WORKSHOP #3:

PLANNING FOR NATURAL AND NATURE-BASED SOLUTIONS

HANDOUT FOR BREAKOUT GROUPS

RESOURCES ON INTEGRATING NNBS INTO HAZARD MITIGATION PLANS, COMPREHENSIVE PLANS, AND STORMWATER PLANS

September 14, 2022

Table of Contents

HAZARD MITIGATION PLAN
BREAKOUT GROUP

RESOURCE INFORMATION – INTEGRATION OF NATURAL AND NATURE-BASED SOLUTIONS INTO HAZARD MITIGATION PLANS

State Hazard Mitigation Plan Requirements

States must have FEMA-approved Standard Mitigation Plans that comply with certain requirements in order to be considered eligible for non-emergency Stafford Act assistance and FEMA mitigation grants. These plans must be developed through a planning process that coordinates with other state and federal agencies, interested groups, and other ongoing state planning and mitigation efforts. The planning process must also include processes for reviewing and updating the plan every 5 years.

Beyond this, plans must include the following elements:

- A description of the planning process
- A **Risk Assessment**, providing the factual basis for activities, that characterizes and analyzes natural hazards and risks throughout the state, enabling comparison of potential losses and determining priorities for mitigation, including overviews of:
    - Type and location of natural hazards, including previous occurrences and future probabilities, and maps as needed;
    - State vulnerability to relevant hazards, based on local risk assessments;
    - Losses to vulnerable structures, including estimations of dollar losses to state-owned and operated facilities.
- A **Mitigation Strategy** for reducing losses from hazards identified in the risk assessment, including a discussion of:
    - State goals to guide activity selection;
    - State capabilities to mitigate hazards, including state and local policies and funding capacities;
    - Prioritization of cost-effective, environmentally sound, and technically feasible mitigation activities and description of linkages to overall strategy and local plans; o Sources of funding to implement activities;
    - Severe and repetitive loss activities and strategy.
- A section discussing **Coordination of Local Mitigation Planning**, including:
    - State processes to support local plans;
    - State process to coordinate, review, and link local plans to state plan;
    - Process of prioritizing community and local jurisdictions for support.
- A **Plan Maintenance Process** including:
    - Monitoring and evaluation for updates;
    - Monitoring and implementation of mitigation measures;
    - Review of progress towards mitigation goals
- A **Plan Adoption Process**
- **Assurances** of compliance with relevant State and Federal statutes and regulations of that period.

44 CFR § 201.4 States may also develop Enhanced State Plans, which make them eligible to receive additional HGMP funds,

Local Hazard Mitigation Plans Requirements

The local mitigation plan is the representation of the jurisdiction's commitment to reduce risks from natural hazards, serving as a guide for decision makers as they commit resources to reducing the effects of natural hazards. Local plans will also serve as the basis for the State to provide technical assistance and to prioritize project funding.

The plan must include the following:

- **A description of the planning process.**
- A ***risk assessment*** that provides the factual basis for activities proposed in the strategy to reduce losses from identified hazards, allowing for prioritization of appropriate mitigation actions. The risk assessment must include:
    - Type, location, and extent of all natural hazards, including previous occurrences and future probabilities;
    - Jurisdiction's vulnerability to the hazards described, including an overall summary of each hazard and its impact on the community; and
    - Vulnerability of NFIP-insured structures, including the types and numbers of existing buildings, infrastructure and critical facilities, estimate of potential dollar losses, and general description of land uses and development trends within the community.
- A ***mitigation strategy*** that provides the jurisdiction's blueprint for reducing the potential losses identified in the risk assessment, based on existing authorities, policies, programs and resources, and its ability to expand on and improve these existing tools, including:
    - A description of mitigation goals to reduce or avoid long-term vulnerabilities to the identified hazards.
    - A section that identifies and analyzes a comprehensive range of specific mitigation actions and projects being considered to reduce the effects of each hazard, with particular emphasis on new and existing buildings and infrastructure.
    - Description of how actions will be prioritized, implemented, and administered by the local jurisdiction. Prioritization will include a special emphasis on the extent to which benefits are maximized according to a cost benefit review of the proposed projects and their associated costs.
- A ***plan maintenance process*** that includes:
    - Method and schedule of monitoring, evaluating, and updating the mitigation plan within a five-year cycle.
    - A process by which local governments incorporate the requirements of the mitigation plan into other planning mechanisms such as comprehensive or capital improvement plans, when appropriate.
    - Discussion on how the community will continue public participation in the plan maintenance process.
- ***Documentation*** that the plan has been formally adopted by the governing body of the jurisdiction requesting approval of the plan (*e.g.,* City Council, County Commissioner, Tribal Council).

44 CFR § 201.6

Identifying Types of Nature-Based Solutions for Certain Hazards

NATURE-BASED SOLUTIONS BY HAZARD[1]	
Inland Flooding *Floodplain and Wetland Restoration* Levee setbacks and dam removal Wetland Restoration *Green Stormwater Management* Rain gardens Permeable surfaces *Protecting Floodplains from Development* Open space acquisition and protection Voluntary buyouts	Wildfires *Ecological Forest Management* Fuel reduction treatments Prescribed fire Post-fire restoration *Learning to Live with Fire* Community planning & collaborative risk management Managed wildfire
Coastal Hazards *Coastal Habitat Protection and Restoration* Coastal wetlands Beaches, dunes, and barrier islands Coral and oyster reefs *Living shorelines* Vegetation only Combined vegetation and structural approaches *Protecting Coastal Areas from Development* Voluntary buyouts Coastal open space protection	Extreme Heat and Drought *Watershed Restoration* Headwater stream and forest restoration Beaver restoration *Urban Green Infrastructure* Urban forestry Green roofs Cool pavement *Water Conservation* Rainwater harvesting Xeriscaping Water-saving agricultural practices

[1] Pathak, A., P. Glick, L.J. Hansen, L.E. Hilberg, J. Ritter, and B.A. Stein. 2022. Incorporating Nature-based Solutions into Community Climate Adaptation Planning. Washington, DC: National Wildlife Federation and EcoAdapt.

Nature-Based Hazard Mitigation Actions

There is a wide variety of types of nature-based hazard mitigation strategies,[a] from land conservation and restoration to green infrastructure to land use policy. These projects can address a range of hazards while also providing other environmental and community benefits.

Types of projects include:

- **Land conservation** – Identifying and protecting land for hazard mitigation and ecosystem benefits.
- **Wetland, floodplain, habitat restoration** –Restoring functions and habitat areas that have been lost or degraded for hazard mitigation benefits.
- **Green infrastructure** – Parcel-scale land conservation and storm water management projects (e.g., bioswales, rain gardens, green roofs) that provide flood and drought mitigation benefits, generally in urban areas.
- **Land use projects** – Land use policy and regulatory actions such as zoning, greenways, and growth management in high hazard areas.
- **Dune restoration, living shorelines, coastal wetland restoration** – Coastal protection and restoration projects that provide protection from flooding and storm surge.

Nature-based projects provide additional co-benefits, including:

- Habitat protection
- Wildlife protection
- Other ecosystem services (e.g., improved water quality)
- Increased property values for neighboring properties
- Green jobs
- Recreation space for the surrounding community
- Public health benefits
- Carbon sequestration

a - FEMA, Mitigation Ideas - A Resource for Reducing Risk to Natural Hazards (2013), available at https://www.fema.gov/sites/default/files/2020-06/fema-mitigation-ideas_02-13-2013.pdf; FEMA, Building Community Resilience with Nature-Based Solutions - A Guide for Local Communities (2020), available at https://www.fema.gov/sites/default/files/2020-08/fema_riskmap_nature-based-solutions-guide_2020.pdf

South Carolina Nature-Based Goals and Actions

The following information was taken from the Environmental Law Institute's (ELI) research on *Integrating Nature-Based Goals and Actions in Hazard Mitigation Planning.* https://www.eli.org/land-biodiversity/hazard-mitigation-planning

Current South Carolina Mitigation Goal Relevant to NNBS: (Goal specifically focuses on natural infrastructure/nature-based solutions)

Goal #7: Enhance and encourage the use of natural resource protection measures as a means to reduce the impacts of hazards on people and property.

Current South Carolina Mitigation Actions Relevant to NNBS:

Category	Action
Conservation/ Preservation/ Management	Maintain healthy beach profile.
Funding and Programmatic	Fund the Beach Restoration and Improvement Trust Fund; Establish timely release of Beach Renourishment Trust Fund.
Restoration	Support Dune Restoration Efforts

Nature Based Categories and Actions

ELI reviewed and analyzed state, tribal, and local hazard mitigation plans to identify to what extent they are incorporating conservation and restoration of wetlands and floodplains and green infrastructure as goals or explicit hazard reduction strategies.

ELI Proposed Categories of NNBS Actions:

- Conservation/Preservation/Management
- Restoration
- Green Infrastructure
- Land Use
- Funding and Programmatic
- Policy and Law
- Technical and Information
- Education and Awareness
- Agency Coordination
- Partnerships

Examples of Nature Based Solutions in State and Local Hazard Mitigation Plans (by category):

Conservation/Preservation/Management: actions that are explicitly focused on protection or management of ecosystems or natural resources (e.g., protect wetlands, maintain creek banks, ecosystem preservation).

State	Action
Texas	"Restore and protect coastal wetlands and marshes. Coastal wetlands are transitional areas of vegetation and soils located between uplands and open marine water environments that are typically saturated or periodically inundated by tidal waters."
Minnesota	"[s]tream corridor protection projects and restoration and soil erosion control projects will be used to prevent or reduce risks and increase the protection of natural resources from flooding."
Wyoming	"[p]romote utilizing natural systems protections to protect and restore natural floodplain functions, such as stream restoration, forest management, conservation easements, and wetland preservation."

State	County	Action
Florida	Pasco County	Project 74: Acquire properties adjacent to river and Celtic Dr to establish a canoe/kayak launch site with riverfront park (pg 6)
Mississippi	Jackson County	NRP 1: Preserve trees and vegetation on uninhabited properties to improve stormwater management/flood control. (pg 178) (City of Ocean Springs)
Wisconsin	Bayfield County	Continue to protect the Lake Superior shoreline within Red Cliff Tribal boundaries with "protected" status.

Restoration: actions focused on restoration of natural habitats, usually wetlands, streambanks, floodplains, beaches, etc. These actions include dam removals, dune restoration, and restoration of native vegetation.

State	Action
Iowa	"[i]mplement floodplain and streambank restoration/channel improvement projects that reduce peak flow during flood events,"66 was explicit about the hazard mitigation value of restoration efforts."
Montana	"[e]ncourage Natural Channel Design (NCD) techniques for stream restoration and bank restoration/stabilization projects to increase flood resiliency" and "projects that will increase stream length to regain natural function and reduce impact of flooding."

https://www.eli.org/land-biodiversity/hazard-mitigation-planning

State	County	Action
Florida	Hillsborough County	Restore 1,100 acres [acquired former pasture] to provide habitat based on soils and historic aerials. Restore to pine flatwoods and hardwood hammocks. (pg 19)
Texas	Jefferson County	Action 6: Restore sand dunes to protect inland resources during storm surge events. (pg 397)
Wisconsin	Polk County	Using various methods, prioritize target areas, treatment, and management efforts for terrestrial invasive species in Polk County.

Green Infrastructure: actions that call on the use of parcel-scale green infrastructure projects to address urban stormwater management.

State	Action
Arkansas	"[u]se green mitigation techniques such as bio swales, rain gardens, and permeable pavers," provided examples of specific green infrastructure actions that could be employed."
Iowa	"Encourage and implement green infrastructure practices to create healthier urban environments and manage storm water in cities. Practices include mechanisms that prevent soil erosion or provide flood protection, habitat, and cleaner air and water (riparian forest buffers, infiltration including bioswales, wet detention systems, storm water wetlands, vegetated swales, permeable pavement, and green roofs)"
Minnesota	"Reduce Urban Heat Island Effect. Increase tree plantings around buildings to shade parking lots and along public rights-of-way. Encourage installation of green roofs and cool roofing products that reflect sunlight and heat away from a building."
Maryland	"[i]ncrease opportunities for communication about adaptation planning in Maryland, facilitate the exchange of ideas between Chesapeake Bay watershed partners, and pilot green/grey infrastructure to prepare for and respond to climate impacts to vulnerable populations."

State	County	Action
Texas	Harris County	Action KTY12 (City of Katy) — Provide incentives to private industry and contractors, for using permeable driveways and surfaces to reduce runoff and promote groundwater recharge. (pg 346)
Wisconsin	Grant County	Explore utilizing natural systems such as bioswales to retain stormwater with new development (Village of Mount Hope)

https://www.eli.org/land-biodiversity/hazard-mitigation-planning

Land Use: actions that seek to address risks to communities through land use, including planning and zoning guidelines or policy and managing development in hazard-prone areas.

State	Action
Georgia	"Minimize damage to natural resources through the use of and compliance with greenspace, stream buffers, zoning ordinances as actions to protect Georgia communities"
Iowa	"a comprehensive planning and zoning policy such as development setbacks and limits on density and infrastructure in coastal and transitional zones to consider vulnerability to sea level rise and saltwater intrusion."

State	County	Action
Florida	Hillsborough County	Project 112.8: Construct culvert for wildlife underpass on two roadways near Balm-Boyette Scrub.
Iowa	Fayette County	Acquire flood prone properties and convert to open space/green space, or pursue easements when acquisition is not possible
Minnesota	Goodhue County	Plant a "living fence" along roadways
Wisconsin	Bayfield County	Restrict or limit development in areas with sensitive coastal wetlands

Funding and Programmatic: actions that seek to create or expand preservation, restoration, or green infrastructure programs; develop or enhance funding programs; or develop implementation plans related to nature-based strategies.

State	Action
New Hampshire	"[p]romote funding and resources for land acquisition, conservation planning, land management programs, and land stewardship in areas at risk of loss or degradation due to sea level rise"
Pennsylvania	"[i]dentify cooperative funding opportunities for natural system protection projects."
Vermont	"[e]stablish a statewide conservation and buyout program" and to "[c]reate a dedicated State fund to support the purchase or local match of hazard-prone properties and the purchase of easements to conserve river corridors, floodplains, and wetlands identified as key flood attenuation areas."
Wisconsin	"give extra points to communities applying for DNR Stewardship programs if their proposal includes mitigation elements (including removing floodplain from development)."

https://www.eli.org/land-biodiversity/hazard-mitigation-planning

State	County	Action
Virginia	Hampton County	Hampton Mitigation Action 6: Adopt and implement holistic watershed plan. May include Climate Resilient Mitigation Activities (CRMA).
Wisconsin	Washburn County	Identify sites where environmental restoration work can benefit flood mitigation efforts.
Wisconsin	La Crosse County	Encourage the planting of trees in the City (City of La Crosse)

Policy and Law: actions that call upon different agencies to develop and implement policies and regulations that would encourage or facilitate conservation and/or nature-based mitigation actions.

State	Action
Alabama	"[d]evelop regulations that preserve and rehabilitate natural systems to serve natural hazard mitigation functions (i.e., floodplains, wetlands, watersheds, and urban interface areas)."
Massachusetts	"[p]romulgate wetlands regulations to establish performance standards for work in land subject to coastal storm flowage."
Minnesota	"[r]equire incorporation of water-sensitive infrastructure – such as protection of natural areas, development of green infrastructure, and minimization of impervious areas to treat both water quality and quantity – in all comprehensive plans and watershed plans."

State	County	Action
California	Tulare County	Continue to require buffer areas between development projects and significant watercourses, riparian vegetation, wetlands, and other sensitive habitats and natural communities. These buffers should be sufficient to assure the continued existence of the waterways and riparian habitat in their natural state.
Minnesota	Olmsted County	Regulate zoning and building permit applications to ensure new construction does not occur in flood-prone areas. (Eyota)
Virginia	Southhampton County	Southampton County Mitigation Action 13, p 7:222: Enact tree preservation or landscape ordinance for new construction.

https://www.eli.org/land-biodiversity/hazard-mitigation-planning

Technical and Information: actions related to studies, modeling, and development of tools (e.g., decision support tools).

State	Action
Connecticut	"[i]dentify and map the locations of headwater, main stem and coastal dams, culverts, bridges, and other structures or land modifications that contribute to flood damage and act as barriers to habitat connectivity, and assess the feasibility of removal or modification of these structures."
Massachusetts	"[u]pdate and share a dam removal decision support tool that directly incorporates new climate change projections, climate adaptation benefits and helps municipalities and others prioritize dams for removal."
New York	"[i]ntegrating SLAMM [Sea Level Affecting Marshes Model] results and stakeholder priorities to define marsh adaptation strategies"
Vermont	"[d]evelop hydraulic and stream power models for a range of flood frequencies to analyze and define valley areas supporting essential floodplains and river corridor functions that would increase the storage of flood flows, sediments, and nutrients."

State	County	Action
Minnesota	Wabasha County	Evaluate the locations and numbers of stream monitoring stations throughout the County, and coordinate and/or purchase additional monitoring equipment if necessary.
Washington	Jefferson County	Use technical knowledge of natural ecosystems and events to link natural resource management and land use organizations to mitigation activities and technical assistance.
Wisconsin	La Cross County	Utilize modeling, including EVAAL to identify priority areas for conservation and mitigation practices and projects

Education and Awareness: actions focused on development of guidance, conducting community outreach, and creating technical bulletins and training programs aimed at enhancing understanding of ecosystem services and non-structural mitigation measures.

State	Action
Colorado	"[e]nhance the natural and beneficial functions of floodplains by promoting an increased awareness of stream ecosystem function and its benefits to flood hazard mitigation."
Indiana	"[d]evelop an outreach program to educate communities on green infrastructure and provide opportunities for them to seek additional training."

https://www.eli.org/land-biodiversity/hazard-mitigation-planning

State	County	Action
Washington	Clallam County	Encourage residents and landowners to leave natural erosion barriers, such as driftwood logs on the shore, in place to reduce shoreline erosion.
Wisconsin	St. Croix County	Continue to educate the public and elected officials of flood risks, flood insurance, and alternatives to mitigate stormwater runoff (e.g., soil health, erosion controls, rain gardens, low-impact development). Especially target those municipalities with the greatest assessed improvements in or near floodplain areas.

Agency Coordination: actions that encourage or promote coordination among state agencies or state and local agencies.

State	Action
Massachusetts	"review habitat management, land stewardship, coastal zone management, agricultural and invasive species programs and policies to develop strategies that promote coordination among agencies and support climate change adaptation and mitigation goals."

State	County	Action
Iowa	Bremer	Participate in and cooperate with other jurisdictions in improving watersheds, including Watershed Management Authorities and Drainage Districts
Texas	Cameron County	Action 10: Work with General Land Office to develop a living coastline constructed from natural materials derived from regional materials such as rock and seagrass (pg 139)

https://www.eli.org/land-biodiversity/hazard-mitigation-planning

Partnerships: actions that encourage partnerships with non-profits, utilities, or other organizations to conduct mitigation strategies

State	Action
Tennessee	"Develop a strategy for empowering non-profit groups such as environment or watershed protection organizations to support local hazard mitigation planning by October 2021."
Vermont	"[w]ork with land conservation organizations to include river corridor and floodplain protection provisions, and/or headwater storage in conservation easements"

State	County	Action
Virginia	York County	York County Mitigation Action 7, p 7:89: Continue support of the Newport News Department of Public Utilities (Waterworks) forest management program to mitigate wildfire hazards and promote the health of forests within the reservoir watersheds.
Wisconsin	Polk County	Continue working with lake groups and other partners to implement the County's Aquatic Invasive Species Strategic Plan, enforce the transport ordinance, and complete the AIS rapid response plan.

https://www.eli.org/land-biodiversity/hazard-mitigation-planning

COMPREHENSIVE LAND USE PLAN
BREAKOUT GROUP

RESOURCE INFORMATION –
INTEGRATION OF NATURAL AND NATURE BASED SOLUTIONS
INTO COMPREHENSIVE PLANS

Comprehensive Plans and Natural and Nature-Based Solutions (NNBS)

The following language was taken from the report *Incorporating Nature-Based Solutions into Community Climate Adaptation Planning* by National Wildlife Federation and EcoAdapt.

A community's comprehensive land use plan plays a vital role in guiding a city or county's future development and long-term vision. This is because the plans hold the legal authority to guide and influence community development over the next coming decades. The plans also provide an avenue to embed NbS, particularly green infrastructure concepts, in the local policy instructions and implementation ordinances right from the initial planning stages (Kim and Tran 2018).

Despite the growing need to utilize green infrastructure to balance urban development with ecological benefits, these concepts are not fully integrated into the local comprehensive plans. One recent study evaluated local comprehensive plans of 60 municipalities of the United States. It concluded that most jurisdictions have not sufficiently incorporated the key concepts of green infrastructure planning, except Sumter County in Florida (Kim and Tran 2018). Similar results were found in coastal cities and counties of Texas, where local plans do not include specific goals or benefits of green infrastructure (Woodruff et al. 2021).

As cities and counties amend their local plans, there is a critical need to integrate green infrastructure to address their planning challenges. In their analysis, Kim and Tran (2018) found that local plans that were regularly updated and involved more qualified local planners performed better in incorporating green infrastructure principles.

Comprehensive Plans

Current South Carolina Comprehensive Plan Elements (Comprehensive Planning Enabling Act)

Population	Historic trends and projections, household numbers and sizes, educational levels and income characteristics
Economic Development	Labor force and labor force characteristics, employment, analysis of the economic base
Natural Resources	Considers coastal resources, slope characteristics, prime agricultural and forest land, plant and animal habitats, parks and recreation areas, scenic views and sites, wetlands, and soil types
Cultural Resources	Considers historic buildings and structures, commercial districts, residential districts, unique, natural, or scenic resources, archaeological, and other cultural resources
Community Facilities	Considers water supply, treatment, and distribution; sewage system and wastewater treatment; solid waste collection and disposal, fire protection, emergency medical services, and general government facilities; education facilities; and libraries and other cultural facilities
Housing	Considers location, types, age, and condition of housing, owner and renter occupancy, and affordability of housing
Land Use	Considers existing and future land use by categories, including residential, commercial, industrial, agricultural, forestry, mining, public and quasi-public, recreation, parks, open space, and vacant or undeveloped
Transportation	Transportation facilities, including major road improvements, new road construction, transit projects, pedestrian and bicycle projects, and other elements of a transportation network
Priority Investment	Analyzes the likely federal, state, and local funds available for public infrastructure and facilities during the next ten years and recommends the projects for expenditure of those funds during the next ten years for needed public infrastructure and facilities such as water, sewer, roads, and schools.
Resilience	Considers the impacts of flooding, high water, and natural hazards on individuals, communities, institutions, businesses, economic development, public infrastructure and facilities, and public health, safety and welfare. This element includes an inventory of existing resiliency conditions, promotes resilient planning, design and development, and is coordinated with adjacent and relevant jurisdictions and agencies.

Resilience Element Requirements

Requirement	Suggested Approaches
Considers the impact of flooding, high water, and natural hazards on individuals, communities, institutions, businesses, economic development, public infrastructure and facilities, and public health, safety and welfare.	• Review hazard mitigation plans & historic events • Refer to Statewide Resilience Plan's Flood Vulnerability Assessment • Conduct local risk and vulnerability assessment, mapping assets against current and future risk, consulting other plan elements for key locations
Includes an inventory of existing resiliency conditions	• Inventory array of existing data, plans and studies by organizations in jurisdiction's region/watershed (Sea Grant's Resilience Planning Archive as a starting point) • Review social vulnerability and resilience indices, looking at multiple such as SoVI, SVI, BRIC, CRIA, CRE, to identify strengths, weaknesses, & opportunities
Promotes Resilient Planning, Design and Development	• Identify a suite of potential solutions and how to promote/implement them • Comprehensive Plan Standards for Sustaining Places • APA Hazard Mitigation Policy Guide • Smart Growth Strategies for Disaster Resilience and Recovery • Subdivision Design and Flood Hazard Areas
Coordinated with adjacent and relevant jurisdictions	• Counties, municipalities, public service districts, school districts, utilities, transportation, other public entities (Enabling Act) • Watershed-Based: , considering the flow of water over the built and natural landscape, coordinate beyond jurisdictional boundaries, considering the downstream impacts of upstream actions • SC Sea Grant's Resilience Planning Archive as a starting point to ID partners already engaged in this work
Developed in Coordination with All Preceding Elements	• Consider the role of previous elements impact resilience and the need for resilient, nature-based solutions.

Connecting Other Comprehensive Plan Elements to Resilience & Nature-Based Solutions

Element	Potential Connection
Population	Planning for resilient development associated with population growth
Economic Development	Impact of hazards on business districts, downtowns, major employers and industries
Natural Resources	
Cultural Resources	Vulnerability of cultural assets
Community Facilities	Vulnerability of public utilities, community essential services, education, government
Housing	Vulnerability related to age, type and condition of housing. Retrofits, housing development regulations informed by current and future risk.
Land Use	Considering current and future risk in the development of future land use and zoning maps.
Transportation	Vulnerability of transportation infrastructure, opportunities for multi-modal transportation; strategies for major improvements.
Priority Investment	Analyze likely federal, state and local funds available over next 10 years for nature based and resilience projects. Are there any new investments identified for at-risk areas, do current designs allow for adaptive capacity?
Resilience	Nature based solutions that promote resilient planning, design and development and address impacts of “flooding, high water, and natural hazards”

Nature-Based Hazard Mitigation Actions

There is a wide variety of types of nature-based hazard mitigation strategies,[a] from land conservation and restoration to green infrastructure to land use policy. These projects can address a range of hazards while also providing other environmental and community benefits.

Types of projects include:

- **Land conservation** – Identifying and protecting land for hazard mitigation and ecosystem benefits.
- **Wetland, floodplain, habitat restoration** –Restoring functions and habitat areas that have been lost or degraded for hazard mitigation benefits.
- **Green infrastructure** – Parcel-scale land conservation and storm water management projects (e.g., bioswales, rain gardens, green roofs) that provide flood and drought mitigation benefits, generally in urban areas.
- **Land use projects** – Land use policy and regulatory actions such as zoning, greenways, and growth management in high hazard areas.
- **Dune restoration, living shorelines, coastal wetland restoration** – Coastal protection and restoration projects that provide protection from flooding and storm surge.

Nature-based projects provide mitigation benefits for a variety of hazards, including:

- Riverine flooding
- Urban flooding
- Coastal flooding and storm surge
- Drought
- Wildfire

Nature-based projects provide additional co-benefits, including:

- Habitat protection
- Wildlife protection
- Other ecosystem services (e.g., improved water quality)
- Increased property values for neighboring properties
- Green jobs
- Recreation space for the surrounding community
- Public health benefits
- Carbon sequestration

a - FEMA, Mitigation Ideas - A Resource for Reducing Risk to Natural Hazards (2013), available at https://www.fema.gov/sites/default/files/2020-06/fema-mitigation-ideas_02-13-2013.pdf; FEMA, Building Community Resilience with Nature-Based Solutions - A Guide for Local Communities (2020), available at https://www.fema.gov/sites/default/files/2020-08/fema_riskmap_nature-based-solutions-guide_2020.pdf

Types of Actions (with SC examples)

*All examples can be found in SC Sea Grant's Resilience Planning Archive

- **Conservation/Preservation/Management**: actions that are explicitly focused on protection or management of ecosystems or natural resources (e.g., protect wetlands, maintain creek banks, ecosystem preservation).
- **Restoration**: actions focused on restoration of natural habitats, usually wetlands, streambanks, floodplains, beaches, etc. These actions include dam removals, dune restoration, and restoration of native vegetation.
    - Spartanburg: Mitigate streambank erosion with vegetation and proactive stormwater management.
- **Green Infrastructure**: actions that call on the use of parcel-scale green infrastructure projects to address urban stormwater management.
    - Port Royal: Create a Green Infrastructure Framework plan, in conjunction with the Green Print and Passive Park Plan that considers the connectivity of naturalized stormwater, protection of natural stormwater areas.
- **Land Use**: actions that seek to address risks to communities through land use, including planning and zoning guidelines or policy and managing development in hazard-prone areas.
    - Folly Beach: Create a lower density zoning classification for Long Island and work with Charleston County to ensure marsh islands out of Folly's jurisdiction are regulated. (also involves coordination)
- **Funding and Programmatic**: actions that seek to create or expand preservation, restoration, or green infrastructure programs; develop or enhance funding programs; or develop implementation plans related to nature-based strategies.
    - Fort Mill: Work with local and regional partners to improve and restore surface water to its natural condition. Developing watersheds plans with regional partners and submit applications as applicable for funding assistance for local restoration/stabilization programs for the Catawba River, Steele Creek, and Sugar Creek.
- **Policy and Law**: actions that call upon different agencies to develop and implement policies and regulations that would encourage or facilitate conservation and/or nature-based mitigation actions.
    - Beaufort: Coordinate policies with the recommendations of the Sea Level Rise Task Force, which includes notification to owners within the sea level rise impact area.
- **Technical and Information**: actions related to studies, modeling, and development of tools (e.g., decision support tools).
    - Charleston City Plan: Continue to research and diversify data sources to be data smart thus supporting staff when formulating policy, processes and ordinance development.
- **Education and Awareness**: actions focused on development of guidance, conducting community outreach, and creating technical bulletins and training programs aimed at enhancing understanding of ecosystem services and non-structural mitigation measures.
    - Charleston City Plan: Increase incentives and educational opportunities for residents to increase and maintain green infrastructure on their properties.

- **Coordination:** actions that encourage or promote coordination among state agencies or state and local agencies and with non-profits, utilities, or other organizations to conduct mitigation strategies.
    - Charleston City Plan: Coordinate with Charleston County, Berkeley County and the SC DOT to retrofit existing and design new public rights-of-ways to increase mobility during flooding events and maximize opportunities to intercept, infiltrate, store and drain water.

American Planning Association's Sustaining Places: Best Practices for Comprehensive Plans

https://www.planning.org/sustainingplaces/compplanstandards/

One of Six Principles: Harmony with Nature – ensure that the contributions of natural resources to human well being are explicitly recognized and valued and that maintaining their health is a primary objective.

Best Practices:

1. Restore, connect, and protect natural habitats and sensitive lands.
2. Plan for the provision and protection of green infrastructure.
3. Encourage development that respects natural topography.
4. Enact policies to reduce carbon footprints. Policies designed to reduce the carbon footprint benefit the environment and have associated benefits on air quality and health. Because these policies are often associated with energy conservation, they can also have positive economic benefits for local governments and community members.
5. Comply with state and local air quality standards.
6. Encourage climate change adaptation. Successful adaptation strategies reduce community vulnerability and minimize adverse effects on the environment, economy, and public health.
7. Provide for renewable energy use.
8. Provide for solid waste reduction.
9. Encourage water conservation and plan for a lasting water supply.
10. Protect and manage streams, watersheds, and floodplains.

FEMA's Building Community Resilience with Nature-Based Solutions

https://www.fema.gov/sites/default/files/documents/fema_riskmap-nature-based-solutions-guide_2021.pdf

- ENGAGE: Planning staff typically develop the Comprehensive Plan in coordination with other government and public stakeholders. For coordinated investments in nature-based solutions, planning staff should invite other departments to help develop the. Include staff with roles in parks and recreation planning, public works, environmental protection, utilities planning, transportation planning, floodplain management, and emergency management.

- Land Use Planning
    - ASSESS: The land use planning process can help drive investments in nearly every type of nature-based solution. To prioritize nature-based solutions, consider the community's

most pressing issues, including development or hazards and risks. For communities approaching build-out, for example, preserving parks and greenways before all remaining land is developed may be most important. Communities may choose to restore natural ecosystems like wetlands, and reconnect natural areas. This can help native plants and animals compete against invasive species and resist other stressors.

- UPDATE: The land use planning process should begin with the goals and principles in the Land Use Element. This will provide the rationale and stimulus for ordinance improvements, policy and procedure changes, and training. Once the Land Use Element is updated, make more detailed updates to zoning ordinances and subdivision and land development ordinances. Depending on the type of nature-based solutions prioritized by the community, update ordinances and procedures to:
  - Establish riparian buffers and protect stream corridors
  - Direct development to previously developed areas and areas with existing infrastructure
  - Promote compact (e.g., mixed-use and transit-oriented) development
  - Reduce impervious cover
  - Modify landscape requirements, including tree protection requirements.

- Transportation Planning
  - ASSESS: Transportation and land use planning are closely linked and often interdependent. As with the land use planning process, the transportation planning process can help drive investments in nearly every type of nature-based solution. To prioritize nature-based solutions, consider the community's most pressing issues. For communities with limited options for pedestrians, retrofitting streetscapes to increase walkability may be most important.
  - UPDATE: Updating the transportation planning process should begin with the goals and principles in the Transportation Element. These provide the rationale and stimulus for ordinance improvements, policy and procedure changes, and training. Once the Transportation Element is updated, make more detailed updates to the policies, procedures, and ordinances on street and parking design. Communities can update their street design standards to provide clear direction on the appropriate installation of nature-based solutions. They can adopt a complete streets policy that encourages designs including nature-based solutions. And they can create a green streets manual that provides guidance on designing nature-based solutions. Local ordinances and procedures related to street design and parking can also be updated. Use this process to minimize impervious cover and promote nature-based solutions. Depending on the type of nature-based solutions prioritized by the community, update ordinances and procedures to encourage or require:
    - Adding nature-based solutions to proposed transportation projects in the Transportation Improvement Plan and capital improvement plan
    - Making street trees a part of public capital improvement projects
    - Making streets no wider than is necessary to move traffic effectively
    - Using pervious materials for lower-traffic paving areas, including alleys, streets, sidewalks, driveways, and parking lots

        - Providing alternative parking requirements (e.g., shared or offsite parking), and varying requirements by zone to reflect places where more trips are by foot or transit
        - Using alternative measures to reduce required parking, such as transportation demand management
        - Using nature-based solutions to strengthen the resilience of transportation infrastructure to natural hazards.

- Open Space Planning
    - ASSESS: The open space planning process can help drive investments in nearly every type of nature-based solution. At the watershed scale, it can support interconnected systems of greenways and parks. These mitigate natural hazards and provide co-benefits to the community. At the neighborhood scale, open space planning can incorporate nature-based solutions into local parks and recreational facilities. This helps reduce and treat neighborhood stormwater runoff. In coastal areas, open space planning can drive investments in living shorelines, waterfront parks, and other coastal nature-based practices.
    - UPDATE: Updating the open space planning process should begin with the Open Space and Recreation Element of the Comprehensive Plan. Once the plan is updated, consider more detailed updates to facilities management programs, park planning and design, and local ordinances. Facilities management programs can add neighborhood-scale nature-based solutions to existing parks and playgrounds. As local governments retrofit existing facilities, they can incorporate nature-based solutions to reduce impervious cover, enhance tree cover, and treat and soak up stormwater runoff. Park planning and design are also opportunities. Communities can apply nature-based practices and principles as they expand their network of parks and trails and design each park site. Using nature-based solutions for retrofitting existing parks or acquiring and designing new parks can mobilize new partners and funding sources. Finally, updating local ordinances can help to preserve watershed-scale nature-based solutions. Based on the needs of the community, ordinances can be updated to:
        - Protect natural resource areas and critical habitat
        - Establish no-development buffer zones and other protections around wetlands, riparian area, and floodplains
        - Limit development and land disturbance in source water protection areas.

STORMWATER PLAN
BREAKOUT GROUP

RESOURCE INFORMATION – INTEGRATION OF NATURAL AND NATURE BASED SOLUTIONS INTO STORMWATER PLANS

Stormwater Plans and Natural and Nature-Based Solutions (NNBS)

Below are recommendations for better incorporating NNBS into stormwater plans and actions. Adapted from *ACTION PLAN FOR NATURE-BASED STORMWATER STRATEGIES: Promoting Natural Designs that Reduce Flooding and Improve Water Quality In North Carolina*, by the North Carolina Coastal Federation.

Guiding Principles

There are fewer flooding incidents and better water quality within watersheds where natural hydrology is protected, restored or simulated.	Nature-based stormwater strategies provide social and economic benefits while reducing flooding and improving water quality.
Nature-based stormwater strategies are a costeffective and sustainable way to reduce flooding and improve water quality when sited and designed correctly.	State and local government must lead by example in supporting nature-based stormwater strategies in ways that protect public health, safety and welfare.
There is opportunity for the state and for communities to thoughtfully site and design nature-based stormwater strategies to address racial, income and other inequities.	A comprehensive volume reduction-based watershed management strategy, implemented in a consistent and systematic way across North Carolina, would inform and support the cost-effective application of nature-based stormwater strategies at community and regional scales.

New Development

1. Promote the use of nature-based stormwater strategies and low-impact development decision-making tools already approved by either the state or local government by doing the following:
    a. Expedite permit applications that are designed to achieve runoff volume matching as specified in the state's stormwater design manual.
    b. Secure funding to support technical specialists who can meet with project designers and developers in early stages of the design phase to evaluate, advise and provide technical assistance.
    c. Develop detailed maps to assist with watershed management plan development and guide where and what types of nature-based stormwater strategies are most practical and economical for potential new development sites.
    d. Train industry and trade professionals, government staff and decision-makers so that they understand the benefits and limitations of nature-based stormwater strategies.
    e. Facilitate local government review of development codes and ordinances for potential inclusion of nature-based solutions.
    f. Establish a standardized life-cycle cost analysis for disclosure and include these costs for operating and maintaining permitted stormwater systems as an update to the

state's stormwater design manual. Update periodically to ensure accuracy of cost estimates.

   g. Ensure that maintenance plans prepared as a requirement of state and locally issued stormwater permits include an estimated budget of lifecycle costs for operating and maintaining the authorized stormwater system.
   h. Create a state-sponsored awards program that recognizes notable low-impact development projects and communities leading in applying nature-based stormwater strategies each year.
2. To exemplify support and state leadership, all state-funded construction projects use nature-based stormwater strategies when technically and economically feasible.
3. To exemplify support and local leadership, all local government construction projects use nature-based stormwater strategies.

Stormwater Retrofits

1. Promote nature-based stormwater strategies as a cost-effective and preferred way to retrofit stormwater systems to reduce flooding and protect water quality.
   a. Use nature-based stormwater strategies to bring failing stormwater systems into regulatory compliance. Devise a streamlined process for modifications of existing state and local permit requirements so that nature-based stormwater strategies can be used to obtain regulatory compliance.
   b. Add guidance to stormwater design manuals on the appropriate uses of nature-based strategies to address compliance issues with its existing permits.
   c. Add guidance to stormwater design manuals on how best to use nature-based stormwater strategies to retrofit existing land uses that may or may not have existing stormwater permits.
2. Prioritize the locations and types of nature-based stormwater strategies that can be used to retrofit existing land uses whenever a watershed management and restoration plan is prepared or updated.
3. Expand the use of nature-based stormwater strategies by state and local agencies when retrofitting government-owned existing properties, especially capital improvements already being undertaken.
   a. Consider nature-based approaches first when upgrading, updating, or redeveloping existing government facilities.
   b. Educate the public about nature-based stormwater strategies by incorporating these practices into facilities that are frequently visited by the public, such as government office buildings, parks, boat ramps, schools and beach access areas. Include educational signage and exhibits in these retrofit projects to spread public awareness and use of these strategies.
4. Allocate state resources and secure significant additional financial resources to finance retrofit projects that use nature-based stormwater strategies.
   a. Develop and identify significant new sources of federal, state and local funding to support retrofit projects that reduce flooding, improve water quality and reduce economic disruptions by achieving "hydrologic matching."

b. Direct federal and state disaster mitigation funding to plan, design and install nature-based stormwater strategies as part of recovery programs.
c. Adopt policies within all state-administered financial assistance grant and loan programs used to acquire and retrofit public lands and infrastructure that promote the use of nature-based stormwater strategies.

Working Lands

1. Working lands already serve nature-based stormwater functions to significantly reduce flooding and improve water quality. Additional funding should be secured for financial support and incentives to owners of working lands to maintain the working landscape of South Carolina and its many natural services.
    a. Promote the use of forest and agricultural products to maintain and expand these markets so that landowners have strong economic returns from their working lands. Develop a partnership between trade organizations, conservation interests and academic institutions to help with this outreach effort.
    b. Increase economic incentives from local, state and federal sources to landowners, including industrial owners, to preserve wetlands within forest lands, and to preserve forested and agricultural floodplains. Support ongoing efforts to identify forest lands that are a high priority to maintain and determine financial assistance or economic incentives needed to keep these lands working.
    c. Integrate efforts to maintain working lands into a state watershed management program. Secure additional funds to support technical, legal and financial assistance to integrate efforts to maintain working lands through watershed management strategies designed to reduce flooding and improve water quality.
2. Pursue strategic partnerships and regional planning to protect, restore or replicate natural hydrology on working lands that provide mutual benefits to landowners and the state.
    a. Continue and expand watershed level initiatives to identify and maximize strategic opportunities that provide water quality and flood reduction benefits to local and downstream communities. Seek to incorporate watershed initiatives with other ongoing landscape level programs that have different but compatible benefits.
    b. Create opportunities to hold more water on working lands to provide downstream benefits while compensating for potential crop loss due to the additional water being held on these lands.
    c. Using the most up-to-date projections available, determine where production zones for working lands may change due to climate change to inform agricultural management, land use and conservation decisions.

Integrated Stormwater/NNBS Planning Examples and Resources from South Carolina:

- Low Impact Development in Coastal South Carolina: A Planning and Design Guide -- http://northinlet.sc.edu/lid/

  Ellis, K., C. Berg, D. Caraco, S. Drescher, G. Hoffmann, B. Keppler, M. LaRocco, and A.Turner. 2014. Low Impact Development in Coastal South Carolina: A Planning and Design Guide. ACE Basin and North Inlet – Winyah Bay National Estuarine Research Reserves, 462 pp.

- The City of Charleston updated its Stormwater Design Standards Manual in 2020. Updates to the 2020 manual include:
  - Incentivize green infrastructure
  - Design for future sea level rise
  - Develop to mimic natural systems
  - Design for bigger rainstorms
  - Add special rules for areas with flooding

  The City allows for use of the LID manual cited above in its stormwater manual. This helps design firms not have to reinvent the wheel when doing City of Charleston work that uses LID/GI approaches.

- Smith Branch Watershed Assessment, Columbia, SC
  A good example of a watershed level management plan that led to implementation of nature-based project.

Integrated Stormwater/NNBS Planning Examples and Resources from other states:

- **Norfolk, VA** - Ohio Creek integrated coastal and stormwater flood mitigation ($112m construction/NDR funding)
  - *Construction completed this year*
- **Hampton, VA** – Environmental Impact Bond (EIB) projects for stormwater mitigation, part of a larger Resilient Hampton plan ($12m construction)
  - *3 EIB projects currently at 90% design/engineering; Resilient Hampton completed 2017*
- **Gretna, LA** - Gretna City Park stormwater demonstration project, diverting/storing/treating neighborhood runoff, part of a larger regional LA SAFE adaptation strategy ($5m construction value, $2m regional planning effort/NDR funding)
  - *LA SAFE strategy completed 2018, City Park under construction, tentative Dec '22 opening*
- **New Orleans, LA** – Greater New Orleans Urban Water Plan, oldie but goodie, a regional paradigm shift from gray to green, and Mirabeau Water Garden, will be the first large-scale green infra. project of the plan to break ground (Water Plan $2.5m, Mirabeau $15m construction/HMGP & FEMA funding)
  - *Water Plan completed 2013, Mirabeau preparing to bid for construction*