by the Committee using the Risk Assessment Tool. If measures in existing plans are not successful at reducing risk, the community should consider revising the existing plan to increase community resilience.

Scoring will be a best estimate based on information in the inventory and input from the Committee. If an asset's Risk Score decreases substantially under a particular set of management measures, it is an indicator that the asset would be at less risk if the management measures were undertaken as opposed to a different set of management measures. However, other factors should be considered prior to finalizing the NY Rising Community Reconstruction Plan.

APPENDIX 7: SCENARIO PLANNING

Scenario planning uses a range of environmental conditions to test management alternatives. The process helps decision makers understand the potential environmental, social and economic outcomes associated with alternative management options. Scenario planning is different from cost - benefit estimates. As a result of scenario planning management options that are viable in a range of potential future conditions should be more apparent. Public input should still inform selection of measures that are implemented in a resilience plan. The procedure below will help test management measures for their effectiveness in improving coastal storm resilience.

Step 1: Select a set management measures that address identified risks.

Review the assets at risk identified in the risk assessment process and identify a variety of management measures to reduce those risks to a safe level. Proposed measures should include non-structural, structural and relocation options. From this first broad set of measures define one or more sets of measures to be tested. Each set of measures should be mutually compatible and conceptually effective at reducing risk. Proposed measures may address high risk assets individually or they may reduce risk to multiple assets in a geographic area. The Committee should pay particular attention to assets with high community value and critical facilities. The six classes of management options provided in Appendix 4 can help stimulate ideas on measures that may be effective.

1. **Non-structural measures:** Natural shorelines have an inherent natural, social, and economic value that should be maintained to respond to coastal processes and ensure continuing benefits to the state and region. Examples of measures include:

- Relocate development and structures away from Extreme and High Risk areas (see Risk Assessment Maps). Buildings, infrastructure or other assets that are susceptible to deep water flooding, high water velocity, flash flooding, debris flow, or severe erosion could be moved to lower risk areas.
- Elevate structures. Buildings and infrastructure can be elevated to withstand current and expected future water levels. Single story, wood frame houses are easier and cheaper to lift than masonry structures. Mechanical equipment can be elevated above the ground floor in multi-story and high rise buildings.
- Enhance existing natural protective features (wetlands, dunes, beaches, barrier islands, floodplains). These features reduce storm impacts and provide other environmental services. Identify areas suitable for restoration of natural protective features or areas that could accommodate their gradual migration. Wetland conservation and provision for upland migration is particularly important because wetlands provide important environmental services including reducing flood impacts and many have already been consumed.

2. **Structural:** Hard protection structures should only be used to protect public structures or areas of significant public investment where non-structural measures are not practical. Dune and beach construction are considered structural protection, but have fewer negative effects on the environment than other structural measures such as stone, steel, concrete and earthen structures. Avoid placing fill in areas where it will displace flood waters to adjacent property or increase inland or downstream flooding.

More than one set of management options can be tested. A comprehensive set of management options may include both non-structural and structural measures depending on local conditions and the vulnerable aspects of the assets at risk. Consider location dependence and life expectancy of the assets when evaluating options. Water dependent uses such as maritime commerce and boating require locations adjacent to the water to function.

Step 2: Test options under the current and future flood water level scenarios.

When one or more sets of management measures have been identified, evaluate performance under current and future water level scenarios:

1. Current 100-year flood water levels. (Available in the community's FEMA Flood Insurance Study.)
2. Future 100-year flood water levels, assuming sea level rise. Use the estimates below for projected increase in sea level. These are approximations representing the mid-range of current sea level rise projections.

Table 4
Estimated Water Level Increase for Future Scenarios

New York City, Lower Hudson and Long Island	**2050**	**2100**
1 in 100 yr still water level	2010 BFE + 1.5 ft	2010 BFE + 3.0 ft
Mid-Hudson and Capital Region	**2050**	**2100**
1 in 100 yr still water level	2010 BFE + 1.25 ft	2010 BFE + 3.0 ft

Evaluate the effectiveness of proposed measures by re-calculating the Risk Scores for assets in the inventory. Use a copy of the Risk Assessment tool to test the risk to assets by revising the scores for Exposure, and/or Vulnerability based on how they would change if the proposed management measures were implemented. Test each scenario: current water levels of the 100-year storm events, and future water levels of the 100-year storm events, for each set of management measures. Use the best available Mean Higher High Water (MHHW) level to estimate current and future shoreline location in cases where sea level rise will encroach on assets. Local tide gauges can help identify MHHW. If desired additional sea level rise scenarios can be created to test more extreme conditions. Some estimates of sea level rise by 2100 are as much as six feet.

Scores for the Exposure and/or Vulnerability of the assets under each set of proposed measures will be a best estimate based on information in the inventory and input from the Committee. Modify the Exposure and/or Vulnerability scores based on how the future water levels and proposed measures affect the assets under each scenario. For example, if an asset is relocated to a different risk area the Exposure score might be reduced. If an asset is elevated or flood-proofed the Exposure or Vulnerability scores might be reduced. Certain actions may adequately reduce risk under current water levels but may not be adequate under the future, higher water levels.

Step 3: Analyze results.

Analyze each scenario and prepare maps representing proposed actions, changes in land use, population protected and resources affected. Report on each scenario describing the proposed management measures and include estimates of the following factors:

1. Population protected
2. Population affected by implementation
3. Overall life-cycle costs of implementation
4. Environmental outcome
5. Cultural/Social outcome
6. Residual risk (Likelihood for failure or overtopping for structural defenses, other unaddressed flood causes, future uncertainty, etc. and their consequences)
7. Possible financing mechanisms for proposed measures

Structural defenses may fail or be overtopped and some protective measures may not be failsafe against flood damage. This is a type of residual risk that should be reported along with the effects and likelihood of occurrence in the scenario report.

Step 4: Identify viable measures.

The Committee should review the scenario analysis to identify measures that are viable for the region. Note the measures in each scenario that seem to be

effective. Select measures from the scenarios that are compatible and effective in both the near and long term to assemble an overall regional strategy. For example, rebuilding a dune may provide a certain level of protection at an affordable cost, but leave other assets unprotected or inadequately protected. In this example other assets may need to be relocated and some critical infrastructure may have to be defended by additional protective measures. Seek opportunities to improve environmental quality, with particular emphasis on wetland restoration where feasible. Some assets may be left as-is pending future reconstruction or other adaptive measures. Depreciated assets may be candidates for relocation or reconstruction in a more resilient form rather than protection if substantial maintenance is needed.

APPENDIX 8: INTERPRETING RISK SCORES

Using the Risk Assessment Tool described in the report, Table 5 presents the range of possible risk scores using a hazard score of 3 (representing the likelihood of a 100-year event occurring in 100 years) and various combinations of exposure and vulnerability. Risk scores fall into four categories: Severe, High, Moderate, and Residual.

Table 5
Risk scores based on Hazard, Exposure, and Vulnerability

Exposure					
5	15	30	45	**60**	**75**
4.5	13.5	27	40.5	54	67.5
4	12	24	36	**48**	**60**
3.5	10.5	21	31.5	42	52.5
3	9	18	27	36	45
2.5	7.5	15	22.5	30	37.5
2	6	12	18	24	30
1.5	4.5	9	13.5	18	22.5
1	3	6	9	12	15
0.5	1.5	3	4.5	6	7.5
	1	**2**	**3**	**4**	**5**
	Vulnerability				

Risk scores help identify assets with elevated potential for storm damage. In addition to the risk score, other factors also contribute to determining which assets should be addressed, how soon they should be addressed, and their priority for the community. Some factors that should be considered for each asset in developing a community risk management strategy include:

- Contribution to life safety
- If asset is a Critical Facility
- Value of asset to the community
- Environmental services provided
- Economic contribution of the asset
- Whether alternatives are available
- Capacity of the asset to adapt

Severe Risk **Risk Score >53**

Risk Scores greater than 53 occur only if one of the two factors, exposure or vulnerability, is rated 5, and the other is 4 or higher; this could represent that the asset is in a dangerous situation. Both exposure and vulnerability should be reduced, if possible. Consider relocation a priority option for assets with Risk scores greater than 53.

High Risk **Risk Score 24 – 53**

Risk Scores in the range of 24 to 53 indicate conditions that could lead to significant negative outcomes from a storm. Using the risk scoring system a total of 24 can only be achieved if the vulnerability is 4 and Exposure 2, or vice versa. A vulnerability of 4 indicates the likely loss of service of an asset for an extended period of time. For many assets this may be unacceptable. Actions should be taken to reduce Vulnerability, such as elevating or flood-proofing the asset, to help avoid a long-term loss of function. A score of 4 for exposure indicates most of the local landscape attributes that help reduce storm damages are absent. Actions to restore landscape attributes may be appropriate. All other risk scores higher than 24 indicate either the exposure or the vulnerability, or both, are higher than the conditions discussed above, lending more weight to the need to take actions that reduce risk. Relocation may be necessary in the future if other means of adaptation or management actions are not effective.

Moderate Risk **Risk Score 6 – 23**

Risk Scores between 6 and 23 pose moderate to serious consequences, but adaptation may be of lower priority due to one factor, exposure or vulnerability, remaining relatively low. Use a combination of measures to reduce exposure and/or vulnerability.

Residual Risk **Risk Score < 6**

Risk Scores less than 6 occur when both exposure and vulnerability are relatively low. This situation suggests floods would pose minor or infrequent consequences. However, a vulnerability score of 3 may not be acceptable for critical facilities or high

community value assets, because the community cannot afford to be without these services, even on an infrequent basis. Note that risk is never completely eliminated. Some residual risk still remains even after management measures have been implemented. Monitor conditions and adapt as necessary.

Guidance for Reducing Risk:

For assets with elevated Risk Scores, reduce risk by reducing exposure and vulnerability. For any asset with a vulnerability score of 4 or 5, consider options to reduce vulnerability, such as elevating the asset or floodproofing. A vulnerability score of 4 or 5 indicates a storm could result in long-term or permanent loss of services. For critical facilities a vulnerability score of 2 or 3 may be unacceptably high. Employing a combination of management measures will help ensure an asset or system can continue functioning in case one measure fails.

Different sets of management measures can be tested by changing the exposure and vulnerability scores in the Risk Assessment Tool (See Appendix 6: Using the Risk Assessment Tool to Test Management Measures and Appendix 7: Scenario Planning). Appendix 4 provides a list of actions a community can take, or urge others to take, to reduce risk.

APPENDIX 9: RELATIONSHIP OF CR PLANS TO LTCR PLANS

Following Hurricane Irene and Tropical Storm Lee, several communities received grants through the NYS Department of State to prepare Long-Term Community Recovery (LTCR) plans while others received direct assistance from the Federal Emergency Management Agency (FEMA) to prepare similar recovery plans.

These communities will not be required to prepare a CR Plan to qualify for implementation funds from the State if their plans contain the information required in CR Plans. Such communities should examine their plans to see if they need to be supplemented. Communities' review of their LTCR plans should focus on the following:

- An assessment of risks to assets. Communities may need to look at assets that were not damaged but are in the 100-year floodplain and are thus susceptible to future storms;
- An analysis of costs and benefits. Communities should assure that their LTCR plan includes an assessment of the costs and benefits associated with the projects and actions being proposed;
- Strategies that address vulnerable populations. Communities should explicitly note strategies benefiting vulnerable populations; and
- Detailed implementation tasks. Communities may need to expand their plans for implementation and assign responsibility for specific actions to specific individuals or organizations, and establish timelines for each action, as appropriate.

APPENDIX 10:
CASE EXAMPLES OF EFFECTIVE COMMUNITY REDEVELOPMENT

The two case studies shown below are examples of communities that took the devastating circumstances of natural disaster and treated it as an opportunity both to revitalize the local economy and build resilience for future events. Both communities tailored their response to their particular circumstances, but both engaged in a thorough and long-term planning process, treated disaster mitigation and economic development as co-equal determinants of project acceptability, engaged with the community throughout, and treated the process not simply as an opportunity to rebuild what was destroyed but to place the community on a stronger foundation than what had existed before.

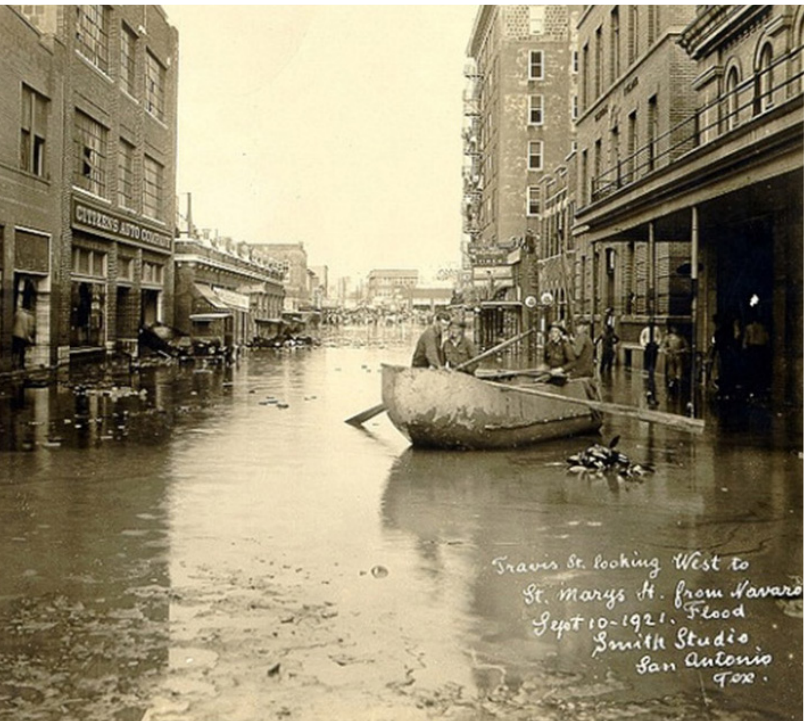
San Antonio, Texas – River Walk[41]

During the 19th and early 20th century, the town of San Antonio had grown from a dusty cattle herd destination into one of the more prosperous and developed cities in Texas. Located in the south-central portion of the state, it was built around the San Antonio river and grew significantly when a railroad junction was established there in the 1870s.

On September 9th 1921, a flash flood surged through the San Antonio river and a number of smaller creeks in downtown San Antonio, killing 50 people and submerging some parts of the city under as much as nine feet of water. The city's immediate response was an attempt to fill the river with soil and turn it into additional roads to serve the growing number of vehicular traffic. However, a group of local conservationists, led by San Antonio architect Robert Hugman, developed a different plan that would preserve the river and establish the riverfront as a prime economic and social destination. This new group, eventually named the San Antonio Conservation Society, presented their plan – titled "The Shops of Aragon and Romula" by Hugman – to the city in 1929. The group engaged city leaders in understanding the plan's vision by hosting a puppet show at the city hall, taking commissioners on canoe rides along the river, and setting up numerous meetings and town halls to present their plan to businesses and citizens alike.

The plan called for a bypass channel, flood gates, a small dam, and other river management engineering

> San Antonio's river walk plan was a response to a natural disaster, but used the opportunity created by that disaster to upgrade its flood management capabilities and develop a previously under-used portion of the city's downtown. The process was marked by a singular driving personality, Robert Hugman, and included extensive community engagement, creative public financing, and a long-term planning approach that continues to bring economic benefit to the city almost 100 years later.



Downtown San Antonio, 1921

San Antonio River Walk, 2011

solutions that would divert future floods – but it also included a number of Hugman's signature design efforts, including arched footbridges, staircases connecting the River Walk to the city's streets, pebbled walkways, and an outdoor theatre with seating on the far side. Though Hugman's plan envisioned immediate economic development, the Great Depression prevented San Antonio from committing any money to the plan for almost a decade.

In 1938, San Antonio recommitted to developing the riverfront and successfully held a referendum to raise $75,000 in a new, one-time tax that would be combined with $325,000 in federal development funding, and by 1939 work had begun. In 1946, another flood hit the city – this time with only minimal damage as most of the floodwaters were channeled and diverted by the engineering work done on the river under Hugman's plan.

It took most of the 1950s and 1960s to completely develop the riverfront as a prime location for residential, office, retail, and hospitality real estate, but today it is one of San Antonio's premiere locations for restaurants, shops, and hotels, and a major driver of the city's economy. Though a formal study of the River Walk's economic impact has yet to be completed, a more general 2008 study[42] of San Antonio's tourism industry – with the River Walk as one of its chief attractions – contributed approximately 18% of the city's budget in taxes every year and cumulatively provided $11 billion to the local economy.

Cedar Rapids, Iowa – Downtown reinvestment and revitalization[43]

Cedar Rapids is the second-largest city in the state of Iowa and sits along the Cedar River in the east-central portion of the state. On June 13, 2008, the Cedar River crested at more than 31 feet and flooded most of Cedar Rapid's downtown, much of which sits within a few blocks of the river's edge. Though the flood took no lives, it caused enormous damage to businesses and residences alike, and in the aftermath the city immediately began crafting a master plan that would strengthen the community's resilience to future floods and re-develop the more than 5,000 public, commercial, and private properties affected by the flood.

The city leadership identified their flood recovery goals within four days of peak flood levels, and in the following month determined the many challenges that they would have to address in their new plans – improving flood protection, restoring affordable housing, ensuring vibrant neighborhoods, protecting residents, and restoring business and downtown vitality. By the end of July, the city had completed a thorough analysis of the topographic and geological features of the land beneath and surrounding Cedar Rapids. They presented that information in the first of three open houses that identified residents' primary concerns and surfaced some initial preferences and strategies for flood management and community redevelopment. In early September,

> Cedar Rapids' response to extreme flooding in the summer of 2008 was immediate. Within six months of the flooding, city leaders had held multiple open houses, elicited feedback from more than 4,000 people, and generated a comprehensive recovery plan. The plan relied on engineering techniques that increased resilience to flooding, but also incorporated citizens' views into how those new structures could best be incorporated into the city's daily life and downtown economic development. Since the flood, Cedar Rapids has regularly been listed as one of the U.S.'s top cities in livability, employment prospects, and government performance.

Cedar Rapids, June 2008

Figure 8
Cedar Rapids planning options presented in open house, September 2008

Option 1 - Floodwall | Option 2 - Levee and Parkway | Option 3 - Naturalized Floodplain

the city held a second open house, this time presenting to the community three different options for flood management. After receiving feedback on those options, the city then held a third open house in October that presented an overall framework for flood management and economic re-development.

The city used the feedback from each of the three open houses to build a plan with three major elements – flood management, connectivity, and sustainable neighborhoods. While much of the flood management effort included re-engineering the riverfront, the types and methods of levees, walls, floodplains, and marshlands were identified with community involvement to ensure that the spaces they created could be used most effectively in commercial development, cultural activities, and recreation.

In connectivity and sustainable neighborhoods, the city used post-flood funding to rebuild a better mix of affordable housing, protect major industrial sites, improve transportation between downtown economic centers and outlying residential suburbs, and invest in new commercial infrastructure that supported retail shops, farmer's markets, local stores, and the development of better medical facilities. And though the plans were made quickly, the city envisioned that it would take 12-15 years to completely recover from the flood.

By the end of 2008 – within six months of the flood – the city had effectively identified its goals, determined the major challenges, developed a variety of planning options, engaged more than 4,000 citizens to get their reaction to various elements of those options, and built a comprehensive re-development plan. As of early 2013, the city had completed over 95% of its buyouts for private residences and demolition of structures damaged beyond repair. Though the results of Cedar Rapid's plan are too recent for economic analysis, it has been cited in 2011 and 2012 as one of the top ten cities in the U.S. in terms of cost-of-living, prevalence of high-paying jobs, presence of affordable homes and housing, and city management performance overall[44].

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