Plan Integration *for Resilience* Scorecard GUIDEBOOK

How to spatially evaluate networks of plans to reduce hazard vulnerability

Acknowledgements: This material is based upon work funded by the U.S. Department of Homeland Security, Coastal Resilience Center under Award Number: 00313690. The views and conclusions contained in this document are those of the authors and should not be interpreted as necessarily representing the official policies, either expressed or implied, of the U.S. Department of Homeland Security.

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October 2017

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Executive Summary

Communities are often overwhelmed by their own plethora of plans, many of which are inconsistent and lack integration to effect increased resiliency. Now, communities have access to a collaborative spatial plan evaluation tool.

The Plan Integration for Resilience Scorecard reveals and provides a mechanism for communities to discuss inconsistencies across a community's network of plans. For instance, a hazard mitigation plan may call for acquisitions and buy-outs in high-hazard areas, while the comprehensive plan may set goals to increase investments in the same location. This is commonplace across communities struggling with how to reduce hazard vulnerabilities. Communities working toward resilience continue to face significant challenges, including:

1) Cities have a "plethora of plans problem" – they are swimming in plans. Even communities with 10,000 people have at least four plans. When we see larger cities with more than 15 plans, there is unlikely to be a coordinated effort, particularly toward resilience.
2) Cities often have no collaborative process to understand that the various policies within plans are pulling in different directions which negatively affects vulnerability.
3) Cities usually have little spatial understanding of how policies affect areas of a community, let alone their effects on hazard resilience.

The Plan Integration for Resilience Scorecard addresses these challenges. Creating a Plan Integration for Resilience Scorecard is a three-phase process.

- First, hazard zones and planning districts (i.e. neighborhoods) are defined and mapped, creating neighborhood-scale units for improved analysis.
- Second, documents in the community's network of plans are evaluated and scores are given to districts for each policy that (a) influences land use, (b) affects vulnerability, and (c) can be spatially assigned. Scores are then summed for each district-hazard zone. Higher scores indicate greater policy focus on reducing vulnerability. Negative scores indicate that the

sum of applicable policies may actually increase vulnerability.

- Finally, physical and social vulnerability are determined for each of the districts and compared to policy scores. This additional analysis demonstrates how well policies target areas of the community that are most vulnerable.

The outcomes include a change in the depth of understanding of planners and community staff, a change in plans to increase their integration, and a change in development policy tools, all of which result in a positive effect on vulnerability outcomes. When the resilience scorecard process is overlaid with a physical and social vulnerability assessment, communities can better set priorities, implement wise decisions, and focus on smart investments.

After applying the Plan Integration for Resilience Scorecard method in a diverse sample of coastal cities, it is evident that conflicts exist within many community networks of plans, and that strong policy scores do not always align with areas of greatest need. Even communities with high overall plan scores exhibit some inconsistencies within their plan networks and mismatches between policies and vulnerabilities.

This spatial plan evaluation can provide planners and decision-makers with the motivation and information they need to better integrate their network of plans and more effectively build resilience throughout their communities.

CHAPTER 1

INTRODUCTION

Prior to Hurricane Sandy, a New Jersey city's hazard mitigation plan called for acquisitions and buy-outs in high-hazard areas, while the comprehensive plan set goals to increase investments in the same location. These plans were not only incompatible, but actively increased vulnerabilities. Unfortunately, this is commonplace in planning practice as local plans—whether comprehensive plans, hazard mitigation plans, small area plans, or functional plans—lack the integration required to address vulnerability to hazards. This guide will provide a step-by-step approach to evaluate your community's network of plans to understand contradictory policies which increase vulnerabilities. The Plan Integration for Resilience Scorecard provides a mechanism to discuss prioritization of community investment with leadership, stakeholders, and the 'whole community'.

Why are plans contradictory?

Even in small communities, and particularly in large communities, there are a variety of local departments and agencies. Within those departments and agencies there may be competing interests and priorities or changes in elected officials and turnover of staff. Sometimes, despite our best intentions, we find ourselves specializing in a particular area, so much so that we rarely interact with the sometimes daunting complex web of city departments and agencies. Whether it's lack of resources or lack of time, communities can easily find themselves 'siloed'. For instance, a planning department may not consider hazards during development review or the emergency management office may not influence planning and development management. For a community to holistically think about resilience, hazards must be considered in every part of community visioning, planning, and development. This horizontal misalignment of planning initiatives (across community-level departments) pulls priorities and investments in different directions.

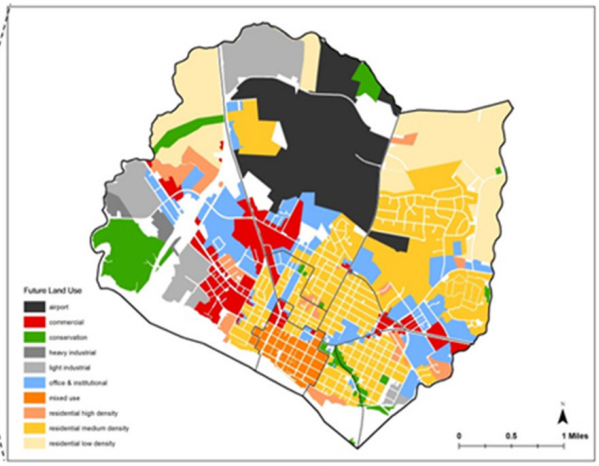
Yet, in planning for hazards, all departments and their associated plans and projects should consider the long-term impacts of development. As seen in Figure 1.1, some plans—such as land use plans, comprehensive plans, or general plans—point to policies and strategies based on administrative boundaries or cultural districts (i.e. Central Business District or downtown). Other plans—such as hazard mitigation plans—develop policies and strategies based on hazard geographies (i.e. 100-year floodplain or flood-prone areas) (Figure 1.1).

Instead of planning in isolation, the Plan Integration for Resilience Scorecard reveals spatial incongruities in planning policies by mapping and overlaying:

- Planning districts with
- Hazard Zones

Figure 1.2 conceptually illustrates spatial data layering and how policies within plans that refer to specific areas intersect to impact a community. Here, we layer planning districts, current and future hazard zones, and conservation areas, which yield scores that reveal increasing or decreasing vulnerabilities.

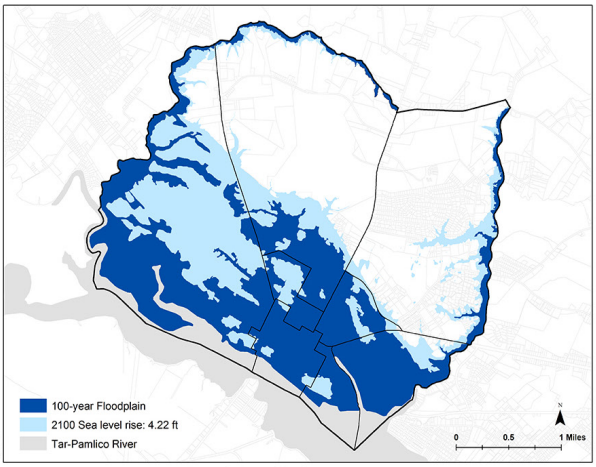
2023 Comprehensive Plan



Future Land Use

Policy 1 Increase and bolster the number of key destinations near the **downtown** and waterfront to provide multiple components and uses catering to different audiences.

Beaufort County Multi-Jurisdictional Hazard Mitigation Plan



Hazard Zone& Planning District

Policy A Strengthen controls on development within **flood-prone and wetland areas** by improving existing ordinances, such as the erosion and sediment control ordinance, zoning ordinance, subdivision ordinance, flood plain regulations and other development regulations.

Figure 1.1: Oftentimes plans are developed in isolation of one another, where a comprehensive plan (top) might not reference hazards and the hazard mitigation plan (bottom) does not reference land use and components of the built environment.

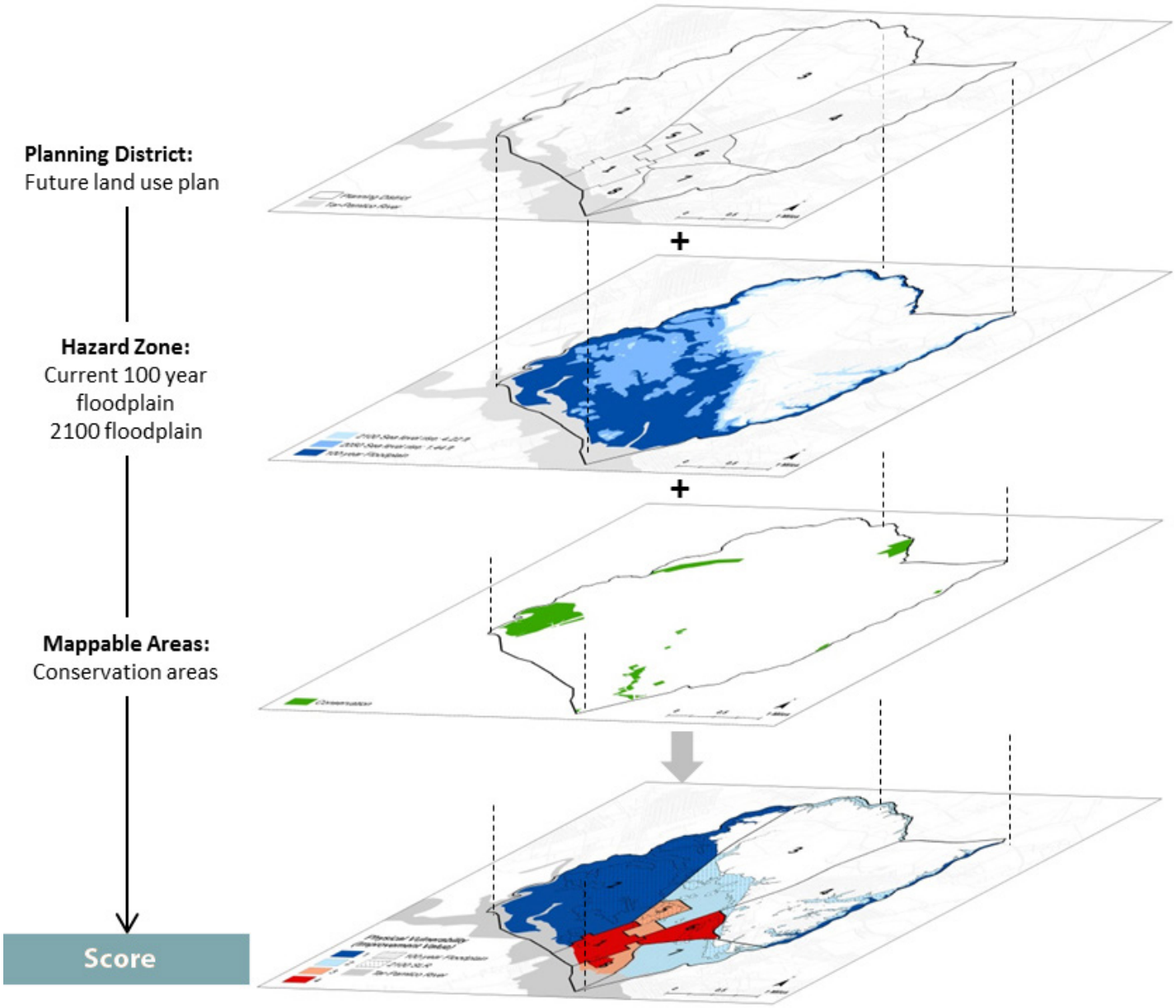


Figure 1.2: Overlay Planning Districts with Hazard Zones. Here we overlay planning districts, hazard zones, and other 'mappable policies', such as conservation areas, to generate scores. The overlay reveals hotspots and areas of plan conflict or alignment.

Disaster Mitigation Act of 2000

The Disaster Mitigation Act of 2000 (DMA) requires all local governments to adopt hazard mitigation plans approved by FEMA to be eligible for federal pre- and post-disaster mitigation funds. For the first time, federal policy shifted to a more proactive approach—hazard mitigation.

NRC believes a resilience scorecard is "essential if communities want to track their progress toward resiliency" and "target efforts where they most need to improve."

Planning and Resilience

Resilience is "the ability to prepare and *plan for, absorb, recover from,* and more successfully *adapt* to adverse events."[1] A resilient community can bounce back from a disaster, learn from past mistakes and adapt to new conditions. We know planning - specifically preventative land use planning- plays a strong role in reducing vulnerability to hazards.[2] Land use approaches can guide new growth to locations outside of current and future hazard zones. In fact, when plans have land use goals and policies that focus on reducing disaster losses, governments are more likely to adopt ordinances or invest in infrastructure,[3] encourage households to reduce their risk,[4] and reduce property damage from hazards.[5]

Because of the Disaster Mitigation Act of 2000, emergency managers are the primary planners to develop local hazard mitigation plans. It is important to note, when emergency managers and land use planners work alongside one another to develop mitigation plans, plans are more likely to include land use policies and other preventative approaches.[6] Within the current guidance, FEMA recommends certain planning approaches and intergovernmental coordination to develop local hazard mitigation plans. A strong interdisciplinary connection between local planners with place-based knowledge can increase the incorporation of land use policies into plans.[7] In essence, communities that plan together are better equipped to handle a disaster when it strikes and are considered more resilient.

Goals of the Plan Integration for Resilience Scorecard

To address concerns of inconsistent plans, the National Research Council (NRC) recommended the development of a resilience scorecard in 2012. The NRC believes a resilience scorecard is "essential if communities want to track their progress toward resiliency" and "target efforts where they most need to improve."[8] There are a number of resilience indicators, tools, and scorecards available to assess community resilience (see full list in Appendix).[9] While some resilience

1 National Academies 2012, p.1. Many relevant organizations adopted this definition of resilience in the "Industry Statement on Resilience" https://c.ymcdn.com/sites/www.nibs.org/resource/resmgr/Docs/StatementonResilience.pdf.
2 NRC 2006, 2014
3 Berke et al., 2006; Burby & May, 1997
4 Horney, Simon, Grabich, & Berke, 2015
5 Burby 2006; Nelson & French, 2002
6 Lyles, 2015
7 Lyles, Berke & Smith, 2014
8 National Research Council, 2014
9 Cutter, Susan. (2015). The landscape of disaster resilience indicators in the USA. Natural Hazards 80:741-758.

scorecards look at community capacities, other scorecards address economies, infrastructure, and other components of the built environment.[10] Still other scorecards look at community plans and mitigation measures.[11] **The Plan Integration for Resilience Scorecard is the first to evaluate the integration of networks of plans.**

A community's network of plans are cornerstones because they 1) represent the community's vision, 2) set goals, and 3) guide community development, actions, and policy decisions. The Plan Integration for Resilience Scorecard aims to:

1. Identify incongruities within networks of plans. The scorecard will uncover compatibility and harmony between plans that reduce vulnerabilities. Plan incongruities may exacerbate existing vulnerabilities or create new vulnerabilities, both physical and social. By identifying incongruities overlaid with hazards and physical and social vulnerability, communities can prioritize resilience projects with multiple co-benefits to strengthen areas with the greatest risk. Ultimately, the scorecard will reveal unforeseen opportunities to create better aligned plans.

2. Help "integrate and improve local plans in ways that reduce losses from hazard events." [12] The NRC recommends focusing on land use strategies and tools to mitigate hazards in the long-term.[13] Researchers have long discussed the positive impacts land use policies have on reducing vulnerabilities.[14] The Plan Integration for Resilience Scorecard evaluates land use plans, but also all the plans that spatially influence a community to encourage comprehensive preparedness and mitigation.

3. Provide communities developing new plans or updating existing plans with a guidance framework to reduce future hazard exposure through smarter and more consistent policies. The methodical approach can be used to monitor and assess progress of the coordination of networks of plans for hazard vulnerabilities. A community can also evaluate the progress and performance of resilience investments and ensure continuity of decisions.

4. Provide a validated tool to address on-the-ground needs and build capacity. Each community has a specific set of challenges and opportunities. The results from the evaluation can facilitate meaningful conversations with stakeholders and residents about new policy priorities or areas to invest.

Aligning with Other Initiatives

The scorecard is aligned with FEMA's 2013 *Local Mitigation Planning Handbook* and is the next generation of FEMA's 2015 *Plan Integration: Linking Local Planning Efforts*. In addition, it aligns with the Community Rating System (CRS) Activity 510, floodplain management planning. The scorecard is not meant to be used in isolation, but as a tool to better reveal congruities and priorities for wise decision making and investments. In fact, the scorecard is complementary to many available plans, funding, and technical assistance (See Table 1.1). For instance, the Community Resilience Planning Guide developed by the National Institute for Science and Technology (NIST) refers to the need for an assessment of plan integration prior to developing the resilience plan it describes. The Plan Integration for Resilience Scorecard can and should be integrated into initiatives, funding opportunities, and other planning efforts your community may already be pursuing, specifically:

10 Cutter, Susan (2015)
11 Cutter, Susan (2015)
12 Berke, Philip, G. Newman, J. Lee, T. Combs, C. Kolosna, D. Salvesen. (2015). Evaluation of networks of plans and vulnerability to hazards and climate change: a resilience scorecard. Journal of the American Planning Association, 81:4, 289.
13 National Research Council, 2014
14 Burby et al., 1999; Burby, French, Cigler, Kaiser & Moreau, 1985; Godschalk, Kaiser, & Berke, 1998; Berke et al., 2006; Burby & May, 1997.

Table 1.1 Examples of Plans, Funding and Technical Assistance that aligns with the Plan Integration for Resilience Scorecard

	Agency	Plan	Funding	Technical assistance
Consolidated Housing Plan (CHP) and Annual Action Plans (AAP)	HUD	X		
Hazard Mitigation Plan [Preparedness Grants, Hazard Mitigation Grant Program, Pre-disaster Mitigation Grants, Flood Mitigation Assistance]	FEMA	X	X	
Community Rating System	NFIP		X	
Community Resilience Planning Guide	NIST	X		
Habitat Management Plan (HMP) and Annual Habitat Work Plans (AHWP)	USFWS	X		
State Wildlife Action Plans (SWAP), aka Comprehensive Wildlife Conservation Strategies [Wildlife Conservation and Restoration Program (WCRP) funds; State and Tribal Wildlife Grants (SWG) program]	Congress by Conservation and Reinvestment Act of 2000	X	X	
Coastal Zone Management Program (CZMP) [Coastal Zone Enhancement Program; Coastal Nonpoint Pollution Control Program]	NOAA		X	
Forest Plan (Land Management Plan)	USFS	X		
Endangered Species Recovery Plan	NOAA	X		
Climate Action Plan (focusing on adaptation, mitigation, and/or resilience)	NA	X		
Historic Preservation Planning Program	NPS	X		
National Conservation Innovation Grants	NRCS		X	
NOAA Climate Program Office: Regional Integrated Sciences and Assessments (RISA) Program	NOAA		X	
Resilience AmeriCorps	CNCS			X
Resilience Dialogues	USGCRP			X
Regional Integrated Sciences and Assessments	NOAA			X
Landscape Conservation Cooperatives	DOI			X
Regional Climate Hubs	USDA			X
Climate Adaptation Community of Practice	USGCRP			X
Clean Water State Revolving Fund (CWSRF)	EPA		X	
Fostering Advancements in Shipping and Transportation for the Long-term Achievement of National Efficiencies (FASTLANE)	DOT		X	
Sustainable Communities Initiative	HUD		X	

- Plans- there are several required and voluntary plans your community may have or choose to develop which can be evaluated as part of this process.
- Funding- there are opportunities to leverage the plan integration evaluation as a foundational assessment to identify needs.
- Technical assistance- you can utilize technical assistance to help complete the plan integration evaluation as a foundational step to understanding needs.

Table 1.1 provides examples of existing initiatives that can be aligned with the Plan Integration for Resilience Scorecard to capitalize on and strengthen planning efforts. Detailed descriptions can be found in Appendix A.

How the Plan Integration for Resilience Scorecard was Developed

The research team evaluated a randomly sampled, geographically dispersed, and variously sized set of coastal communities (Washington, NC; Fort Lauderdale, FL; League City, TX; Boston, MA; Tampa, FL; Asbury, NJ). Each city's network of plans was analyzed and assigned scores to land policy districts, as well as evaluated based on physical and social vulnerability. Collectively, these scorecards helped refine the tool and evaluation process. Then, over several months, the research team 'translated' the research methodology into a user-friendly guidebook for practitioners.

Advisory Board

To validate the tool, the research team invited subject matter experts to participate on an advisory board. The advisory board is composed of hazard planning practitioners from the newly formed Hazard Mitigation and Disaster Recovery Planning Division (HMDR) within American Planning Association (APA). HMDR promotes professional learning and communication about making communities safer from natural and man-made hazards and planning for recovery from disasters. HMDR is a group of more than 300 volunteers within APA. It also features a contact list of more than 400 affiliate members (no dues, mostly non-planners) in related fields concerned with mitigation and recovery.

Advisory Board Members:

- Allison Hardin, CFM- City of Myrtle Beach, Planner and Coastal Hazards Education Specialist
- Barry Hokanson, AICP- PLN Associates, President of the American Planning Association Hazard Mitigation and Disaster Recovery Division (APA-HMDR)
- Chad Berginnis, CFM- Association of State Floodplain Managers, Executive Director
- Darrin Punchard, AICP, CFM- Punchard Consulting
- Gavin Smith, PhD- University of North Carolina, Professor; US Department of Homeland Security's Coastal Resilience Center of Excellence, Director
- Jennifer Ellison- City of Urbandale, Community Development Director
- Matt Campbell- FEMA, National Coordinator for Community Recovery Planning and Capacity Building Recovery Support Function
- Michele Steinberg, National Fire Protection Association, Wildfire Division Manager
- Rich Roths- URS Corporation, Principal Planner

Pilot Communities Staff:

Norfolk, VA Staff:

- George Homewood, FIACP, CFM- Director of City Planning
- Paula Shea, AICP- Principal Planner
- Jeremy Sharp, AICP- Principal Planner
- Steven Pyle- Assistant Emergency Manager
- Matt Straley- GIS Coordinator
- Katerina Oskarsson, Deputy to the Chief Resilience Officer of 100RC

Pilot Communities

After the scorecard guidebook was validated by practitioners, we began recruiting vulnerable cities as potential pilot communities to test the scorecard and guidebook. The following includes the selection criteria for the pilot community participation:

- Population of less than 250,000
- Coastal community with potential for sea level rise
- Networks of plans
- A need for a tool or process for updating a plan
- Leadership and staff in position (planner, emergency manager, etc.)
- Communities positioned to leverage partnerships with other agencies (i.e., HUD, FEMA, EDA, EPA, RPC/EDD, USACE, NIST, USDA, etc.) and NGOs, VOADs, etc. to achieve mutual aims.
- With guidance from the research team, pilot communities commit to:
  - Assemble a team of stakeholders and key informants familiar with local planning documents
  - Receive training on how to apply the Resilience Scorecard to the local network of plans
  - Score their own network of plans with technical assistance from the Scorecard Team

Norfolk, VA

Norfolk, VA was selected as a pilot community. Norfolk is a good fit because of:

- Their exposure to sea-level rise and the 100-year floodplain
- Their pursuit to be a "model community on resilience"
- Their Vision 2100 Plan (which looks at sea level rise in 2100)
- The potential for strong networking of multiple local government agencies to influence plan quality and integration, particularly across jurisdictional lines

How to Use this Guidebook

The guidebook and scorecard should be used by practitioners to understand how existing local plans are coordinated, allowing them to address hazard-prone areas and serving as a guide to improve future plans and policies. The scorecard should be used over time to improve and gauge progress in reducing vulnerabilities in current and future hazard zones.

Throughout the guidebook, we use the city of Washington, North Carolina as an example community. Sidebars and maps describe policies, plan inconsistencies and compatibilities, and other anecdotes we uncovered while evaluating the network of plans:

- *2023 Comprehensive Plan: Washington, NC (2013)* – provides detailed land policy guidance (i.e. density and types of land uses and location, timing, and capacity of infrastructure) and a context for decision-making
- *City of Washington, North Carolina CAMA Core Land Use Plan (2007)* – land use plan adopted to fulfill the requirements of North Carolina's 1974 Coastal Area Management Act (CAMA) by establishing policies and guidelines related to the management of coastal areas, including economic development and the protection of natural resources
- *Beaufort County Multi-Jurisdictional Hazard Mitigation Plan (2010)* -- county-level hazard mitigation plan, developed to coordinate local disaster prevention and response and to fulfill the requirements of the federal Disaster Mitigation Act of 2000. While a more recent hazard mitigation plan has been approved since the scoring of these plans, we will still use the 2010 plan as an example for scoring throughout the guidebook
- *City of Washington Parks and Recreation Comprehensive Master Plan (2011)* -- park plan developed to improve recreational opportunities and quality of life in Washington

Define your Community

In this guide, the term community refers to governmental jurisdiction such as a town, city, or county. Depending on your state and the authorities granted by the state, you may choose various scales to conduct the evaluation. For instance, in some states planning is handled by the county, where smaller municipalities look to counties for planning needs. In other states, the state itself coordinates local hazard mitigation planning efforts through guidance, review, and approval, where smaller municipalities develop the city-specific sub-plans. In still other states, counties have very little authority as far as enforcing ordinances, but they can lead planning initiatives. Additionally, in other parts of the country, regional planning agencies play a large role in hazard mitigation planning development. Knowing the different political dynamics in your state will yield an appropriate community scale for plan evaluation. Within this guidebook, communities are municipalities or city governments.

Example Community : Washington, NC[12]

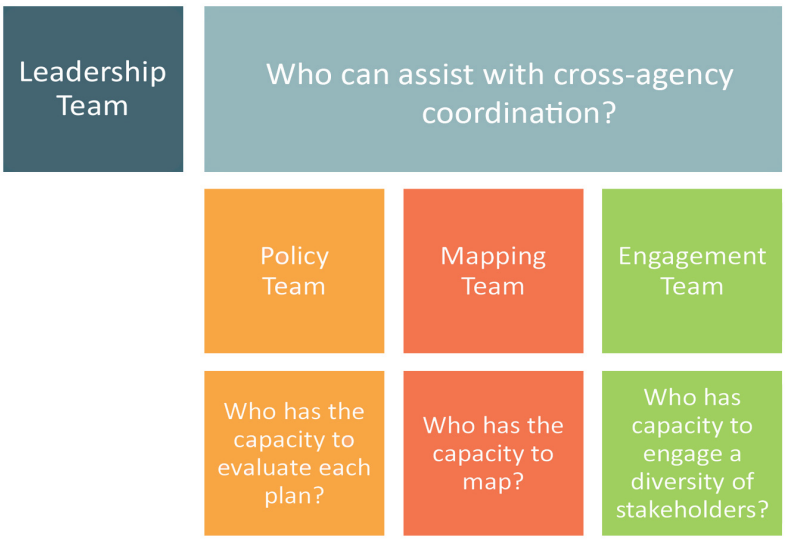
The colonial city of Washington is located in Beaufort County on the North Carolina coast. In 2010, the population was 9,074. Since the 1990s the economy has shifted toward tourism, and the population increased 1.7% between 2000 and 2010. The city's terrain averages about 10 feet above sea level, with slopes ranging from level to 4%; the city is exposed to several recurring natural hazards, including hurricanes, floods, and nor'easters. Flooding due to storm surge and sea-level rise are major threats because of the area's low-lying land and proximity to surface water.

Leadership and Forming Your Team

Once you have defined your community scale, form a leadership team and sub-teams. The evaluation of networks of plans cannot be conducted in silos. We recommend establishing a Leadership Team and sub-teams (depending on the community size and resources) to oversee the spatial plan evaluation. The primary goal of establishing teams is to communicate across departments or entities and understand the content within plans.

The Leadership Team should be composed of 2-4 people to guide plan evaluations and communicate results with stakeholders. The participants of the Leadership Team should include the persons that oversee planning initiatives or plans. The team should assist with cross-agency coordination and include a chief executive official to oversee "silo-busting." **The Leadership Team would ideally include the person responsible for the:**

- Hazard mitigation plan (typically the emergency manager)
- Comprehensive land use plan (typically the planning director, city manager, county commissioner, or other group)



Depending on the size and the number of plans in the community, other participants may be a good fit. We recommend local planners, emergency managers, engineers, community development department, public works, building departments, other local officials, and any other group, person, or agency with land use or emergency planning responsibility play a central role in applying the scorecard and in guiding communities to revise and improve plans. The key to establishing an effective team is the capacity and their ability to advocate for policy change. We recommend utilizing existing committees. For example, metropolitan planning organizations (MPO) or rural planning organizations (RPO), are planning groups required for federal transportation funding and might be a good place to start depending on capacity. You can also refer to already existing mitigation plan teams, recovery teams, and other existing teams when putting the scorecard teams together.

Larger Communities

If you are in a larger community, with many plans, departments, and agencies, the Leadership Team will coordinate and delegate tasks to sub-teams. The sub-teams include the Policy Team, Mapping Team, and Engagement Team. Participants of the Leadership Team should also participate on each sub-team. Others should be invited to the sub-teams depending on their background and expertise. In total, 6-12 participants should make up the three sub-teams.

Policy Team – have a general understanding of land use policies and should be comfortable identifying land use policies within different types of planning documents.

Mapping Team – be able to gather community maps and ideally have a general understanding of geographic information systems software (GIS). Local level maps are needed, as well as the ability to collect from other sources.

Engagement Team – develop a strategy to engage the public and other stakeholders to communicate the results of the Plan Integration for Resilience Scorecard. Using the physical vulnerability and social vulnerability maps, work with stakeholder groups to determine which areas in the community need more attention and an integrated policy approach.

Smaller Communities

We understand many communities have limited time, staff, and resources. If you are in a small city, like Washington, NC, with little staff support, the Leadership Team can take on all the roles and responsibilities of the sub-teams. Small city teams may only include 2-3 people. Smaller communities should also prioritize Chapters 1-3, which include the Policy Team, Mapping Team, and scoring the plans.

Time and Effort

Before you start, set aside staff time to complete the tasks. Table 1.2 breaks down the anticipated time to accomplish the full Plan Integration for Resilience Scorecard. Consider building the Plan Integration for Resilience Scorecard into consulting service fees when developing new plans or plan updates.

Box 1.1: Norfolk's Team

To facilitate the Plan Integration for Resilience Scorecard, the City of Norfolk (a city roughly 250,000 in population) developed a team of six members—the planning director, two planning staff within the department of city planning, one emergency manager, their resilience officer from the 100 Resilient Cities, and a GIS analyst. While all members participated in collecting policies within the plan, the main points of contact included one senior planner and the GIS analyst.

Table 1.2 Time commitment

Team Tasks (per plan)	Staff Time
Policy Team (Chapter 2)	2-12* hr. per plan (A large comprehensive or general plan typically takes the longest time. Most plans range from 2-4 hrs.)
Score Policies (Chapter 3)	2 hr. per plan
Total	*+/- 4 hr. per plan*
Team Tasks	**Staff Time**
Mapping Team (Chapter 2)	8 hr.
Physical Vulnerability (Chapter 3)	8 hr.
Social Vulnerability (Chapter 3)	8 hr.
Engagement Team (Chapter 4)	8-12 hr.
Total	*32-36 hr.*

Structure of the Guidebook

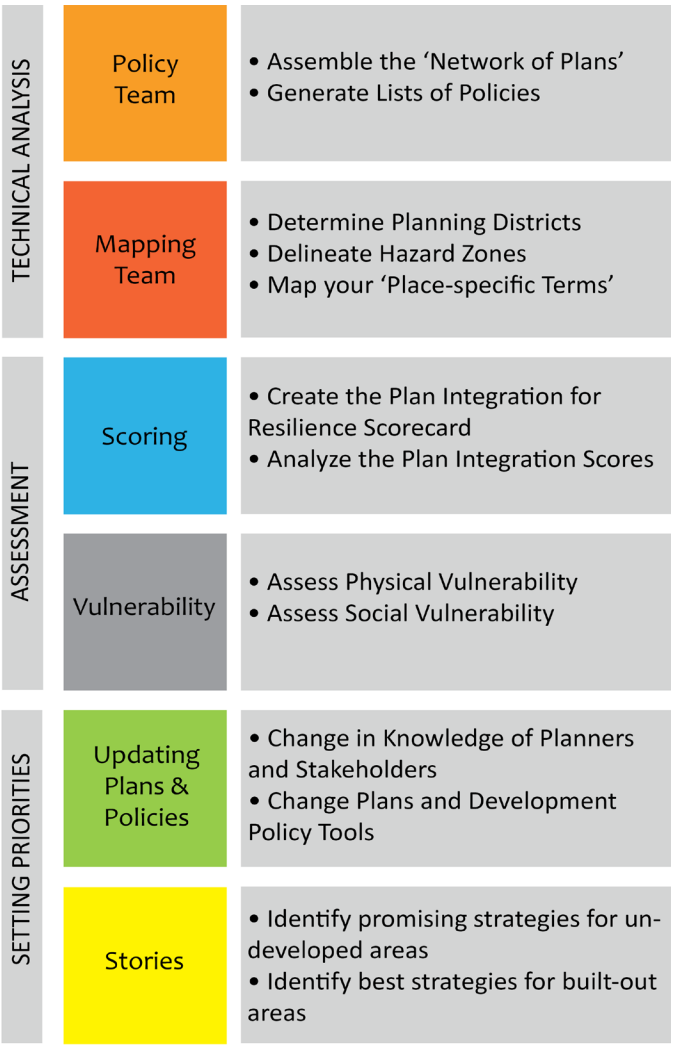
We recommend reading through the entire guidebook as you might read through a recipe, identifying ingredients, materials, and techniques needed to 'cook your meal'. Ask yourself: What plans and data are available? What people have authority to make land use or emergency planning decisions? What skillsets are needed?

The guidebook is broken into the following:

Chapter 2: Technical Analysis - With the Policy Team, gather all community plans and extract applicable policies. With the Mapping Team, use maps—digital, printed, or with geographic information systems (GIS) software—to overlay planning districts and existing and hazard zones.

Chapter 3: Assessment - Using the information from the Policy Team and the Mapping Team, score the policies based on whether they increase or decrease exposure in district-hazard zones and create tables and/or maps to compare planning districts. Then, to better understand the impacts on the district-hazard zone scores, assess the physical and social vulnerability. Compare maps with the scores map to reveal vulnerability hotspots.

Chapter 4: Setting Priorities - Once the technical analysis and scoring is complete, engage the whole community to determine community values and a plan-of-action going forward in light of new information. This may mean amending plans to minimize conflicts and taking advantage of opportunities revealed by the evaluation. Finally, learn from other communities' plan integration stories in preparation for your story.



CHAPTER 2

TECHNICAL ANALYSIS

Evaluating and mapping community policies within the network of plans is a technical analysis and the bulk of the work for the Plan Integration for Resilience Scorecard. The network of plans is all the plans within your community among different departments or agencies including the comprehensive plan (or general plan), hazard mitigation and disaster recovery plan, area plans, and/or functional plans. In order to understand the integration of such varying plans, perform a technical analysis of 1) policies within community planning documents (Policy Team) and 2) the spatial relationships of policies (Mapping Team). The technical analysis will take the majority of your time and will prepare you for the next step, 'Scoring' (Chapter 3). A conceptual diagram of the process can be seen in Figure 2.1.

POLICY TEAM

Checklist:

- Assemble the 'Network of Plans'
- Generate lists of applicable policies

The Policy Team should have a general understanding of land use policies and should be comfortable identifying policies within different types of planning documents. We recommend at least two staff for the Policy Team in order to discuss applicability of each policy for the spatial analysis.

OBJECTIVES:

- Gather all planning documents in the community
- Develop list of all policies (or policy-like language, see Box 2.1) within all planning documents and place in scorecard

MATERIALS REQUIRED:

- Community plan documents
- Plan Integration for Resilience Scorecard

SKILLS RECOMMENDED:

- Ability to identify policies
- Ability to identify place-specific terms within policies
- Ability to link policies to the impacts of hazard vulnerabilities
- Ability to identify policy tools within policies

Task 1: Assemble the 'Network of Plans'

First, gather as many community planning documents as possible. We suggest validating plans with the leadership team and other departments to ensure all relevant documents are included. Focus your attention on city- and county-level plans. State-level plans are not considered for this analysis and regional-level plans may be considered if specific to the community.

Figure 2.1: Gather plans and list policies. These four plans were gathered from Washington, NC. Each plan was scanned for policies—how they increased or decreased vulnerability and integrated or in conflict. The scorecard will answer: How well are different plans in your community integrated? Are there policies within your plans that contradict and exacerbate disaster vulnerability?

2.1.1 Plan Document Types

The types of plans to include in the evaluation are all plans that govern land use and development in hazard areas. Typically, community planning includes a comprehensive or general plan. Of all the plans that local governments prepare, the comprehensive or general plan deals most directly with how and where development will take place. The hazard mitigation plan is also a very common planning document adopted by local governments (though it may be county- or metro-wide in scale, which is acceptable). Such plans were mandated by the Disaster Mitigation Act of 2000 as a requirement for communities to become eligible for federal pre- and post-disaster mitigation funds. It is important to note that FEMA has recently placed more emphasis on the integration of land use tools with mitigation planning.[15]

Other stand-alone plans might also influence development within hazard zones, such as 'area' plans that focus on a particular area (i.e. downtown district or a waterfront development). Transportation and infrastructure plans, park and recreation plans, or wildlife habitat management plans, can and should complement hazard mitigation plans. Other 'functional' plans can include economic development plans, housing consolidated plans, etc. Capital improvement plans also influence where development will occur and can actively steer development away from hazard zones with disinvestment. Some examples of potentially applicable plans are included in Table 2.1.

2.1.2 Plan Criteria

As you are gathering plans make sure they contain policies or policy-like language (see Table 2.5 and Table 2.6) that meet the following criteria:

- Plans should still be relevant; that is, they should be relatively recent (produced or updated within the past 10 years) and/or should still influence policy decision-making
- Area plans must (at least partially) intersect with a designated hazard zone (See Table 2.1). If the subject of an area plan is located entirely outside of hazard zone, it is less likely to be at risk and therefore should not be included in this analysis.
- Consider plans which impact the way a community grows or develops referring to spatial aspects of a community.

Double Check:

Be sure to double check with local and regional departments to ensure plans are not left out. Even a thorough initial search may miss some plans. You may want to circle back and contact specific agencies.

15 FEMA, 2013, 2014.

Table 2.1 Examples of Types of Plans in a Community's 'Network of Plans'

Plan Type	Purpose	Contribution (+/-) to Vulnerability
Comprehensive/General Plan	Main community planning document	Policies can guide future development into or away from hazard zones.
Hazard Mitigation Plan	Reduce long-term risk to human life and infrastructure	Advocates vulnerability reduction and resiliency building, often via general policies or specific "action items"
Disaster Recovery Plan	Address disaster recovery related needs to be activated during recovery	Advocates vulnerability reduction and resiliency building post-disaster. Coordinates agencies to assist people post-disaster.
Area Plans:	Address planning issues pertaining to a portion of the community	Targeted policies may increase or decrease vulnerability, depending on purpose and location. Area plans may also contribute to policy district delineation.
Downtown (Redevelopment)		
Small Area/Neighborhood/ District		
Waterfront		
Corridor Plan		
Functional or Sector-specific Plans:	Focus on individual or related functions or sectors in need of specialized planning	Individual plan policies (or objectives, action items, etc.) may increase or decrease vulnerability, and are often distinct from those found in comp or hazard mitigation plans. Applicability to individual policy district may be aided by additional function/sector maps.
Transportation (or Transit)		
Parks / Open Space		
Economic Development		
Environmental Management		
Climate Adaptation/Mitigation		
Housing (Consolidated/Strategic)		
Wildlife Management		
Wildfire Protection		

Task 2: Generate Lists of Policies

In order to generate policy lists for each community plan, thoroughly read each plan and compile lists of potentially applicable policies and place within scorecard (see Appendix C for scorecard spreadsheet). For many plans, policies will be plainly labeled; for others, they may be labeled as 'objectives' or 'action items' (or may simply exist as policy-esque language in the document's narrative). Because of their unique role within the network of plans, hazard mitigation plans typically contain action items rather than 'true' policies. Action items are discussed in section 2.2.3. In many ways, determining a plan's applicable policies is as much an art as it is a science – remain flexible and responsive to the variation of your community's plans. Ideally, two people should independently compile lists to later compare and discuss. Place applicable policies within the scorecard spreadsheet found in Appendix C. You can organize your scorecard based on recommendations in Box 2.1.

To be applicable for spatial plan evaluation, a policy should include all the following criteria of the three-point test for policy inclusion:

(1) Contain at least one mappable, place-specific term;
(2) Potentially reduce or increase vulnerability to hazards; and
(3) Contain a recognizable policy tool, or a form of government intervention to achieve specific objectives and outcomes. Descriptions of policy tools are provided in Table 2.4.

2.2.1 Identify Place-specific Policies

Read through each plan and generate a list of all the **place-specific policies**. Policies that are considered 'place specific' are those which contain at least one **place-specific term** that can be (or preferably that already has been) mapped within the community. Place-specific terms can include:

- Cultural or administrative areas, e.g. 'downtown' or 'the riverfront';
- Geographic features, e.g. 'wetlands' or 'Main Street'; and even
- Individual buildings, e.g. 'repetitive loss structures' or 'critical facilities'.

To illustrate this concept, we use an example from Washington, NC. Several policies in the comprehensive plan refer to the same specific place: conservation areas. In this case, 'conservation areas' were well-defined in the plan as park land or other preserved areas. As shown in Figure 2.2, policies referring to 'conservation areas' could be considered 'place-specif-

Types of place-specific terms:

Political or cultural areas
- Neighborhoods
- Commercial centers
- Cultural or recreational districts

Geographic features
- Natural areas
- Floodplains
- Conservation areas
- Rivers
- Streets

Individual buildings
- Frequently flooded structures
- Community facilities

ic.' The simplified map illustrates how community policies are often spatial due to their inclusion of place-specific terms that refer to mapped areas, features, or facilities. However, you will find some policies written in an aspatial way. Policies with no place specific term may not reference specific areas, features, or facilities and cannot be included in this spatial analysis. Examples of place-specific and non-place specific policies are shown and described in Table 2.2.

2.2.2 Identify Policies that Affect Vulnerability

The question of whether a policy will affect vulnerability is an important, though potentially subjective, one. The first thing to consider is whether the policy impacts an area exposed to hazards or an area within the hazard zone. Remember, this analysis is a spatial evaluation based on vulnerabilities, so be sure to gather policies that intersect

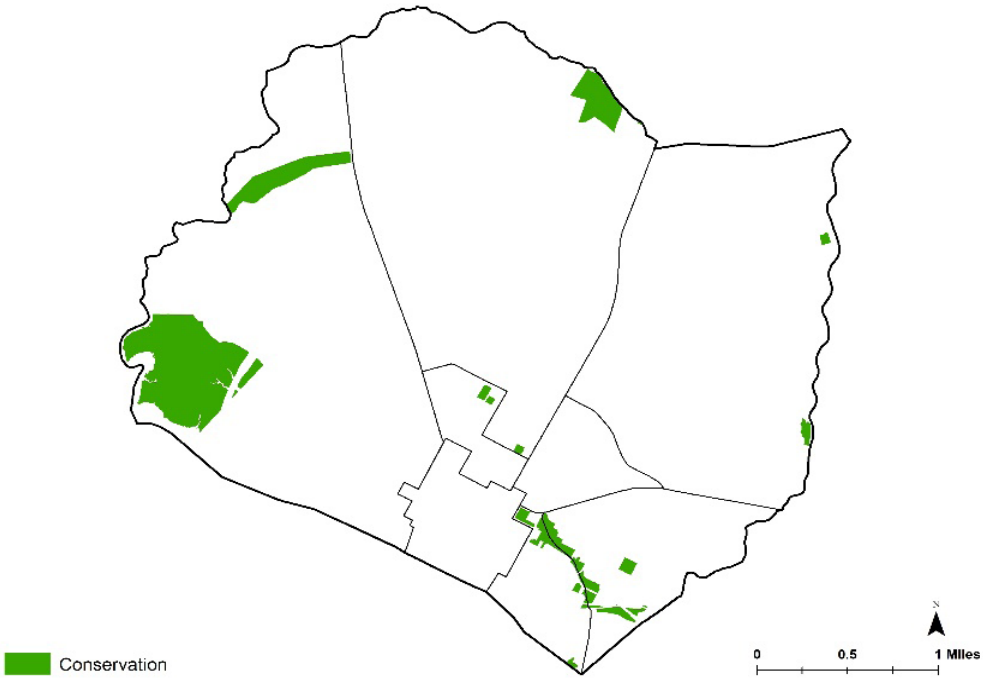


Figure 2.2 Map of conservation areas in Washington, NC (planning district boundaries also shown). Because the location of "conservation areas" is known – and is, in fact, mapped – we can spatially assign policies that reference such areas to the planning districts.

Table 2.2 Examples of Place-specific and Non-Place-specific Policies

Place-specific policy	Justification for inclusion
Strengthen controls on development within flood-prone and wetland areas by improving existing ordinances, such as the erosion and sediment control ordinance, zoning ordinance, subdivision ordinance, flood plain regulations and other development regulations. (2023 Comprehensive Plan, p. 46)	The floodplain and wetland areas can be identified and have been mapped within the community.
Assure that as changes are planned for improvements to the downtown and especially the waterfront area that consideration is given to access issues and to environmentally-friendly building techniques. (2023 Comprehensive Plan, p. 42)	The downtown and waterfront areas can be identified within the community.
Non-place-specific policy	**Justification**
Develop strategies that increase homeownership opportunities while also ensuring the City achieves an appropriate balance of other housing choices (rental housing, housing for the aged, etc.). (2023 Comprehensive Plan, P. 66)	While housing and residential land use can easily be mapped in a community, this policy is not mappable because it does not indicate the places in which homeownership should take place. If the policy would have specified the development of owner-occupied housing within a known hazard area, there would have been justification for including this policy within the scorecard.
Continue to pursue construction of greenways and walking trails throughout the community. (2023 Comprehensive Plan, P. 58)	While greenways and walking trails are mappable, this particular policy does not specify the location of future greenways and trails. If the policy had pointed to a specific plan or design of new trails, this policy would have been mappable. If the policy would have referred to the maintenance of existing greenways and trails this policy would have been mappable.

the spatial extent of a hazard. You might not know the hazard zones yet, but your Mapping Team will gather that data. If you are unsure whether the policy influences a hazard zone, it is better to include the policy and later it can be omitted if it does not impact hazard zones. Second, as you're reading the policies think about whether it might increase or decrease vulnerability. For instance, a policy from Washington, NC stated:

> Encourage higher-density multifamily development in pedestrian-oriented urban areas with access to transit, a broad range of services and amenities and access to employment to: ... (86)

This policy encourages greater residential population density in "pedestrian-oriented urban areas" (see Table 2.3). While certainly an effective new urbanist policy to increase walkability and reduce carbon emissions, if these areas are in hazard zones, this would increase the number of people and the amount of infrastructure in harm's way. You might find that many policies within your plans have good intentions, but may exacerbate hazard exposures.

Keep in mind, the Plan Integration for Resilience Scorecard is not just assessing whether your community is *in* or *out* of a hazard zone. In other words, the evaluation is not two-dimensional. If, for example, the above policy referred to higher density multi-family development in the same areas, but specified "vertical elevation of the residential floor above the base flood elevation" or "special building codes to withstand hazard impacts", this policy would decrease vulnerability. Be aware of these nuances, which are tweaks you can make to policies as you update or renew planning documents.

The Policy Team should work together to judge the potential effects of policies on vulnerability in the community. Table 2.3 presents examples of policies that ought to be included and excluded from the scorecard.

2.2.3 Identify Policies with a Policy Tool

The Policy tools are a set of techniques and form of government intervention to achieve specific objectives and outcomes. The inclusion of a recognizable policy tool is important, because a statement without such language – even if labeled a policy – is unlikely to be actionable. The literature is clear that a plan without policies has no "teeth" and limited ability to influence local legislation and decision making. Table 2.4 describes policy tools and definitions and are the basis for the policy tool categories and sub-categories in the first column of the Plan Integration for Resilience Scorecard spreadsheet found in Appendix C. The following policies from Washington, NC were included within the evaluation:

> **Permitted Land Use:** The city should discourage development in areas designated for light-density residential use with the exception of low-density residential/agriculture land uses (see Map 21). Because of its current land use patterns, rezoning and amendments to the future land use map should be carefully balanced with a demonstrated need for such proposed development that will be the overall best management policy for Washington's future land development. (p. 189)

> **Subdivision Regulations:** The city supports the enforcement of local controls and the efforts of state and federal agencies with regulatory authority to require development to be above the base flood elevation and comply with the NC State Building Code. (p. 203)

> **Density of Land Use & Cluster Development:** The City of Washington supports larger lots, decreased impervious surface areas, and cluster development in conservation classified areas and areas with low land suitability (see future land use map, Map 21) through enforcement of the city's subdivision and zoning ordinances. (p. 193)

Additionally, there may be policies within your plans that do not contain policy tools. For instance,

Table 2.3 Examples of Policies Likely and Unlikely to Affect Community Vulnerability

Policy likely to affect vulnerability	Justification for inclusion
Encourage higher-density multifamily development in pedestrian-oriented urban areas with access to transit, a broad range of services and amenities and access to employment to: ... (86)	This policy encourages greater residential population density in certain parts of the city; if some of these "pedestrian-oriented urban areas" are in hazard zones, this effectively increases the number of people and the amount of infrastructure in harm's way.
All proposed development adjacent to wetlands shall provide adequate buffers to protect wetlands and surface waters. (249)	In contrast, this policy encourages the establishment of adequate buffer zones which, while ostensibly for the purpose of protecting sensitive areas, also have the effect of limiting the amount of development in potentially hazardous areas.

Policy unlikely to affect vulnerability	Justification for exclusion
The city will capitalize on the Tar and Pamlico Rivers as community amenities for enjoyment by residents and visitors.	At first glance, this policy appears to encourage preservation of the rivers and their environs (which would have a positive effect on resilience), but it might also be interpreted as advocating increased use and investment in these "community amenities" (which may place more infrastructure and people in harm's way). Because of such ambiguity, this policy should be excluded.
Improve the infrastructure at city boat docks to increase visitation. Infrastructure improvement to include picnic tables, benches, boater bathrooms, a dock attendant's station, and other amenities near public ramps and waterfront destinations.	Although this policy advocates for greater investment in potentially hazardous coastal areas, the infrastructure improvements listed are generally water-oriented and therefore likely to be constructed in a resilient way, given the obvious potential for flooding.

Washington's plan stated:

> The City of Washington will protect waterfront/shoreline areas, historic district, and valuable scenic areas.

While a policy to protect such areas is laudable—and likely to result in greater community flood resilience – it offers no concrete tool or mechanism by which the city might go about protecting such assets (Table 2.5). Examples of policies containing and not containing policy tools are shown in Table 2.5.

The Case of Multiple Policy Tools in a Policy. As you read through your plans, you might find policies that describe multiple tools within one policy. Because each policy tool is considered a separate strategy to reduce vulnerability, you can include the policy multiple times under its respective policy tool sub-category. For instance, Washington's policy stated:

> Use techniques, which may include *clustering and transfer of development rights,* to protect environmentally sensitive areas.

This policy includes clustering and transfer of development rights and therefore can be placed under the Cluster Development sub-category of the Development Regulations category and under the Density Transfer Provisions category (see categories in scorecard spreadsheet of Appendix C).

The Case of Hazard Mitigation Plan "Policies". Whereas comprehensive and functional plans contain policies designed to guide and manage a community's growth, hazard mitigation plans are more narrowly focused on hazard assessment and mitigation. This difference in purpose often (though not always) results in hazard mitigation plans that contain few 'true' policies. FEMA recommends certain planning approaches to develop local hazard mitigation plans because preventative land use planning strongly influences a community's vulnerability.[16] Despite this, studies show that hazard mitigation plans are not utilizing the full range of policy tools and tend to focus on structural mitigation measures, such as dams, levees, etc.[17]

Oftentimes, hazard mitigation plans contain policy-like statements which come in the form of mitigation action items. As long as an action item satisfies the requirements – i.e. contains a place-specific term, affects vulnerability, and contains a policy tool – it should be included in the scorecard analysis. For example, within the Hillsborough County, FL hazard mitigation plan, it stated:

> Construct new stormwater system to connect to the box culvert and eliminate flooding along Napoleon.

This action item has a place-specific term (box culvert along Napoleon), it impacts vulnerability (eliminate flooding), and the policy tool refers to a drainage capital improvement project, so it meets the three-point test to include within the evaluation (Table 2.6). Table 2.6 contains examples of action items from Washington's hazard mitigation plan, the Beaufort County Multi-Jurisdictional Hazard Mitigation Plan (which happen to be very similar to policies), as well as, from several other community hazard mitigation plans, thereby illustrating the range of action items one might find in a plan. Justifications for why such action items should be included or excluded from the analysis are also provided.

16 FEMA 2013; NRC 2006, 2014
17 Masterson et al. 2014

Table 2.4 Policy Tools: Land Use Policy categories and sub-categories*

LAND USE APPROACH	APPLICATION TO HAZARD VULNERABILITY
Development Regulations	
Permitted Land Use	Provision regulating the types of land use (e.g. residential, commercial, industrial, open space, etc.) permitted in areas of community; may be tied to zoning code
Density of Land Use	Provision regulating density (e.g. units per acre); may be tied to zoning code
Subdivision Regulations	Provision controlling the subdivision of parcels into developable units and governing the design of new development (e.g. site storm water management)
Zoning Overlays	Provision to use zoning overlays that restrict permitted land use/density in hazardous areas; may be special hazard zones or sensitive open space protection zones
Setbacks or Buffer Zones	Provision requiring setbacks or buffers around hazardous areas (e.g. riparian buffers and ocean setbacks)
Cluster Development	Provision requiring clustering of development away from hazardous areas, such as through conservation subdivisions
Land Acquisition	
Acquire Land & Property	Purchase land/property in hazard area
Open Space or Easement Requirement/Purchase	Provision encouraging open space purchase by the community or open space easements as an element of development approval
Density Transfer Provisions	
Transfer/Purchase of Development Rights	Provision for transferring development rights to control density; may be transfer of development rights or purchase of development rights
Financial Incentives and Penalties	
Density Bonuses	Density bonuses such as ability to develop with greater density in return for dedication or donation of land in areas subject to hazards
Tax Abatement	Tax breaks offered to property owners and developers who use mitigation methods for new development
Impact / Special Study /Protection Fees	Provision requiring impact fees, special study fees, or protection fees for development in hazardous areas; fees could cover costs of structural protection

LAND USE APPROACH	APPLICATION TO HAZARD VULNERABILITY
Land Use Analysis and Permitting Process	
Land Suitability	Hazards are one of the criteria used in analyzing and determining the suitability of land for development
Site Review	Provision requiring addressing hazard mitigation in process of reviewing site proposals for development
Design/Construction Guidelines/ Requirements	Guidelines or requirements that apply to the design or construction of developments in hazard areas
Public Facilities (including Public Housing)	
Siting	Provision to site public facilities, including municipal buildings and public housing, out of hazard areas
Sizing/Capacity	Provision limiting capacity of public facilities, including public housing, in hazard areas to cap amount of development
Post-Disaster Reconstruction Decisions	
Development Moratorium	Provision imposing a moratorium on development for a set period of time after a hazard event to allow for consideration of land use change
Post-Disaster Land Use Change	Provision related to changing land use regulations following a hazard event; may include redefining allowable land uses after a hazard event
Post-Disaster Capital Improvements	Provision related to adjusting capital improvements to public facilities following a hazard event
Capital Improvements	
Infrastructure "Hardening" or Weatherproofing	Provision encouraging or requiring development in hazard zones to increase structural resilience to hazards
Elevating	Provision pertaining to the physical elevation of structures in hazard zones
Drainage Improvements or Flood Control	Provision that pertains to drainage or flooding issues within the community
Ecosystem Enhancement	Provision that seeks to improve or preserve the functioning of the natural environment within the community
Slope/Dune Stabilization	Provision that pertains specifically to stabilization of slopes or dunes or seeks to control erosion

*A more detailed table is provided in Appendix B.

Table 2.5 Examples of Policies With and Without a Policy Tool

Policies with a Policy Tool	Justification for Inclusion
LU Policy 6.1.3: Support proposals to convert non-residential properties along mixed-use corridors, between major intersections, to residential or mixed-use residential uses and ensure the development is compatible with surrounding land uses and has adequate access to transit services and community services. (47)	The policy tool in this example is permitted land use; this land use policy encourages conversion of currently non-residential properties to residential use, effectively increasing the number of people in harm's way in cases where the "mixed-use corridors, between major intersections" happen to be in hazard zones.
ENV Policy 1.2.5: Use techniques, which may include clustering and transfer of development rights, to protect environmentally sensitive areas. (240)	This policy actually contains two policy tools: clustering and transfer of development rights (TOD). Both of these tools can be used to guide development away from certain undesirable areas (including flood hazard zones).

Policies without a Policy Tool	Justification for Exclusion
The City of Washington will monitor sea level rise and respond to threats to property and important natural areas as threats are identified.	Even though the policy directs the city to be cognizant of the land use implications of sea level rise, it fails to offer any policy tools that would lead directly to land use actions.
The City of Washington will protect its waterfront/ shoreline areas, historic district, and valuable scenic areas.	A policy to protect such areas is laudable -- and likely to result in greater community flood resilience -- but this example offers no concrete tools by which the city might go about doing so.

Table 2.6 Examples from Around the Country of Applicable "Action Items"

Action Item	Justification for Inclusion
Revise local development ordinances to encourage shoreline vegetation protection to help mitigate flooding (Beaufort County Multi-Jurisdictional Hazard Mitigation Plan, 2010, p. 6-15)	The river shoreline can be identified within the community. Development regulations are to be used to protect shoreline vegetation. Flood vulnerability will likely be reduced as a result.
Continue to maintain all property acquired with public mitigation funds within the Special Flood Hazard Area (SFHA) as undisturbed open space in perpetuity. Continue to pro-actively establish open space within the floodplain and floodway as grant funds become available to carry out this initiative. (Beaufort County Multi-Jurisdictional Hazard Mitigation Plan, 2010, p. 6-21)	The extent of the SFHA and the floodplain and floodway can be identified within the community. Land use planning tools used include development regulations, zoning overlays, and land acquisition. Flood vulnerability will likely be reduced as a result.
Coastal Erosion – Columbia Point *• UMass and the state should stabilize the bank or establish a new bank. (Metro-Boston Multi-Hazard Mitigation Plan, 2008, p. 70)*	The extent of the Columbia Point district in Boston, MA, is known. The capital improvements policy tool of bank stabilization/improvement is used. This will likely reduce flood vulnerability.

BOX 2.1 : Organize Policies in the Resilience Scorecard

When collecting policies, organize them in the Resilience Scorecard by completing the following:

1. Place each selected policy in an appropriate policy tool category or sub-category (see Table 2.4).
2. Underline the place-specific term in each selected mappable policy.
3. *Italicize* the policy tool in the policy. If there is more than one distinct (and applicable) policy tool present in a single policy, include multiple 'copies' of the policy in the policy list (in the appropriate sub-categories).
4. After separate policy lists have been generated, the Policy Team should convene to discuss the applicability of each policy to spatial analysis (again, per the criteria in Task 2, Section 2.1) – accepting some policies, rejecting others, and re-categorizing, as needed (through trial and error, we've learned that this is the best way to get a comprehensive list of applicable policies) – in order to generate a *final list of policies* for each of the community's plans. Some plans may have dozens of applicable policies, while others may have very few. Plans that contain zero applicable policies should not be included in the analysis

- **Underline Spatial Indicators**
- ***Italicre* Policy Instrument**

Exhaustive List of All Policies Related to Land Use

☑ **Policy 1** Increase and bolster the number of key destinations near the **downtown** and waterfront to provide multiple components and uses catering to different audiences.

☑ **Policy A** ***Strengthen controls*** on development within **flood-prone and wetland areas** by improving existing ordinances, such as the erosion and sediment control ordinance, zoning ordinance, subdivision ordinance, flood plain regulations and other development regulations.

MAPPING TEAM

The Plan Integration for Resilience Scorecard is unique because it spatially evaluates policies and plans and their effects on vulnerability to hazards. The Mapping Team has a critical role in producing or gathering maps that will be used for scoring the network of plans. This team will first identify and map planning districts in the community. Then, they will identify and map hazard zones to generate the unit of analysis "district-hazard zones". Finally, using the policies gathered by the Planning Team, the Mapping Team will create or use maps that refer to the place-specific terms within the policies collected. Because of the many online mapping tools available, the Mapping Team does not need geographic information systems software (GIS) to complete the tasks. GIS will enhance the evaluation if there are spatially specific elements in the community that are not available with online tools. Additionally, GIS can enhance the analysis at a smaller scale, such as by using census block group as opposed to more readily available and larger scale online tools at the census block or census tract level.

Checklist:

- Determine Planning Districts
- Delineate Hazard Zones to create the new District-Hazard zone
- Map your 'Place-specific terms'

OBJECTIVES:

- Create or gather Planning Districts Map (or GIS layer)
- Create or gather Hazard Zones Map (or GIS layer)
- Create the District-Hazard Zone(or GIS layer)
- Create or gather maps of place-specific terms in the mappable policies

MATERIALS REQUIRED:

- Plan Integration for Resilience Scorecard
- Maps of:
    - *Planning Districts*
    - *Hazard Zones*
    - *Place-specific terms in Mappable policies*

SKILLS RECOMMENDED:

- Ability to gather maps within plans
- Ideally, ability to bring shapefiles and data into GIS software to generate new information (manual overlay of maps can work as well).

Download data to build maps:

- FEMA's 100-year floodplain (Zones A, AE….) (https://msc.fema.gov/portal/), or(http://www.data.gov/).
- United States Army Corps of Engineers (USACE) sea level rise estimations-- http://www.corpsclimate.us/ccaceslcurves.cfm)
- Elevations from USDA's Geospatial Data Gateway-- https://gdg.sc.egov.usda.gov/
- Block groups and specific planning districts in your community (i.e., Central Business District)-- (https://www.census.gov/geo/maps-data/data/tiger-line.html)

Task 1: Determine Planning Districts

In order to spatially analyze the applicable plan policies[18] (see Policy Team: Task 2), the community must be divided into areas known as planning districts. The purpose of dividing the community into sub-geographies is to better understand the policy integration (or lack thereof) across different segments of the community. The smaller the planning district, the more fine-grained the analysis. The evaluation of different districts may reveal areas in the community that are lacking plan integration for hazard vulnerabilities.

2.3.1 Choose Planning Districts

Communities should determine the spatial area they wish to analyze. Generally, there are two strategies for selecting planning districts.

1. Readily available data, such as US Census block groups (or tracts, depending on the size of your community) are a convenient and widely utilized sub-jurisdictional spatial unit.
2. Community-specific areas or 'specialized' planning districts which are often the focus of planning initiatives and policies, such as historic districts, overlay districts, planned-unit developments, or other areas designated within local policies.

Some communities may choose to use planning districts referenced in your community's plans because there are often specific policies associated with the planning districts. Others may choose census block groups or tracts because they are inherently apolitical. You can also define your planning districts

Choosing Planning Districts:

Washington, NC- the city is so small, a fine-grained analysis of Census block groups was most appropriate.

Norfolk, VA- the city decided to use Census tracts (roughly 80) which was a more manageable size, despite losing a more fine-grained analysis.

Boston, MA- the city's official neighborhoods are used as planning districts, given their significance to current and historical planning.

Houston, TX- the city is divided into 'super neighborhoods,' which may be a relevant planning district.

18 Each applicable policy affects the vulnerability of the population (or of the infrastructure, ecology, etc.) in each LPD differently, depending on the land use characteristics in that district. Many of the community's land uses or classifications are mapped, which allows for spatial differentiation. Thus, the LPD acts as the basic unit of analysis for this research.

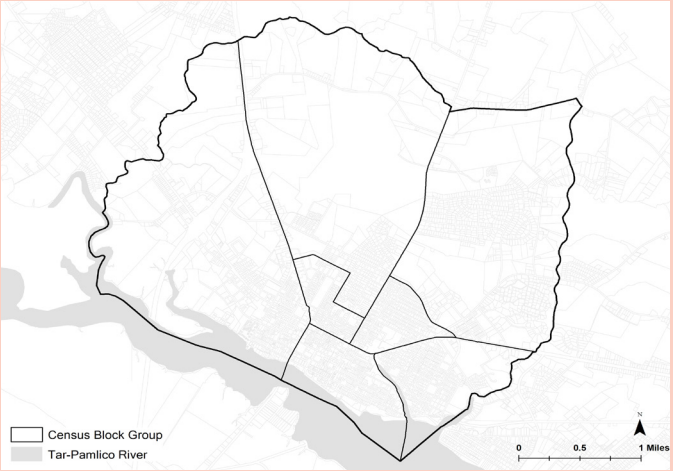
with a few 'specialized' planning districts and identify the remaining with Census block groups. In Washington, we selected planning districts using land use maps from the 2023 Comprehensive Plan and the CAMA Land Use Plan. Planning districts are important to identify because many planning efforts attempt to develop goals and coordinate policies within these areas.

2.3.2 Map Planning Districts

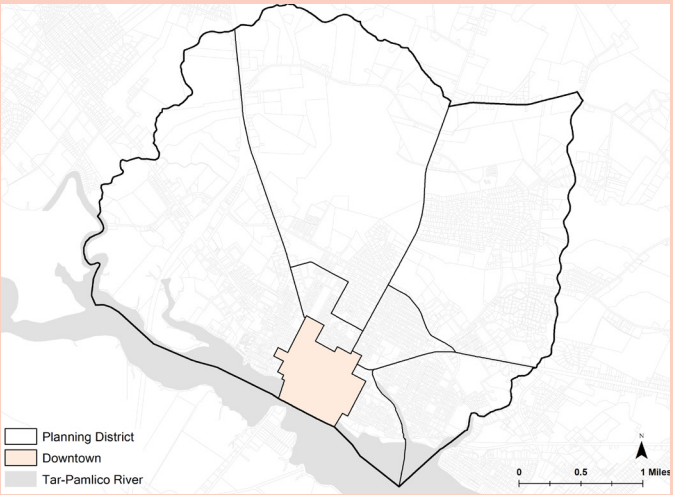
After determining the planning districts, map each district as a single GIS layer and number them in a logical manner (to help with future analysis and description). For those with limited GIS capability, overlay image files with a slight transparency in Microsoft PowerPoint or other software. Images can also be

BOX 2.2: Customizing Planning Districts

The map (left) displays Census block groups for Washington, NC. Because there was a strong focus on the central business district (CBD) within the plans, we created a customized planning district map. In GIS software, the CBD is clipped on the Census block groups to create a new geography.



Census Block Group (top) and Planning Policy District (bottom)



Online resources for sea level rise:

- SLR Tools Comparison Matrix is a helpful tool for future SLR inundation mapping. http://sealevel.climatecentral.org/matrix/
- NOAA has developed an interactive map that models sea-level rise against a number of factors. The web tool displays socio-economic vulnerability. (http://www.csc.noaa.gov/slr/viewer/)
- NOAA has also developed a tool for lake level rise for the Great Lakes https://coast.noaa.gov/llv/
- NOAA Sea Level Rise and Coastal Flooding Impacts: https://coast.noaa.gov/slr/
- Rhode Island Coastal Resource Management Council (CRMC) also developed Sea Level Affecting Marches Model (SLAMM) to project three different sea level rise scenarios of 1, 3, and 5 feet in the future for all 21 coastal communities of Rhode Island. http://www.crmc.ri.gov/climatechange.html

printed and physically overlaid, but using digital platforms will make it easier to overlay the various maps. District numbers will be the columns within your scorecard spreadsheet (see Appendix C).

Task 2: Delineate Hazard Zones

The first step is to delineate hazard zones—where the community is affected by a given hazard. You can map different types of hazards, but for our purposes in Washington, NC we evaluated coastal hazard zones—the 100 yr. floodplain as the 'current hazard zone' and sea level rise projections with the 100 yr. floodplain as the 'future hazard zone' (Figure 2.2). Your community can gather other hazard maps, such as surge zones, wave action locations, dam inundation areas. It is also common for communities to buffer flood hazard areas, acknowledging changes in flood patterns, as opposed to only using the 100-year floodplain. If your community is exposed to more than coastal hazards, we encourage you to explore the relationship of such hazards in the community. Non-coastal hazards may include, fire risk areas, liquefaction zones, earthquake risk zones, high wind zones, etc. Consider your context when delineating hazard areas. Manually collect maps or gather the GIS layers.

2.4.1 Thinking about the Future

In order to better plan for the future, we consider potential risks that could happen over the course of time. The United States Army Corps of Engineers (USACE) provides alternative sea level change projections in 10-year increments, up to 2100. Consider using the 2100 sea level rise projections because it shows the larger extent of future hazard exposures; the year 2100 is a useful long-term planning horizon of land use commitments and urban infrastructure.

In Washington, NC we combined the 2100 sea level rise estimates with the elevation data to get a quick picture of what the new 100-year floodplain might be in 2100 - we labeled the "future hazard zone." This overly simplistic model, while not perfect, allowed us to have a conversation about future risk in the community. To do this we collected the USACE sea level rise estimations based on NOAA coastal gauge measurements (http://www.corpsclimate.us/ccaceslcurves.cfm). We used the "intermediate high" scenario for the year 2100 (chosen from a range of possible sea level rise scenarios). Then, we added the base elevation of the 100 year floodplain to the USACE sea level rise estimates for the year 2100.

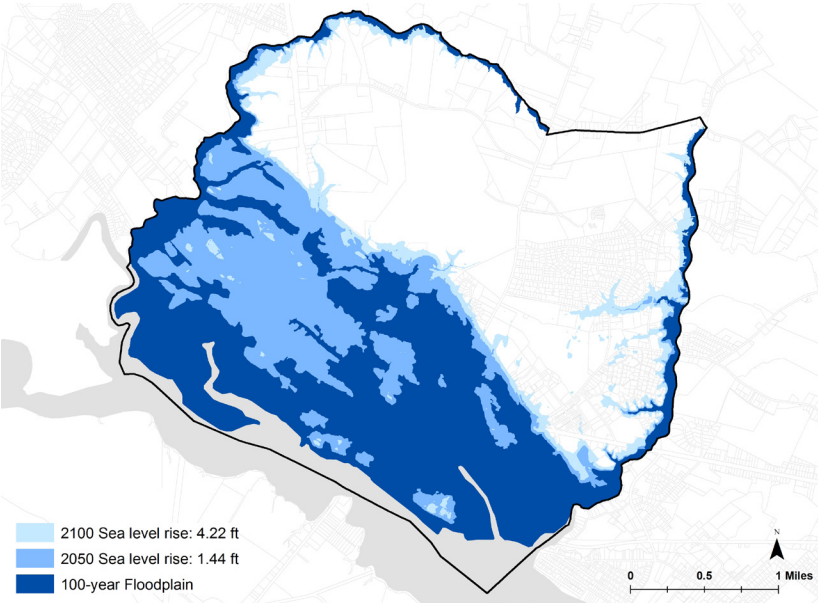


Figure 2.3 100-year Floodplain. The current 100-yr floodplain is mapped, along with the new floodplain due to sea level rise in year 2050 and 2100.

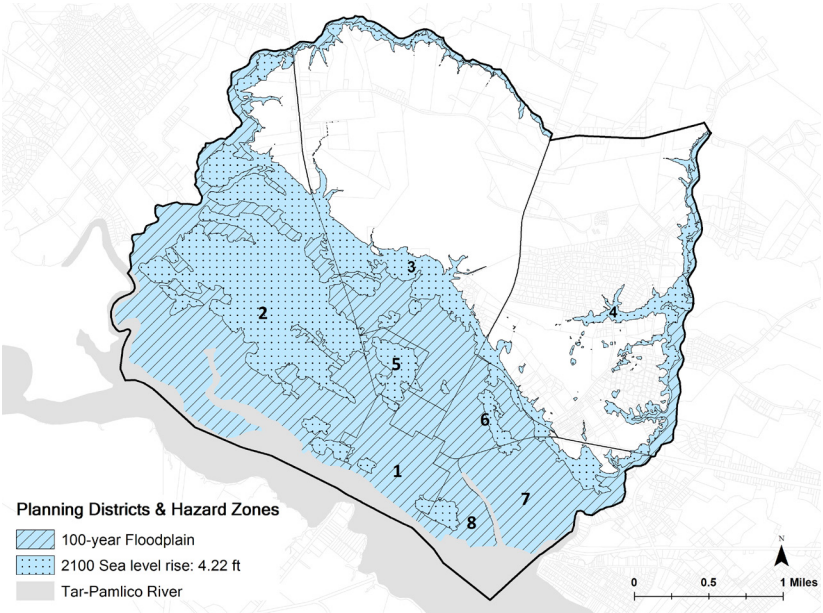


Figure 2.4 District-hazard Zones. The map represents the newly joined "district-hazard zones," created from the planning districts and hazard zones layers. The "district-hazard zone" represents the true unit of analysis.

BOX 2.3: Other Online Hazard Zone Mapping Resources

Since not all cities build hazard-related GIS data to delineate hazard zones and analyze the impacts, HAZUS-MH is a good alternative for mapping hazard zones. HAZUS-MH is a nationally applicable standardized risk-based disaster management tool to assess damages, estimated economic losses for buildings and infrastructures, and mitigation benefits from earthquakes, coastal floods and hurricanes. You can visually display the hazards and identify vulnerabilities. With the information, it enables users to prioritize mitigation measures to determine how those can be implemented in order to reduce future losses. There are other online mapping tools for communities that lack data and maps.

- NOAA Coastal Flood Exposure Mapper: https://coast.noaa.gov/floodexposure/#/map
- NOAA Sea Level Rise and Coastal Flooding Impacts: https://coast.noaa.gov/slr/
- NOAA Sea Level Rise Viewer: https://coast.noaa.gov/digitalcoast/tools/slr.html
- Climate Explorer: https://toolkit.climate.gov/tools/climate-explorer
- FEMA's National Flood Hazard Layer on ArcGIS Online: http://www.arcgis.com/home/webmap/viewer.html

Elevation data for every county in the US can be obtained from the USDA's Geospatial Data Gateway website (https://gdg.sc.egov.usda.gov/). Generally, the most detailed LiDAR elevation dataset provided is a 1-meter elevation dataset. Alternatively, we noticed the 500 year floodplain oftentimes reflected a similar 2100 floodplain scenario.

2.4.2 Combine Planning Districts and Hazard Zones

The "planning district" layer should then be spatially joined to the "hazard zone" layers, resulting in a separate **"district-hazard zone"** layer (Figure 2.5). The district-hazard zone is the intersection of the planning district and the hazard zone and represents the true unit of analysis for this research, because we are not considering policies that impact areas outside hazard zones. You will have a district-hazard zone layer for each hazard you are analyzing. For example, in Washington we assessed the 100 year floodplain and the future 100 year floodplain due to sea level rise. This resulted in two separate district-hazard zone layers, where in the scorecard spreadsheet we referred to them as the "current hazard zone" and "future hazard zone" respectively. If you are assessing more hazards, you will have additional layers, which is important when scoring the policies in Chapter 3.

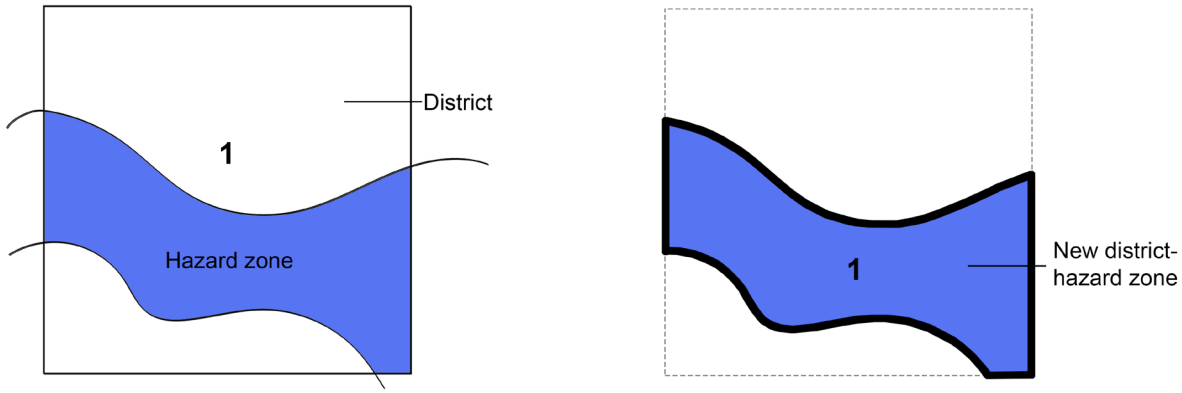
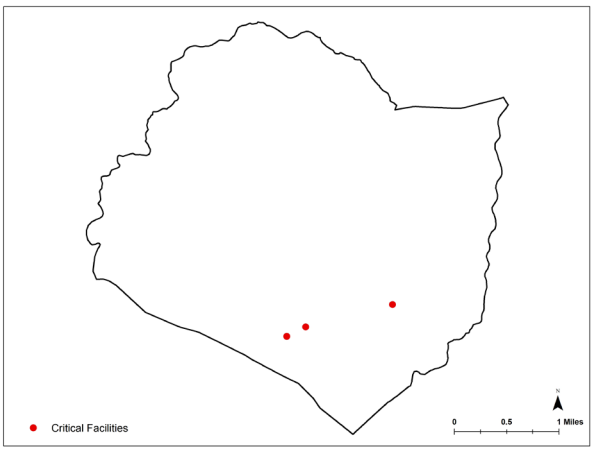


Figure 2.5 Spatially join the planning district and hazard zone to form the true unit of analysis, the "district-hazard zone."

Task 3: Map your 'Place-specific Terms '

In Task 2 of the Policy Team, you generated lists of 'place-specific' policies within the plans. In order to fully understand how hazard zones impact each policy, it may be useful to collect maps that reflect the 'place-specific terms' within the policies (Figure 2.6). For instance, in Washington several policies referred to conservation areas and 'natural areas'. These areas are place-specific and when overlaid with hazard zones, we found conservation areas were reducing vulnerability by absorbing flood waters. If we overlay the waterfront commercial area with the hazard zone, we see a different story—commercial investments in areas exposed to hazards, increasing vulnerability. Take some time to collect maps of your 'place-specific terms' so that you can better under their exposure to hazards.

Keep in mind, you do not need map layers for every place-specific term. For example, in Norfolk, VA an often referenced place-specific term within policies was "shoreline." The city did not create a separate layer or special map for this geography, because it was easily recognizable already. Place-specific terms that might need mapping could include, repetitive loss structures, critical facilities, public housing, etc. Set up layers or maps in GIS software where you can easily turn layers on and off as it overlays the "district hazard zone."



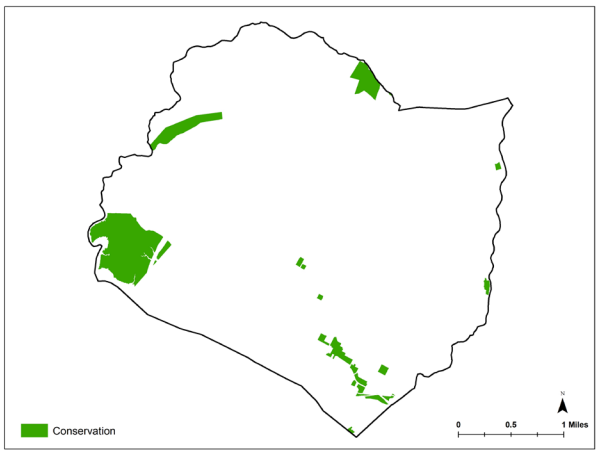


Figure 2.6 Here are two place-specific terms that can be mapped. Gathering map layers to speed the scoring process (see Chapter 3).

KEY CONCEPTS – Chapter 2, Technical Analysis

Applicable policies within plans should include the following criteria of the three-point test for policy inclusion:

1. Contain at least one mappable, place-specific term; or has the ability to be mapped within the community. Examples include cultural or administrative areas ('downtown' or 'the riverfront'), geographic features ('wetlands' or 'Main Street'), and even individual buildings ('repetitive loss structures' or 'critical facilities').

2. Potentially reduce or increase vulnerability to hazards; and

3. Contain a recognizable policy tool, or a form of government intervention to achieve specific objectives and outcomes. Descriptions of policy tools are provided in Table 2.4.

District-hazard zone is the intersection of a planning district and a hazard zone and represents the true unit of analysis for this evaluation because we are only considering policies that impact areas within hazard zones. You will have a district-hazard zone layer for each hazard you are analyzing.

CHAPTER 3

ASSESSMENT

Scoring the network of plans and mapping vulnerability—appropriate for the Policy Team and Mapping team, respectively—are assessments to understand the spatial extent of policies, structures, and people exposed to hazards. In this chapter, you will use the policies put into the scorecard and maps to determine whether policies increase, decrease, or have no effect on district-hazard zones. The result will reveal policies exacerbating vulnerabilities of structures and people inside hazard zones. As we know, not everything or everyone can rebound from disasters in the same way. We encourage you to assess physical and social vulnerability as the "gold standard" to understand the cumulative effect of policies across the community.

SCORING

All the work done so far leads up to this – scoring! Communities can score the network of plans to understand policy implications within hazard zones. The Plan Integration for Resilience Scorecard, or scoring spreadsheet, generates a numeric score for each policy, plan, and the network of plans. We recommend your team come together as a group to score policies. The Policy Team may find it easier to score because of their familiarity with the policies. Once all team members have scored plans, discuss your results. Communities may adjust the number of evaluators based on available resources and personnel.

Checklist:

- *Create the Plan Integrations for Resilience Scorecard*
- *Create Tables, Maps, and Indexes*

OBJECTIVES:

- Score your Network of Plans

MATERIALS REQUIRED:

- District-Hazard Zone Map (or GIS layer)
- Maps showing place-specific terms (or GIS layers)
- Plan Integration for Resilience Scorecard

SKILLS RECOMMENDED:

- Ability to determine whether a policy might increase or decrease exposure in hazard zones

Task 1: Create the Plan Integration for Resilience Scorecard

Box 3.1 The value of scoring goes beyond the scores

To reveal incongruities among community plans, the score itself is important. It allows you to map and visualize incongruities, but the real value of the scorecard comes from the conversations had during the process. Whether scores are positive, negative or neutral, cities are able to have better conversations, make better decisions and therefore better investments. This collaborative process allows cities to become self-aware regarding their overall network of plans and the integration of the policies for a particular district.

Using the Plan Integration for Resilience Scorecard spreadsheet (see Appendix C), score each applicable policy in the spreadsheet—in each district. All district-hazard scores compiled will result in a total score for each planning document, which then accumulates into the community's network of plans score. An example scorecard is shown in Table 3.1.

To start, determine how each policy affects hazard vulnerability. Evaluate each policy based on whether it will increase or decrease vulnerability for each district-hazard zone (see Chapter 2 for examples). The policy in each district-hazard zone receives a score based on the vulnerability to each hazard. Ask yourself:

> Is the policy contributing (directly or indirectly) to greater exposure of people and structures to the hazard?

Every district-hazard zone (hazard zone in each planning district) receives a score of '+1', '-1', '0', or 'not applicable' for every policy, depending on how it affects vulnerability.

In some cases, a community policy may reduce vulnerabilities (+1) in one hazard zone, but may increase vulnerabilities (-1) in another hazard zone.

A score of '+1' indicates that a policy positively affects (that is, it reduces) vulnerability for a specific district-hazard zone. In other words, it reduces (directly or indirectly) the exposure of people or structures to the hazard or mitigates the negative effects of the hazard.

A score of '-1' indicates that a policy negatively affects (that is, it increases) vulnerability for a specific district-hazard zone. In other words, it increases (directly or indirectly) the exposure of people or structures to the hazard or perpetuates the negative effects of the hazard.

A score of '0' indicates the policy is neutral and has no effect on vulnerability, whether positively or negatively, in the district-hazard zone. The policy itself could increase vulnerability in one district-hazard zone and be neutral in another district-hazard zone.

'Not applicable' indicates the policy does not refer to the district-hazard zone (or the policy's place-specific term is not located in the district-hazard zone). 'NA' is important to identify (or grey out the cell in the spreadsheet) in order to easily see the spatial impact of policies on district-hazard zones. If left as an empty cell in the spreadsheet, it could easily be confused as not yet scored.

In order to quickly and accurately score policies, display the district-hazard zone map with the place-specific term layer of the policy. You can easily toggle on and off map layers with each place-specific term. For instance, a policy may refer to wetlands, which is the place-specific term. The next policy may refer to public housing, which is the place-specific term. If you have these as layers within your map, you can easily see where these are located and within which district-hazard zone.

Keep in mind, there is a level of professional judgment in the scoring process. The policies can be complex and nuanced. It is not appropriate to only think two-dimensionally, or whether the policy is inside or outside of the hazard zone. Carefully consider each policy and ask yourself how the policy avoids or resists the hazard.

Below are some policy score examples with justification with additional policy scores in Table 3.1:

Example 1: A policy in the infrastructure element of the City of Washington Comprehensive Plan states, "Assure the provision of public and private parking in support of increased development and activity" (City of Washington, 2013, p. 30). The City of Washington aims to expand infrastructure capacity to foster downtown development, which is entirely in the 100-year floodplain and future hazard zone due to sea level rise. There is no discussion of vertical elevation, but instead seems to disregard the hazard completely. Thus, for District 1, this policy received a score of -1 for the current hazard zone and a -1 for the future hazard zone.

Example 2: A policy in the City of Washington hazard mitigation plan, which is part of a county multi-jurisdiction mitigation plan, states the need for "acquisition of properties located in the city's repetitive loss areas…including areas adjacent to Jack's Creek…passing through areas that are largely utilities for public housing" (Beaufort County 2010, p. 4-14). These areas cover *part of* three districts (5, 6, and 8). Districts 1, 2, 3, 4, and 7 would be excluded from scoring for this policy because they are not part of its geographic scope and thus not directly affected. The future hazard zones in districts 5, 6, and 8 are similarly unaffected and are thus also excluded. The policy of "acquisition" receives a score of +1 for each of the current hazard zones in districts 5, 6, and 8, given their "adjacen[cy] to Jack's Creek."

Table 3.1 Example of Portion of Scorecard for Washington, NC.

Development Regulations	District:	01	02	03	04	05	06	07	08	TOTAL (ALL LPDs)
Permitted Land Use										
[GOAL] Public facilities and publicly owned lands will be used at their highest and best use, except for those public lands that are in environmentally sensitive locations, where conservation should be the objective. (p. 47)	Current hazard zone	NA	1	NA	NA	NA	1	NA	NA	2
	Future hazard zone		1				1			2
Subdivision Regulations										
Strengthen controls on development within flood-prone and wetland areas by improving existing ordinances, such as the erosion and sediment control ordinance, zoning ordinance, subdivision ordinance, flood plain regulations and other development regulations. (p. 46)	Current hazard zone	1	1			1	1	1	1	6
	Future hazard zone	1	1	1		1	1	1	1	7
Zoning Overlays										
Consider creation of a Conservation Overlay Zoning District to help protect sensitive areas. (p. 42)	Current hazard zone		1				1			2
	Future hazard zone		1				1			2
Increase and bolster the number of key destinations near the downtown and waterfront to provide multiple components and uses catering to different audiences. (p. 38)	Current hazard zone	-1	-1					-1	-1	-4
	Future hazard zone	-1	-1					-1	-1	-4
Seek out opportunities to enhance downtown as a center of arts and cultural resources. Promote efforts to enhance the visibility and use of the historic Turnage Theater. (p44)	Current hazard zone	-1								-1
	Future hazard zone	-1								-1
Policy Category Total	Current hazard zone	-1	2	0	0	1	3	0	0	5
	Future hazard zone	-1	2	1	0	1	3	0	0	6

Task 2: Analyze the Plan Integration Scores

You can analyze the final scores within the Plan Integration for Resilience Scorecard using tables and maps. The relatively simple tables and maps described below are helpful for initial visual comparisons and pattern recognition.

3.2.1 Tables

Developing a table that contains the summed values for each district and policy is one simple analysis to perform. Create separate tables for each planning district and each plan. Table 3.2 provides an example table for all four plans scored in Washington, NC. You can see some plans are scoring far better than others. Also, the tables reveal plans that decrease vulnerabilities in the current hazard zone versus the future hazard zone.

Table 3.2 Scores by district, plan, and hazard zone for Washington, NC for the comprehensive plan.

	District (total score for all policies in district)	District 1 *(Down-town)*	District 2	District 3	District 4	District 5	District 6	District 7	District 8	Total
Core Land Use (CAMA)	100-year Floodplain	-2	5	0	0	0	5	5	2	**15**
	SLR	-6	2	-3	-2	-4	0	-2	-2	**-17**
2023 Comprehensive	100-year Floodplain	-5	0	-1	0	0	2	-2	-2	**-8**
	SLR	-5	0	0	0	0	2	-2	-2	**-7**
Hazard Mitigation	100-year Floodplain	6	6	1	1	6	6	6	6	**38**
	SLR	1	1	1	1	1	1	1	0	**7**
Parks & Recreation	100-year Floodplain	0	1	1	1	1	0	1	1	**6**
	SLR	0	1	1	1	1	0	1	1	**6**
All Four Plans (Combined)	100-year Floodplain	**-1**	**12**	**1**	**2**	**7**	**13**	**10**	**7**	**51**
	SLR	**-11**	**4**	**-1**	**0**	**-2**	**3**	**-3**	**-3**	**-13**

*In Washington, NC we used the 100 yr. floodplain as the 'current hazard zone' and the sea level rise (SLR) projections as the 'future hazard zone'.

3.2.2 Maps

To go a step further, you can create choropleth maps—or maps with differences in shading and coloring—from the totals and sub-totals (see Figure 3.1). Figure 3.1 shows choropleth maps for scores in each plan. Remember, scores are given for each district-hazard zone per policy. Because of this, we can see different scores in each district-hazard zone—a visual interpretation of the spatial analysis. Notice that scores are not given to areas outside the hazard zones, because the unit of analysis is the "district-hazard zone."

First, we can compare the scores of each plan based on the different hazard zones. In Figure 3.1, the Core Land Use Plan (CAMA) (top left) had more policies focused on reducing vulnerabilities in 'current hazard zones' (or 100 yr. floodplain and hatched) in the western-most district-hazard zone (district 2), than the areas in the 'future hazard zones' (or 2100 sea level rise and dotted). Additionally, we can compare policy score maps across plans. In Washington, NC, the Comprehensive Plan (top right) and the CAMA Plan had more policies that increased vulnerabilities in current and future hazard zones, particularly in districts 1, 3, and 5. On the other hand, the Hazard Mitigation Plan (bottom left) and Park and Open Space Plan (bottom right) actively decreased vulnerabilities. Figure 3.2 provides the composite Policy Scores Map by district-hazard zone for all plans in Washington. Washington can prioritize policy changes and investments in districts 1, 3, and 5, where there are the greatest incongruities among the plans and where vulnerabilities are increased. Knowing the scores by policy, hazard zone, district, and plan while facilitate plan updates which promote compatibility to decrease vulnerabilities.

BOX 3.2: Formatting the Scorecard for ArcGIS

Once finishing the plan evaluation, separate the sheets by different hazard zones (i.e. 100-year floodplain, 2100 sea level rise, etc.) and delete districts which are not included in each hazard zone (see Figure 3.1a). Since the number of districts in those two different hazard zones might be different, it would be useful to see the patterns of each hazard zone separately. Then, check the District ID name and format so both ArcGIS and the spreadsheet match, and join the table and District Boundary using ArcGIS (Figure 3.3).

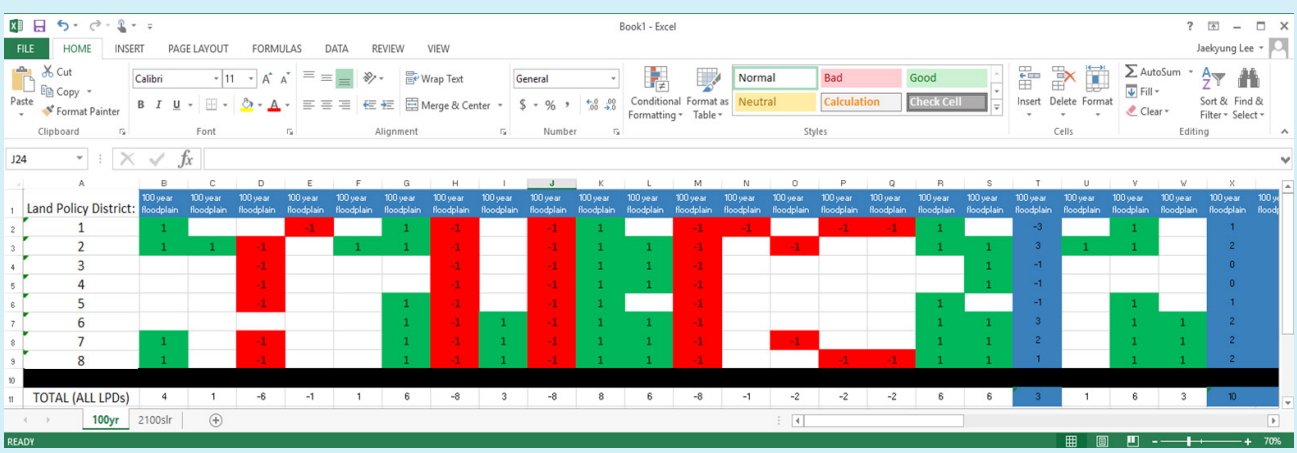


Figure 3.1a. A Plan Evaluation Sheet of 100-year floodplain

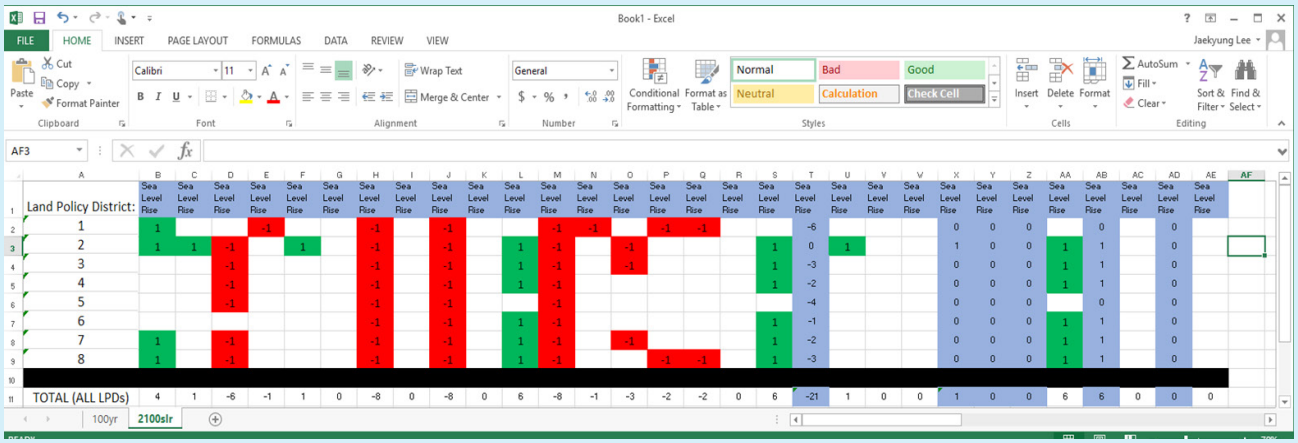


Figure 3.1b. A Plan Evaluation Sheet of 2100 sea level rise

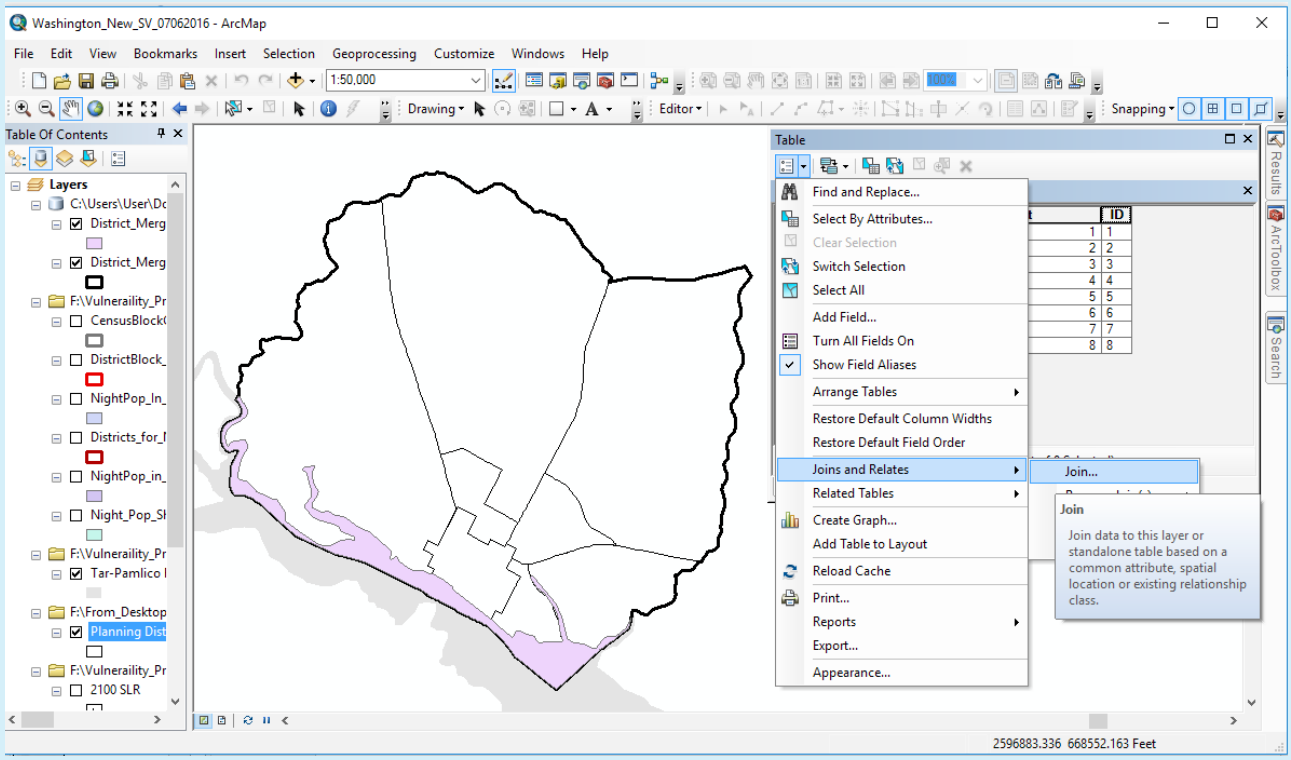


Figure 3.1c. Join the Table and District Boundary using ArcGIS

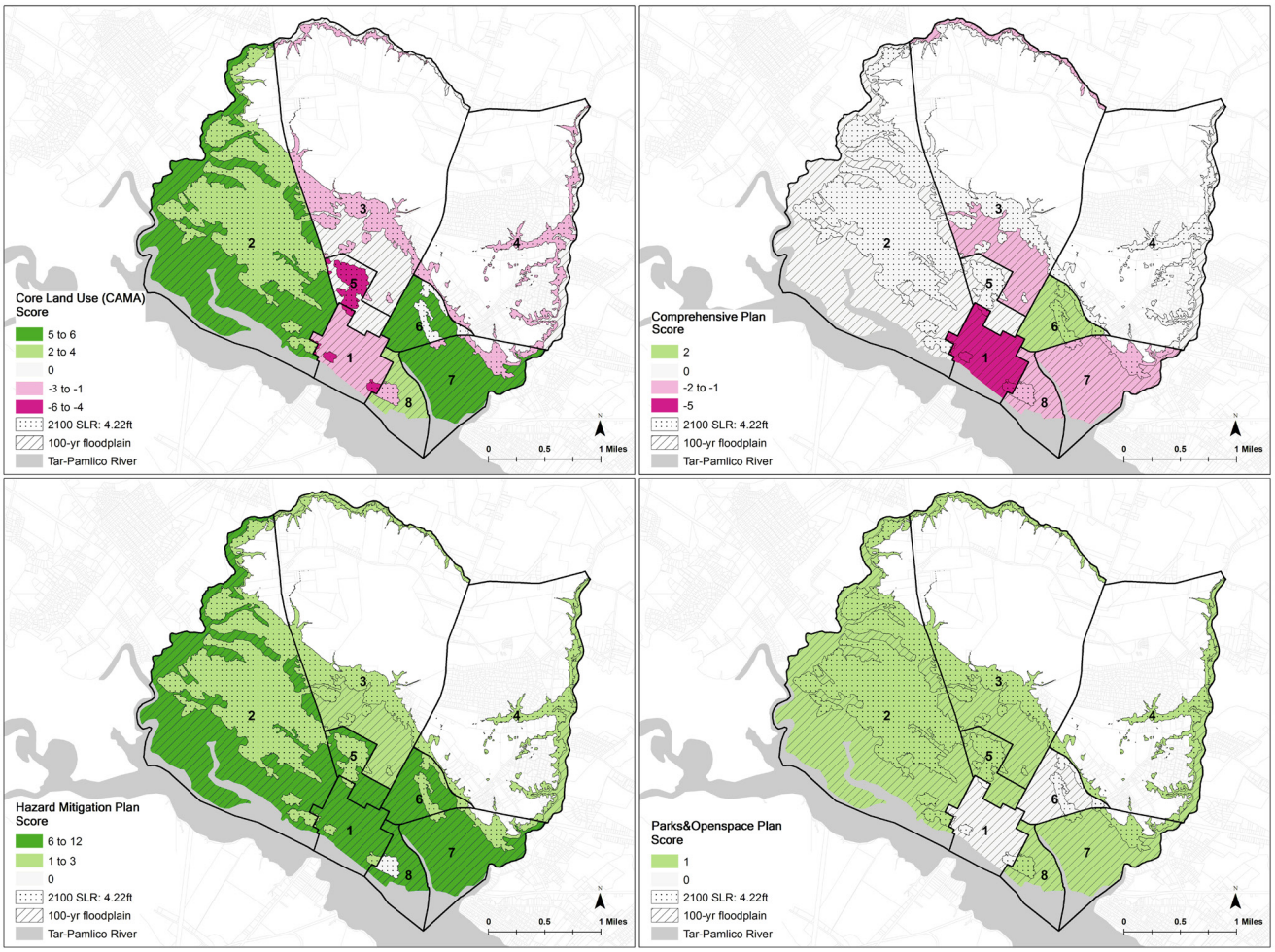


Figure 3.2 Comparing Scores of Different Planning Documents in Washington, NC.

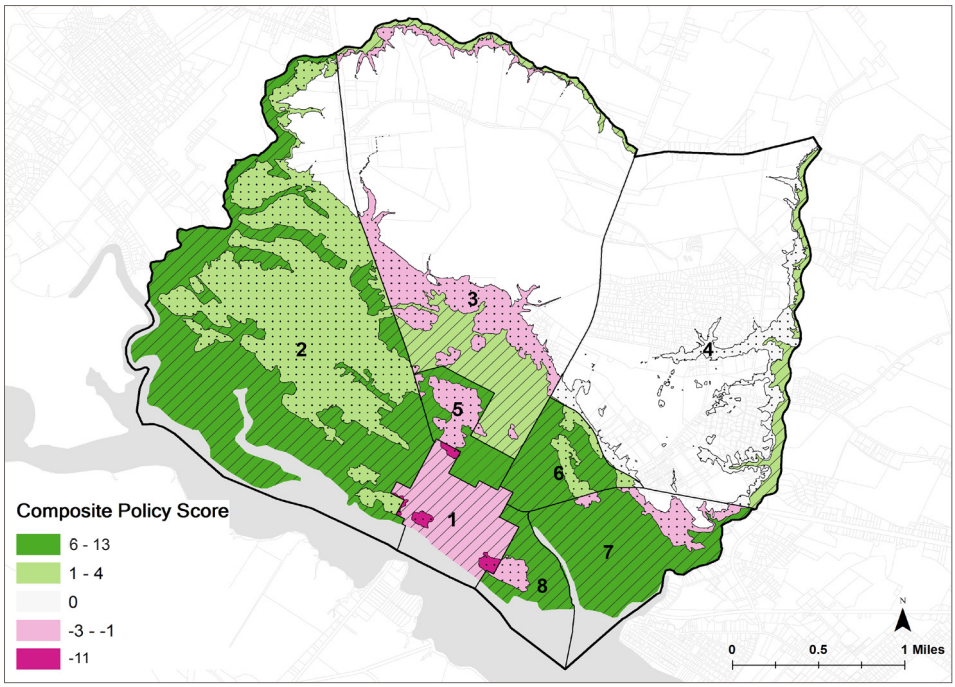


Figure 3.3 Composite score among all plans.

Scoring the Network of Plans in Washington, NC

Most of the city of Washington, NC is located in either the 100-year floodplain or the projected sea-level rise hazard zone. However, the relationships between ability and plan scores are not consistent. For example, the network of local plans proposes to raise physical vulnerability in at least part of every planning district in the city—including all of downtown (District 1), which is already highly physically vulnerable). In contrast, policies in the network of plans are likely to reduce existing physical vulnerability in the 100-year floodplain in Districts 2, 5, 6, 7, and 8.

The resilience scorecards also reveal discrepancies in the way Washington's network of plan documents individually affect vulnerability in the city. Most notably, Figure 3.2 shows that the current comprehensive plan receives negative scores in several planning districts, particularly the Central Business District, indicating that the plan is likely to increase vulnerability in parts of the city, whereas the hazard mitigation plan receives uniformly positive scores. These results point to differences in emphasis; the comprehensive plan is largely concerned with economic development, while the mitigation plan's explicit focus is vulnerability reduction.

The resilience scorecards for Washington, NC indicate that the city's plans are having an overall effect of increasing vulnerability to coastal flooding in many areas, a troubling finding for an already vulnerable community. They also reveal conflicts between the documents in the community's network of plans; some appear to be exacerbating vulnerability, even as others work to reduce it. These and other insights revealed through the resilience scorecard analytical method will be valuable for local planners and decision-makers as they work to improve planning for coastal flooding hazards in Washington.

Checklist:

- Assess Physical Vulnerability
- Assess Social Vulnerability

VULNERABILITY

Congratulations, your community has a Plan Integration for Resilience Score—now what? While your plan integration scores may be discouraging, don't lose sight of what this is—a diagnosis revealing how various policies are pulling in different directions. The path forward is to adjust and adapt policies and priorities based on this new knowledge. To help prioritize, we strongly recommend conducting a physical and social vulnerability assessment, overlaid with your policy score map (see Figure 3. 4).

We consider this section the "gold standard" of the Plan Integration for Resilience Scorecard and recognize not all communities have the resources or capacity to complete it. This section describes some general techniques 'unpacking' the vulnerabilities a bit more into: physical and social vulnerabilities.

Physical vulnerability refers to the types of buildings, structures, and infrastructure that are exposed to hazards.

Social vulnerability refers to the types of people that are exposed to hazards.

In both cases, not all types of structures or people respond in the same way to disasters. Knowing and understanding which people and structures may have a more difficult time bouncing back from the event will point to needs in the community. In this section, you will overlay and compare physical and social vulnerability 'hotspots' with the policy scores map as seen in Figure 3.4. We recommend using GIS to calculate the physical and social vulnerability by district. We understand GIS may be challenging for some communities and see this chapter as an enhancement to smarter planning. Communities that are able to assess their physical and social vulnerability will have a more informed picture of community needs.

OBJECTIVES:

- Assess physical and social vulnerability

MATERIALS REQUIRED:

- District-Hazard Zone map (or GIS layer)
- Policy Scores Map
- Data on physical vulnerability
- Data on social vulnerability

SKILLS RECOMMENDED:

- GIS knowledge and experience creating maps

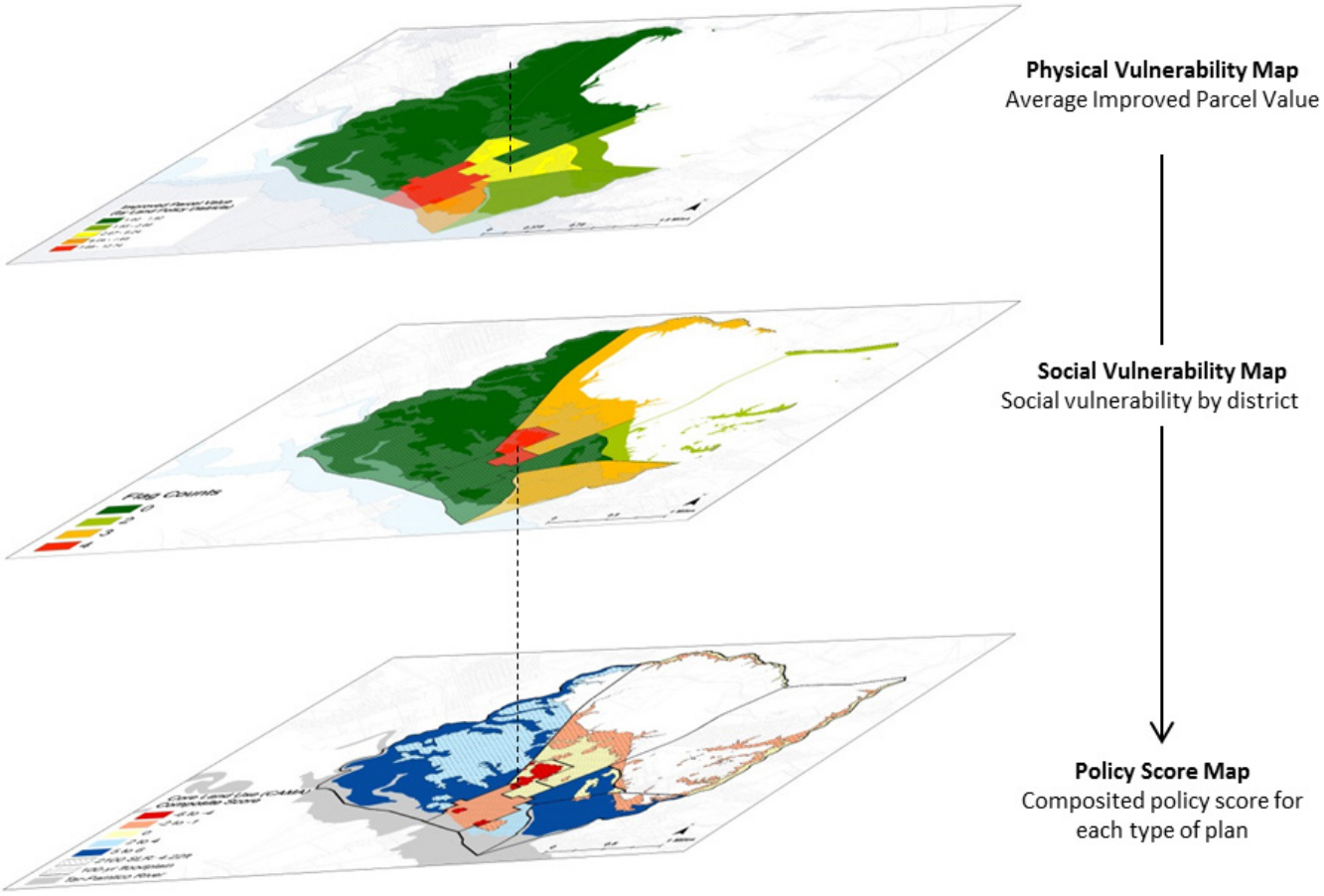


Figure 3.4 Overlay and compare Physical Vulnerability, Social Vulnerability, and Policy Score Map to find hotspots and priority areas.

Task 1: Assess Physical Vulnerability

What is physical vulnerability? The simplest way to view physical vulnerability is to think about the investments that will be impacted if a disaster strikes. What structures—whether homes or businesses—will need support to recover? What infrastructure—whether roads, public transportation services, stormwater drains, electrical, water and wastewater lines and facilities or even levees and dams—will be damaged or effected by the disaster? What other critical community facilities—such as schools, fire stations, police stations, hospitals, post offices, etc.—will be exposed to hazards? As you can imagine there are a number of elements in the built environment that may be affected.

Why assess physical vulnerability and plan integration together? Interestingly, through an analysis of six cities, we found inverse correlations between plan integration scores and physical vulnerability.19 In other words, the higher the plan

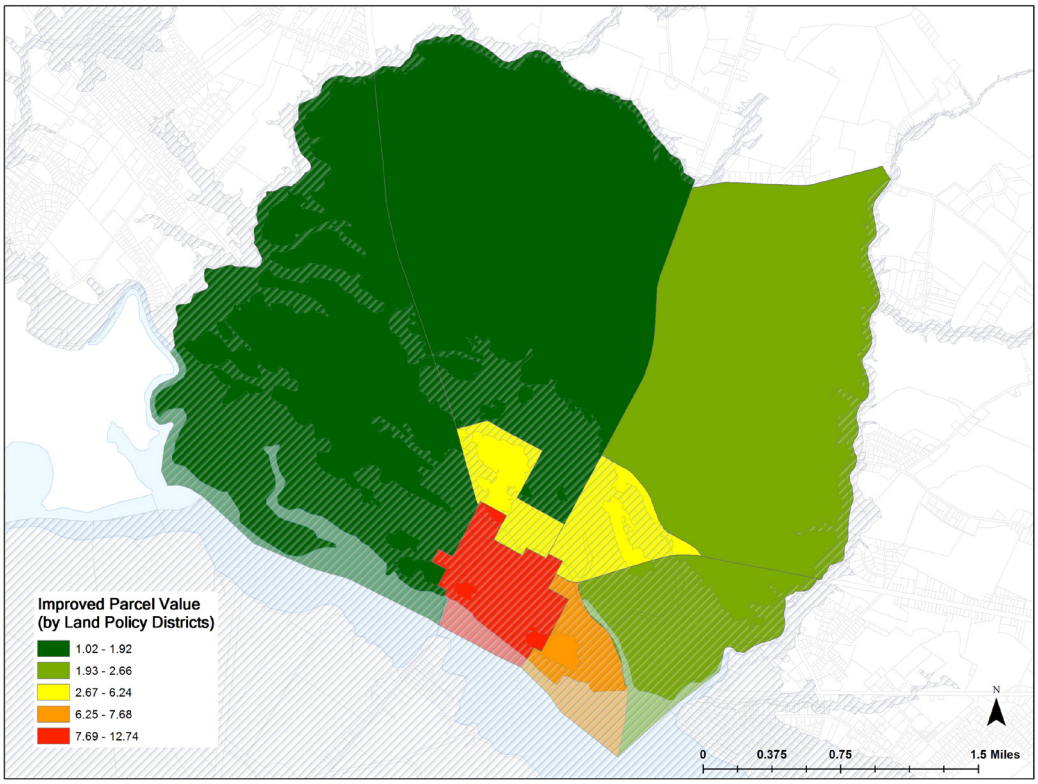


Figure 3.5 Physical Vulnerability by Planning District in Washington, NC.

19 Under review: Berke, Philip, Matthew Malecha, Siyu Yu, Jaekung Lee, Jaimie H. Masterson. Plan Integration for Resilience Scorecard: Evaluating Networks of Plans in Six Coastal Cities. *Landscape and Urban Planning*

score, the lower the level of physical vulnerability across districts. The analysis suggests how various land use policy tools might work together in support of physical vulnerability reduction and the value of targeting districts that are most physically vulnerable. The following describes a few general strategies you can use. There are other great resources available that describe more detailed approaches.

3.3.1 Mapping Parcel Value

One simplified strategy to calculate physical vulnerability is to use the improved parcel value data, along with the previously delineated district-hazard zones. While the improved value data is not all encompassing, it provides two benefits:

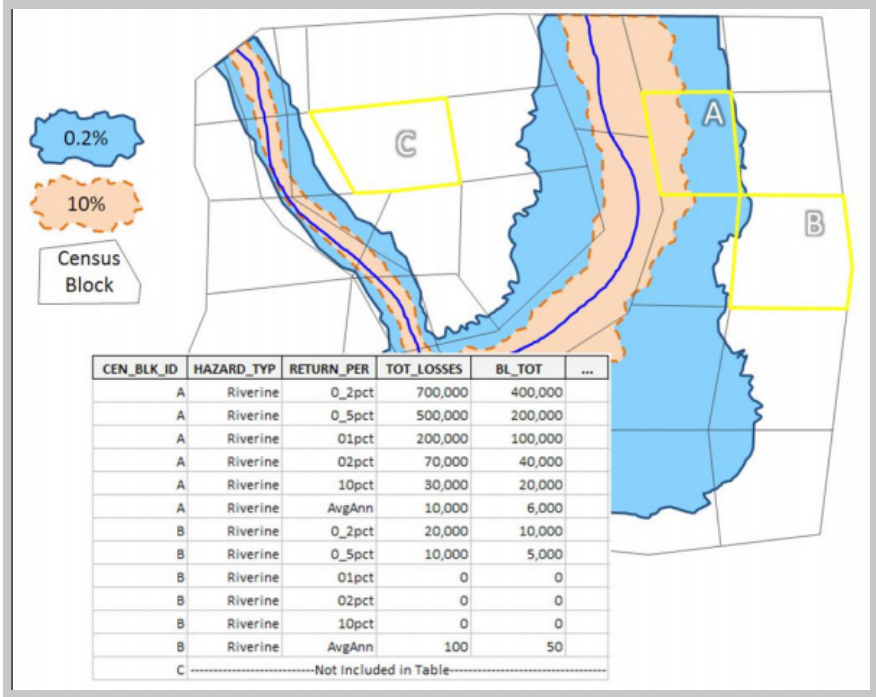
1) All communities have appraisal records available, making it easily accessible.

2) The improved parcel value acts as a simple proxy for investments in the community.

Gather the latest improved parcel value from the appraisal records database, which is usually provided by the county assessor. Also gather the latest parcel boundary shapefile with the parcel code. Ideally you'll want to create a GIS layer by joining the improved parcel

BOX 3.4 Physical Vulnerability within the HAZUS-MH Flood Loss Tool

To quantify the economic and social aspects of flood vulnerability, HAZUS-MH flood loss tool provides a national level database of not only demographic (age, income, race etc.) and infrastructure data, but also critical facilities, transportation and utility networks, and building inventory (GBS: general building stock). Figure 3.6 shows how HAZUS-MH is applied to calculate annualized loss values by different hazard zones. HAZUS provides a table that represents census block, hazard type and flood frequency for the risk assessment performed. In this example, a census block contains flood loss estimates for the 0.2% (500-year) and 10% (10-year) annual chance events.



CEN_BLK_ID	HAZARD_TYP	RETURN_PER	TOT_LOSSES	BL_TOT	...
A	Riverine	0_2pct	700,000	400,000	
A	Riverine	0_5pct	500,000	200,000	
A	Riverine	01pct	200,000	100,000	
A	Riverine	02pct	70,000	40,000	
A	Riverine	10pct	30,000	20,000	
A	Riverine	AvgAnn	10,000	6,000	
B	Riverine	0_2pct	20,000	10,000	
B	Riverine	0_5pct	10,000	5,000	
B	Riverine	01pct	0	0	
B	Riverine	02pct	0	0	
B	Riverine	10pct	0	0	
B	Riverine	AvgAnn	100	50	
C	----------Not Included in Table----------				

Figure 3.6. Example showing economic impacts based on HAZUS results

BOX 3.5 Online Physical Vulnerability Tools:

USGS Structures Inventory Database provides critical facilities data (http://nationalmap.gov/structures.html) reproduced by NOAA within the coastal geographies including coastal shoreline counties, coastal watershed counties, coastal states, the coastal zone and FEMA flood zones. There are 40 different types of facilities grouped into 4 categories; Fire/EMS, Hospital/Medical, Law Enforcement, and Schools.

The data includes point locations and can be downloaded in ESRI geodatabase format for U.S coastal areas. Data can be downloaded from the web at: ftp://rockyftp.cr.usgs.gov/vdelivery/Datasets/Staged/Struct/GDB/

Definitions, methodologies and the geographic descriptions can be found here: https://coast.noaa.gov/dataregistry/search/collection/info/criticalfacilities

Hazus-MH Software from FEMA provides data on physical damage to residential and commercial buildings, schools, critical facilities, and infrastructure and is free to download.

value data to the parcel boundary data using the parcel code shared by both datasets. Find the average improved parcel values for each planning district. The improved values are divided into quintiles by planning district, where 5 is the highest and 1 is the lowest. Values across districts are $0.7 to $12.1 per square foot in the 100-year floodplain and $2.9 to $22.2 per square foot in the sea-level rise zone. Comparing this to the plan policy scores for each district we can see how some districts, like District 1, have higher improved value, but also have the lowest policy scores.

Figure 3.5 shows physical vulnerability in Washington, NC planning districts using the improved parcel value. The most physically vulnerable area is the Central Business District (district 1). It is not a surprise that compared to the scorecard, the Central Business District also scored low because policies within plans were increasing vulnerability in hazard zones. Not only are policies guiding investments into the hazardous areas, property owners are making investments in the area. Policies should focus on ways to decrease vulnerabilities to protect investments.

3.3.2 Looking at Critical Facilities and Infrastructure

Of course, there are drawbacks to using improved parcel value data. For instance, some rural communities do not always have up-to-date reappraisals. We encourage you to explore other metrics and indicators and take the analysis a step further by overlaying critical facilities and other infrastructure to fit your community's context. Critical facilities include structures and infrastructure that are important for proper functioning of a community including, water and wastewater treatment facilities, electricity facilities, hospitals, police and fire departments, schools, public transportation facilities, etc. The true value of a critical facility is often greater than the appraised value, in that when a community's electricity is out for several days, the quality of life is significantly affected. Pull this data, which is already collected by emergency managers within hazard mitigation plans, and overlay with parcel values. Identify which districts have high parcel values and critical facilities. The intersection of the two create hotspots where policies and plans can align to protect and reduce vulnerability to the critical components of our communities. These are a few general strategies to assessing physical vulnerability.

Task 2: Assess Social Vulnerability

Social vulnerability is a term that emerged in the disaster research field in the 1990's and is considered a person or groups "capacity to anticipate, cope with, resist and recover from the impacts of a natural hazard."[20] In other words, disasters affect people in different ways, resulting in some populations that are more vulnerable. There are a number of ways to assess social vulnerability and a number of methodologies in the research literature, and a number of detailed descriptions in other publications and online applications. The general strategy we describe comes from the Center for Disease Control (CDC) has two benefits:

1) Data is easy to access, utilizing data collected from the U.S. Census Bureau's American Community Survey, and

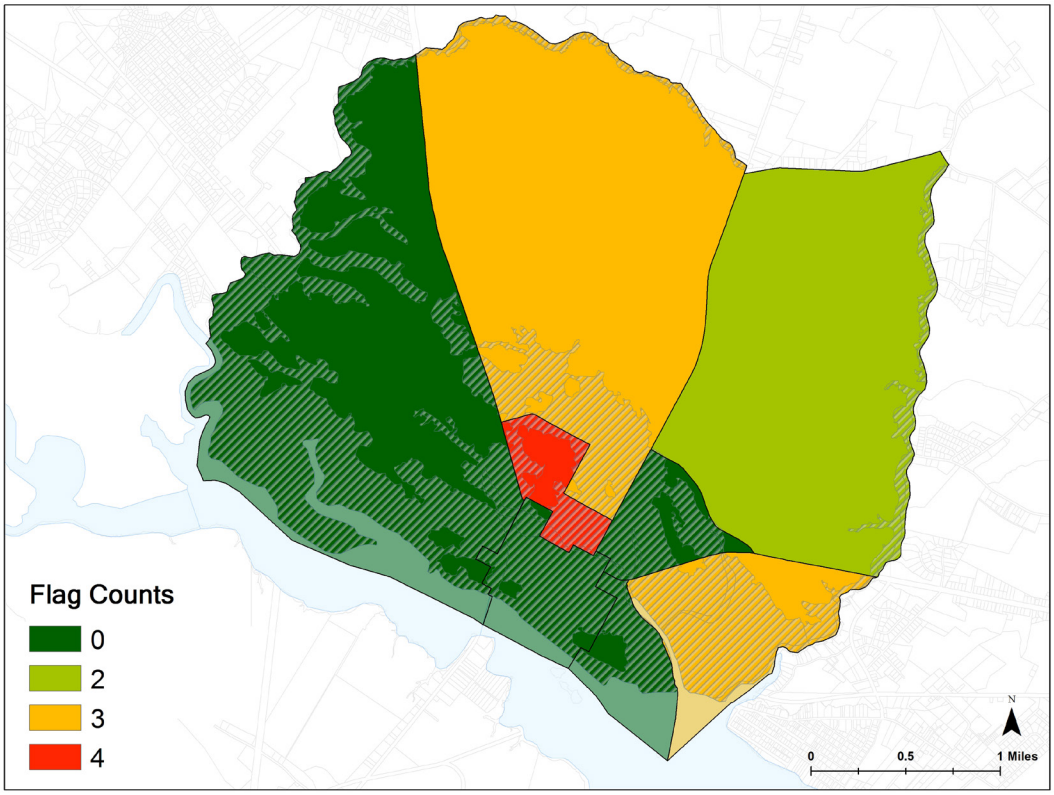


Figure 3.7 Social Vulnerability by Planning Districts. Higher 'flag counts' represent areas with higher levels of social vulnerability and a social vulnerability 'hotspot'.

20 Blaikie, P.M., T. Cannon, I. Davis, and B. Wisner. At Risk: Natural Hazards, People's Vulnerability and Disasters. London: Routledge, 1994. P.

2) The demographic information is combined to generate areas of potential 'need'.

Why assess social vulnerability and plan integration together? In an initial assessment of 6 cities, we found very little attention to social vulnerability within plans. This results in communities developing plans and policies without the most socially vulnerable in mind, potentially impacting response and recovery times. Understanding the spatial distribution of socially vulnerable populations can help prioritize policy changes and investments within the community.

There are several metrics and indicators to assess social vulnerability. The Center for Disease Control (CDC) has mapped social vulnerability by county and census tract and specifically looks at:

Socioeconomic characteristics
- Below poverty
- Unemployed
- Income
- No high school diploma

Household composition and disability characteristics
- Aged 65 or older
- Aged 17 or younger
- Civilian with a disability
- Single-Parent households

Minority status and language barriers
- Minority
- Speak English "less than well"

Housing and transportation characteristics
- Multi-unit structures
- Mobile homes
- Crowding
- No vehicle
- Group quarters

The CDC's 15 social vulnerability indicators (SVI) allow communities large and small to access mapped data as well as download data to use in GIS software. Of course, this data does not need to be gathered in a vacuum. Communities can also use data already gathered in other planning initiatives. If your community already has data on socially vulnerable populations, use it.

Because CDC's data comes from the U.S. Census Bureau, communities that want to take a closer look can download data at the finer scale of census block group. Communities can consider using all 15 indicators or a few that may be more applicable to the context.

Figure 3.7 shows the social vulnerability by district of Washington, NC overlaid with hazard zones. The most socially vulnerable area is district 5, just north of the Central Business District (or district 1) and exposed to flood hazards. Additional attention and investments in this area will make the community more resilient. There is an opportunity to incorporate social vulnerability into plans to prioritize decisions and policy initiatives.

BOX 3.6 Online Resources:

The Center for Disease Control has mapped social vulnerability by county and specifically looks at socioeconomic characteristics, household composition and disability characteristics, minority status and language barriers, and housing and transportation characteristics. (http://svi.cdc.gov/map.aspx)

Digital Coast, NOAA Coastal Services displays hundreds of maps on hazard vulnerability, natural vulnerability, and social vulnerability. (http://csc.noaa.gov/digitalcoast/dataregistry/#/)

NOAA, Office of Science and Technology- Mapping Social Vulnerability maps coastal cities and their social vulnerability which includes, labor force characteristics, housing characteristics, poverty, population composition, and personal disruption. (http://www.st.nmfs.noaa.gov/humandimensions/social-indicators/map)

NOAA's State of the Coast displays population data for coastal counties in the U.S. It also provides important information on coastal communities, economies, ecosystems, climate, and more. (http://stateofthecoast.noaa.gov/population/welcome.html)

The Texas Planning Atlas, as discuss in Masterson et al., 2014, provides social vulnerability indicators described above. Currently, the Atlas only covers Texas, but we anticipate 'lighting up' other states in the near future. (http://coastalatlas.arch.tamu.edu/)

Esri SoVI Mapping Tool summarizes risk for states and counties. At scales greater than 1:3 million, vulnerability is calculated on the state level. At scales less than 1:3 million, scores are calculated for each county. Although this web service provides a simplistic view of social vulnerability, it shows which areas have a greater potential for damage caused by disaster events. (http://www.arcgis.com/home/webmap/viewer.html?layers=0a85781f7890497185d6cde6760a20c5&useExisting=1)

The U.S. Census Bureau, Center for Economic Studies has developed a web mapping tool for communities to better understand their economies. On The Map (http://onthemap.ces.census.gov/) lets you evaluate the primary industries, and the inflow and outflow of your community, among other things.

Social Explorer is an interactive website that pulls Census data in an easy to read format, through maps, tables, graphs. (http://www.socialexplorer.com/explore/tables)

American FactFinder has downloadable data from the U.S. Census Bureau and communities can pull Census Block Group boundary information and shapefiles (https://factfinder.census.gov/faces/nav/jsf/pages/index.xhtml; https://www.census.gov/cgi-bin/geo/shapefiles/index.php?year=2010&layergroup=Block+Groups)

KEY CONCEPTS – Chapter 3, Assessment

Scoring your Network of Plans

'+1' score indicates that a policy positively affects (that is, it reduces) vulnerability for a specific district-hazard zone. In other words, it reduces (directly or indirectly) the exposure of people or structures to the hazard or mitigates the negative effects of the hazard.

'-1' score indicates that a policy negatively affects (that is, it increases) vulnerability for a specific district-hazard zone. In other words, it increases (directly or indirectly) the exposure of people or structures to the hazard or perpetuates the negative effects of the hazard.

'0' score indicates the policy is neutral and has no effect on vulnerability, whether positively or negatively, in the district-hazard zone. The policy itself could increase vulnerability in one district-hazard zone and be neutral in another district-hazard zone.

'Not applicable' score indicates the policy does not refer to the district-hazard zone (or the policy's place-specific term is not located in the district-hazard zone). 'NA' is important to identify (or grey out the cell in the spreadsheet) in order to easily see the spatial impact of policies on district-hazard zones. If left as an empty cell in the spreadsheet, it could easily be confused as not yet scored.

Assess physical vulnerability and social vulnerability as a way to understand vulnerability hotspots for more informed decision making.

Physical vulnerability can include:

- Infrastructure—whether roads, public transportation services, stormwater drains, electrical, water and wastewater lines and facilities or even levees and dams;
- Other critical community facilities—such as schools, fire stations, police stations, hospitals, post offices, etc.
- Structures—whether homes or businesses;

Social vulnerability can include:

- Socioeconomic characteristics—below poverty, unemployed, income, no high school diploma
- Household composition and disability characteristics—aged 65 or older, aged 17 or younger, civilian with a disability, single-parent households
- Minority status and language barriers—minority, speak English "less than well"
- Housing and transportation characteristics—multi-unit structures, mobile homes, crowding, no vehicle, group quarters

CHAPTER 4

SETTING PRIORITIES

One of the first questions from stakeholders will likely be, what can we do to tweak policies so plans are integrated and focused on reducing vulnerabilities? Chapter 4 will facilitate setting priorities among a variety of stakeholder groups and developing a narrative about the patterns among your network of plans. This job of 'translating' the raw scores into a meaningful narrative is critical for changing knowledge of planners and stakeholders. The case studies described in this chapter provide examples in translating the plan integration for resilience scores into a story that stakeholders can easily grasp. The case studies describe communities exposed to hazards, their policies that are reducing vulnerabilities, and recommendations they might pursue to increase plan integration for resilience.

UPDATING PLANS AND POLICIES

You will determine the specific policies that are in conflict across plans including the following:

- Identify weak scores within districts
- Extract policies that are conflicting within districts
- Identify districts with few policies or little policy attention to integration
- Flag specific policies within plans and districts that increase vulnerabilities
- Consider possible policy changes to increase plan integration for resilience
- Flag policy changes that may be the most politically acceptable
- Identify policy changes that require long-term thinking or investments

With a new understanding of the community's network of plans, physical vulnerability, and social vulnerability—whether there are strengths or weaknesses in the network of plans or whether policies increase or decrease vulnerabilities—there is an opportunity to align community values with policies. A key challenge to successful planning is thinking holistically about the future and engaging stakeholders in thinking broadly about the community. So what do you do next?

We see these outcomes as indicators of success for the overall process (as seen in Figure 4.1):

a. Change in knowledge of planners and stakeholders
Increases in knowledge by local planners, emergency managers and stakeholders about roles of alternative plans, how they can be better integrated to increase support for mitigation, reduce duplication of effort, and use limited resources more wisely.

b. Change in plans
Local plans—including a community's general plan, hazard mitigation plan, and others related to reducing vulnerability—should be updated across the board and better integrated.

c. Change in development policy tools
New or revised development policy tools influencing land use and development in hazard areas consistent with the revision of plans, including development regulations (e.g., zoning and subdivision ordinances), incentives (density bonuses, property tax breaks), land acquisition strategies, and design and location of capital improvement projects (transportation, water, sewer).

d. Change in vulnerability outcomes
Reductions in vulnerability as a result of limitations or prohibition of new development (and population) in hazard areas, or the expansion of existing development (and population) in hazard areas across geographic areas.

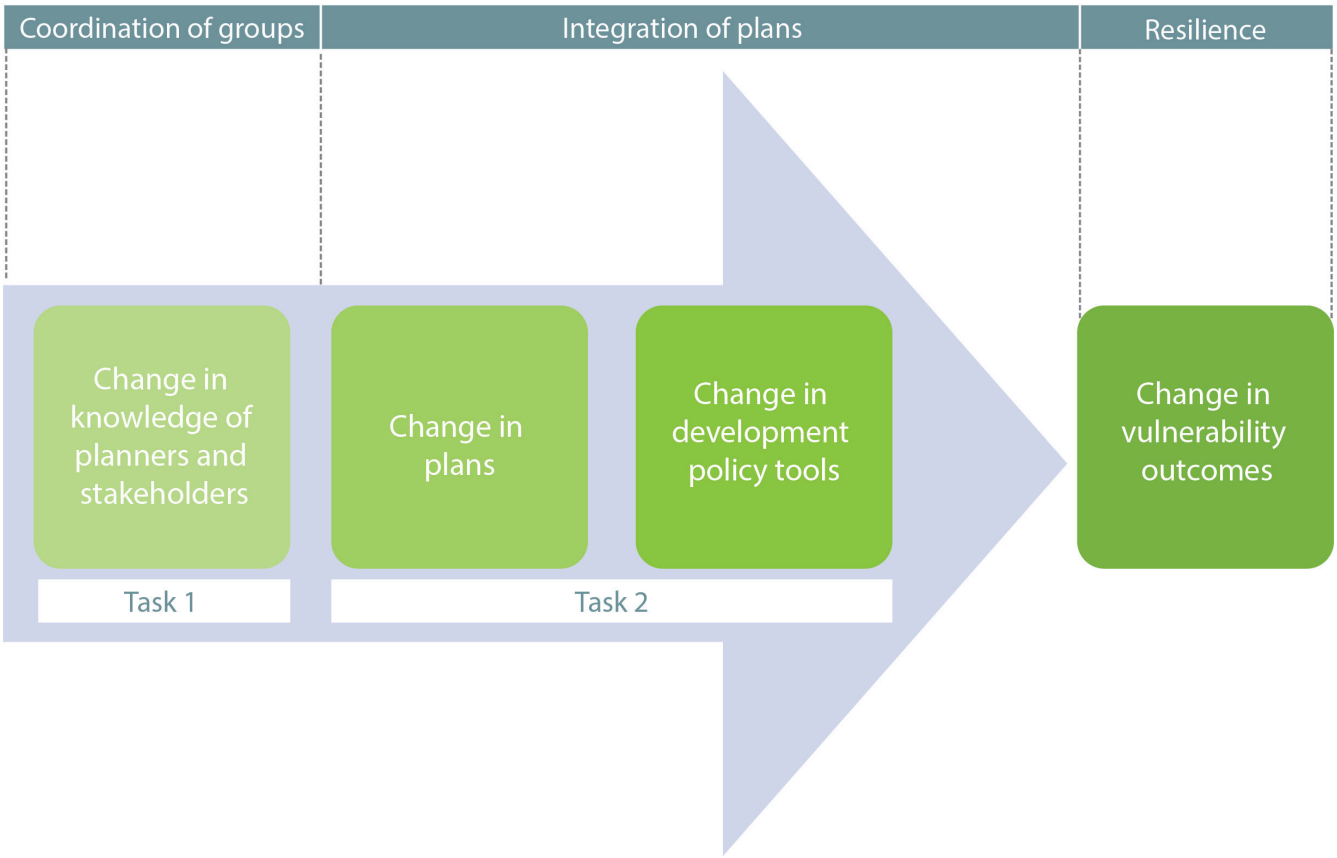


Figure 4.1 The impacts and outcomes of the Resilience Scorecard

OBJECTIVES:

- Engage the community in setting priorities for policy change

MATERIALS REQUIRED:

- Previously created maps
- Tables of policy scores

SKILLS RECOMMENDED:

- Ability to recruit diverse stakeholders
- Ability to design an inclusive public involvement process
- Ability to facilitate group conversations

Checklist:

- Change knowledge of planners and stakeholders
- Change plans and development policy tools

Task 1: Change in Knowledge of Planners and Stakeholders

The change in knowledge of planners and stakeholders begins once a community starts to apply the scorecard. Again, the scorecard is not just about scores, a key component of the scorecard is knowledge derived from the engagement process. The engagement process should yield information about how specific policies might influence public and private land use, foster consistency across the network of plans, and build support for plan implementation. Application of the scorecard provides a comprehensive assessment and deeper understanding of how a network of plans—including those not explicitly intended to address hazard mitigation—are inextricably linked to mitigation and disaster loss. Here is testimony on the value of the collaborative nature of the scorecard tool from planners in the demonstration communities:

"We wanted to see the effect of all our policies on flood resilience because we had never taken such a comprehensive look our policies before. It was also an opportunity to see how different plans stacked up, particularly because we had not previously evaluated the hazard mitigation plan side by side with other community plans." –City of Norfolk;

"We were very intrigued by the spatiality of our policies and hadn't thought about our policies spatially before. This was important to us because our Vision2100 document specifically designates areas of flood protection and retreat." –City of Norfolk;

"We utilized this to update our comprehensive plan and zoning ordinances" –League City; and

"It is important for practice that you are tracing back to the policy." –League City

Problem solving requires many decisions be made with the input and consent of stakeholders and others with "relevant information about the problem and its causes, its solutions, and potential effects."[21] To facilitate the collaborative process, the Engagement Team's primary role is to identify and disseminate the new information to groups of stakeholders with different interests, capacities, and roles within the community. Consider those with the following roles in your community and their respective target audiences (see Table 4.1).

Table 4.1 Who to Engage

Role	Group
Those responsible for planning	Internal staff and or planning consultants
Those responsible for implementing the decision	Elected and appointed officials
Those affected directly by the decisions	Key stakeholders
Those affected indirectly or can influence whether or how the solution is implemented	Residents

Adapted from (Schwarz 2002, p. 27).

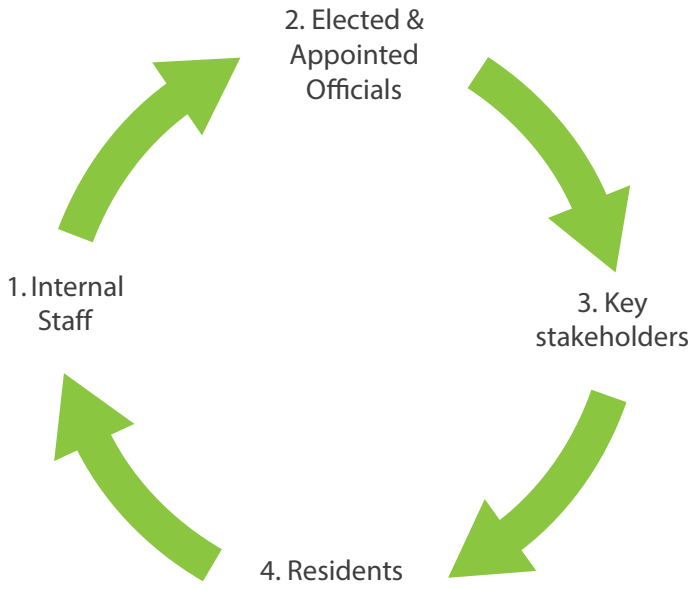


Figure 4.2 The Engagement Team should discuss the Resilience Scorecard with the following groups.

21 Schwarz, R. The Skilled Facilitator : A Comprehensive Resources for Consultants, Facilitators, Managers, Trainers, and Coaches. 2002. p27.

4.1.1 Work with Internal Staff

Meet with internal staff within the various departments responsible for planning to communicate the results. Be sure to identify how plan integration impacts each department's core mission. The group should include a representative from each department or agency responsible for each plan and identify other internal teams that need to be aware of results. Consider discussing the following in the meeting:

- Project background and history
- Plans analyzed
- Policy score maps by plan
- Composite policy score map
- Physical vulnerability and social vulnerability maps

After discussing the results more broadly, discuss specific policies by plan that received negative scores. Start with districts that have high physical and social vulnerability. Brainstorm possible amendments or additional policy tools to align plans. Consider the level of financial investment needed to decrease vulnerability. Communities may also want to discuss vulnerable districts with relatively few policies focused on reducing vulnerability. Brainstorm possible policy tools that could be added to increase resilience. Example worksheets to organize your thoughts can be found in Appendix D.

4.1.2 Engage Elected and Appointed Officials

Now that you have gathered internal staff feedback, you can better communicate to those responsible for implementing the decisions and policy changes, which may include:

- Local legislative bodies (city council, commissioner's court, or other)
- Executive bodies (mayor or other)
- Regional planning commissions
- Other established boards and committees

You may choose to hold a special committee meeting or hearing to discuss the project background and policy score maps, including the physical and social vulnerability maps. Discuss policies in detail by reviewing the worksheet informed by conversations with internal staff (see Appendix D). Speak to bodies about economic resilience, economic loss, and return on investment when there is plan integration. Elected and appointed officials may also anticipate opposition to policy amendments and develop a communication strategy to allay the concerns of potential opponents. Elected and appointed officials and staff should work with groups in opposition early and often.

4.1.3 Engage Key Stakeholders

Next identify stakeholders in the community that may be affected directly by policy changes and decisions. Stakeholders in the planning process may range from individuals and families, to regional, state and national stakeholders, depending on the jurisdiction or resources required. FEMA's Local Hazard Mitigation Planning Handbook offers guidance on who to involve in the process (FEMA 2013). Consider the following stakeholder groups beyond individuals and households:

- Public and private developers
- Owners and operators of buildings and infrastructure systems
- Local business and industry representatives
- Representatives of the community's social institutions (e.g., community organizations, nongovernmental organizations, business/industry groups, health, education)
- Other stakeholders or interested community groups

The purpose and intent of hosting meetings with stakeholder groups is to solicit feedback on possible policy consequences, so elected and appointed officials can make informed decisions for wise and balanced city invest-

ments. Use the steps described in Task 4.1.3 to discuss the Plan Integration for Resilience Scorecard with stakeholders. Describe the areas vulnerable to hazards and the policy score maps that show competing policies. Summarize the suggested policy changes for vulnerable districts with policy conflicts. Discuss the cascading impacts of plan incongruity and or policy change. For instance, a stakeholder group may not agree with policy tools that may increase densities in a particular district. Questions of what to prioritize and the most appropriate strategies will vary by stakeholder groups. Avoid attempting to resolve those complexities for now and simply document the feedback on balancing priorities, then report back to elected and appointed officials.

4.1.4 Engage Local Residents

FEMA's whole community approach recognizes that the federal role is only one small part of overall emergency management system. Effective emergency management occurs when local, tribal, and state partners come together, as well as non-governmental organizations—like faith-based groups and the private sector—with individuals, families, and even local businesses in your community. To that point, attempt to engage all who are affected or could influence whether or how the solution is implemented. Citizens are particularly important because of their knowledge of the local place and potential to lead community-driven implementation efforts. We recommend hosting workshops in neighborhoods with high physical and social vulnerability. There should be intentional effort to connect with groups in these most vulnerable areas to understand their priorities and brainstorm potential solutions. The engagement team should work with existing groups already engaging and trusted in communities (i.e. Resilience AmeriCorps).

To establish trust, we suggest connecting with leaders who are trusted themselves, such as community based non-profit groups, civic clubs, teachers, faith leaders, or social service workers, to effectively reach members of the community.

Similar to hosting meetings with stakeholders, provide residents with a historical overview and the purpose of the Plan Integration for Resilience Scorecard, describing the areas vulnerable to hazards and the policy score maps that show competing policies. Summarize the suggested policy changes for the neighborhood. Residents inherently think about how they and their loved ones will be affected and might think:

- Where is my home and how might it be affected by hazards?
- How might my elderly relative, differently abled neighbor, young child or pregnant wife be impacted by these hazards?
- How will I get to my job or pick up my child from school?
- How will my basic routines be affected---access to basic necessities, healthcare, gas?

Consider asking residents:

- What priority should the city/county/government place on reducing vulnerabilities?
- Which areas of the community are you most concerned about?
- What can the city/county/government do to reduce vulnerabilities and do you think the policy changes will help?
- What time, talent or treasure are you willing to invest in reducing your community's vulnerability

Document the feedback on balancing priorities and report back to elected and appointed officials.

Task 2: Change Plans and Development Policy Tools

The change in plans and development policy tools will likely occur in the short term (3-12 months) after completion of an engagement effort. Change in plans and policies can include amendments to planning documents. For example, the City of Norfolk explained they had not taken such a comprehensive approach to their policies and plans before, that the evaluation process allowed them to see policies spatially and have conversations about the impacts of specific policies. The City of Norfolk planning commission conducted a public hearing which specified policy amendments across various plans, such as:

- Norfolk stated their actions were far too one-dimensional with little specificity or policy implementation tools identified. For example, the hazard mitigation plan did not specify "appropriate strategies to mitigate the impact of flooding to existing flood-prone structures."
- The tool also revealed weaknesses and inconsistencies throughout plans. For example, the location criteria for community facilities within the comprehensive plan did not factor in resiliency metrics, but instead only focused on accessibility to populations and other public uses.
- Norfolk planning staff also indicated they had not previously reviewed or evaluated the hazard mitigation plan in the planning process and the scorecard provided a methodical tool. The public hearing document specifies a variety of "text amendments to better incorporate the actions aimed at mitigation and resilience as outlined" in the hazard mitigation plan across other planning documents (see Box4.1).

With feedback from all the relevant stakeholder groups, your internal staff should work with elected and appointed officials on policy prioritization.

Using the worksheets developed in Appendix D, evaluate the range of policy tools in hotspot areas (with physical and social vulnerability). Take time to review policy alternatives and determine which are the 'low hanging fruit' that could be easily added or amended with little effort, cost, or political opposition. Develop a phased action plan with timelines to address priorities. Actions may include:

- Amending language within existing plans
- Amending subdivision regulations or zoning ordinances
- Adopting new zoning
- Prioritizing vertical elevation in hazard zones
- Strategically moving public facilities out of hazardous areas
- Considering a new resilience planning process (such as the NIST guidance)

The action plan can help guide legislative changes and facilitate plan integration when updating existing plans or drafting new plans.

For more controversial or harder to implement policies, discuss alternative strategies with legislative and executive bodies. There is no easy answer for communities that desire economic investment in hazard zones. For areas that experience perpetual loss for example, the city must weigh the return on investment. Because policies do not change the environment overnight, governments can wisely guide development toward safer areas or in safer ways to avoid the market fall-out that opponents fear will inevitably occur.

BOX 4.1 Norfolk, VA changing plans and policy tools

The City of Norfolk planning commission public hearing demonstrates how Norfolk is amending policies to incorporate elements within the network of plans:

- Incorporate the Vision 2100, their resiliency strategy for sea level rise, into plaNorfolk—the comprehensive plan—to address land use, transportation issues, and facility siting.
- Incorporate the hazard mitigation actions into plaNorfolk as well.
- Amend plaNorfolk to include location criteria of public facilities to address resiliency.
- Amend zoning regulations to better incorporate Vision 2100 and resiliency principles described.
- Include Vision 2100—specifically, the areas in the community they will protect and areas they will strategically abandon—into plaNorfolk, the housing plan, and the waterfront plan.
- Incorporate Vision 2100 into their housing plan to analyze acquisitions that would further resilience.
- Incorporate Vison 2100 into their capital improvement projects to determine major roadway improvements, rail, ferries, etc.
- Will also evaluate the development proposals and budgets based on the Vision 2100 and sea level rise.
- Use the hazard mitigation plan and Vision 2100 as a guide to decide mitigation options.
- Incorporate Vision 2100 into their capital improvement projects when deciding the location of new schools and facilities.
- Assess and re-write ordinances, regulations, and development review criteria to increase integration of resiliency principles and plan policies.
- Include flood insurance rate reductions for residents based on more credits under the NFIP's Community Rating System.

4.2.1 Change in Vulnerability Outcomes

The Plan Integration for Resilience Scorecard identifies compatibilities and conflicts among local plans to reduce vulnerability to hazards. Local plans should target areas most vulnerable to hazards and include policies to decrease vulnerabilities. The scorecard reveals opportunities to improve local hazard mitigation planning to inform decision-makers and the public. Communities can re-evaluate their network of plans in order to monitor and track their progress on increasing resilience over time. In the end, the Plan Integration for Resilience Scorecard is an excellent exercise to identify inconsistencies across plans so communities can holistically tackle the pervasive threat of disasters.

STORIES

Here we tell the plan integration for resilience story of two communities' network of plans, League City, TX and Fort Lauderdale, FL. Both communities face development pressures and have successfully integrated promising strategies to reduce vulnerabilities. The first community (League City) has far better strategies for undeveloped areas, while the second community (Fort Lauderdale) has innovative strategies in already developed areas. Learn from their plan integration stories to better incorporate the lessons learned into your own community. Identifying strategies within other communities will prepare you to change your own community's plan integration for resilience story.

Checklist:

- Identify promising strategies for undeveloped areas
- Identify promising strategies for developed and built-out areas

OBJECTIVES:

- Learn from other communities' network of plans
- Identify strategies for undeveloped and developed areas
- Consider ways to incorporate lessons into your own community

SKILLS RECOMMENDED:

- Familiarity with the Plan Integration for Resilience Scorecard
- Understanding of policies tools

Task 1: Identify promising strategies for undeveloped areas

To begin, let's start with low hanging fruit or policy changes that effect undeveloped areas. League City, Texas is a fairly young community with large amounts of undeveloped land slated to grow considerably in the coming decades. Communities like League City have the potential to change the course of history and guide development to less vulnerable areas or build in such a way to reduce vulnerabilities. Carefully read through the case study and identify strategies that may be applicable to areas in your community that are undeveloped or expected to grow.

City (State)		League City(TX)
Area of Hazard Zone (%)	100-yr*	8.1 sq.mi (15.4%)
	2100 SLR**	19.5 sq.mi (37.0%
Population in Hazard Zone (%)	100-yr	8,488 (9.9%)
	2100 SLR	41,811 (49.0%)
Standard-ized Parcel Value	100-yr	$2.65/ sq.ft (10.7%)
	2100 SLR	$4.75/ sq.ft (43.1%)

*: 100-year floodplain

**: Estimated sea level rise change in 2100 (Excludes 100-year floodplain); League City: 6.29 ft.

Plans Evaluated:

- League City Comprehensive Plan 2035—June 2013
- City of League City Local Mitigation Plan, 2010
- 5-Year Strategic Plan for League City, Texas
- City of League City, Texas Parks & Open Space Master Plan – November 2006

The Plan Integration Story in League City, TX: A Case Study

League City, TX is a bedroom suburb of Houston located in low-lying coastal region facing significant flooding and hurricane hazards. The city has experienced four major flood events since 2000 that were designated as Presidential Disaster Declarations and thus eligible for federal recovery funds. Additionally, the city is rapidly growing with a population increase from 83,500 in 2010 to a projected 228,000 in 2040 (League City 2013). Current land use patterns are dominated by conventional development characterized by low-to-moderate density suburban residential neighborhoods, commercial strip corridors and retail centers. About 4,730 acres (15% of the city's total land area) is in the 100-year floodplain mostly due to the Clear Creek riparian area that runs east to west through League City. Of the floodplain lands, only 496 acres are designated as permanent open space (public parkland and conservation areas), while only 496 acres of floodplain lands designated as permanent open space (public parkland and conservation areas), and the remaining 4,234 acres of floodplain lands are privately owned. There is considerable potential for increased floodplain development as about 57% of the privately-owned floodplain land is undeveloped. Past floodplain development has fragmented aquatic systems and filled in wetlands along major coastal creeks and lake shorelines, which offer critical flood hazard mitigation functions.

4.3.1 Overview of Network of Plans

League City's network of four plans (comprehensive, hazard mitigation, parks, and capital improvements) is highly integrated and supports a common policy framework aimed at hazard vulnerability reduction. The introduction of the comprehensive plan reflects the city's strong commitment to plan integration by indicating that,

> "the Comprehensive Plan embraces the intentions and recommendations of other plans and serves as a bridge tying the solutions of other plans [to achieve]…the desired character and development patterns in the community"
>
> (League City 2011, p. 4).

All plans include similar hazard goals involving protection of people and structures through sound development and/or environmental practices that support flood mitigation. The comprehensive plan, mitigation plan, and parks plan contain the city's future land use map to guide future new development and redevelopment.

The following sections dive deeper in two planning districts. The first district (Challenger Seven Memorial Park district or District 7), has innovative policies to reduce vulnerabilities, but they are within a low vulnerability area. The second district (W Main St. district or District 10), reveals far less innovation of policies in areas that are most vulnerable to hazards.

4.3.2 Innovative Policies in Low Vulnerability Areas

The Challenger Seven Memorial Park District (or District 7; see Figure 5.1) exemplifies how the city's network of plans prioritizes vulnerability reduction in districts that are less developed. The plan integration score has the fifth highest score in reducing physical vulnerability (+37), but the third lowest in physical vulnerability among the city's 21 districts. About 22%

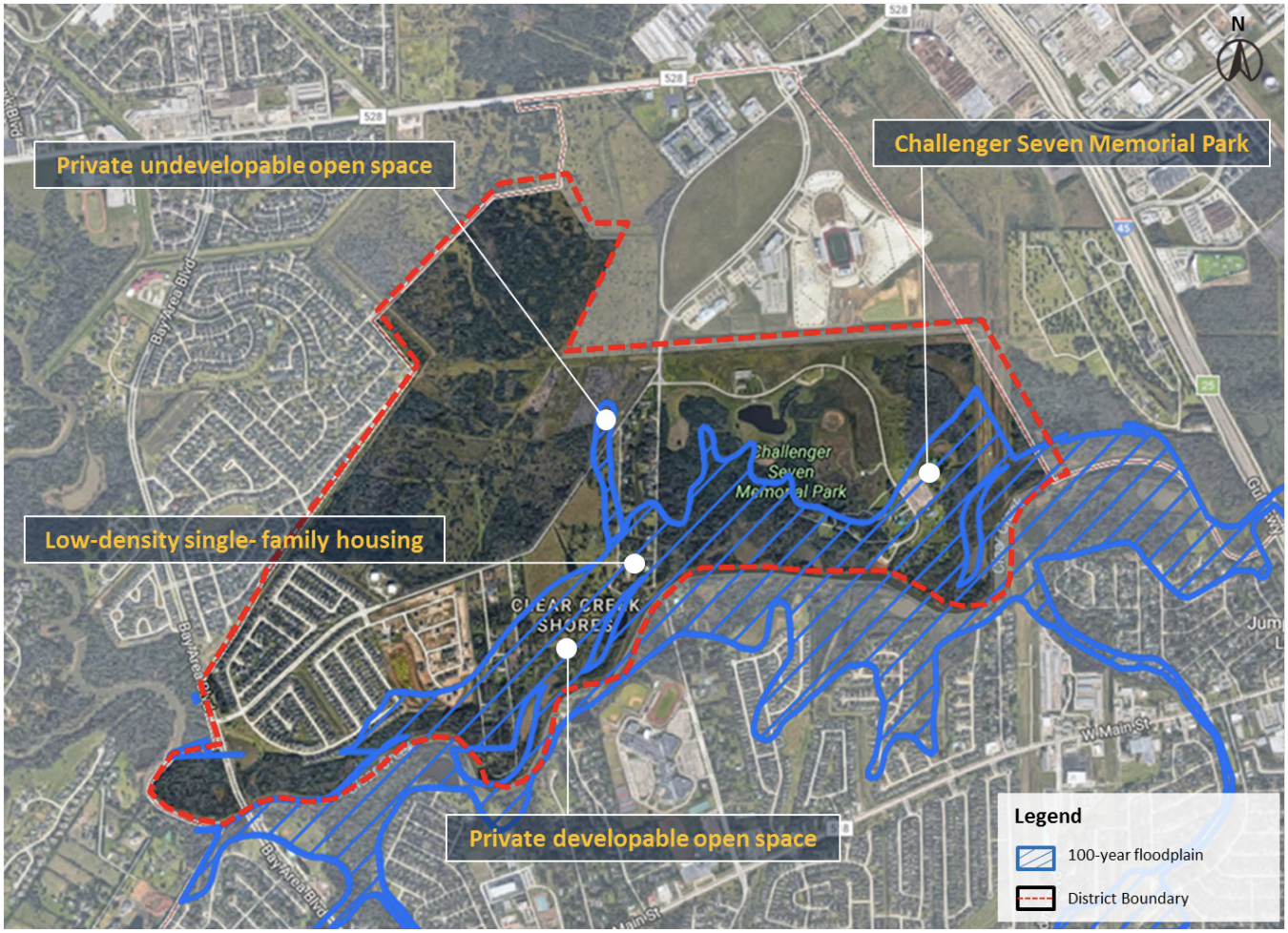


Figure 5.1: District 7, League City Texas

(197 acres) of the district is located in the 100-year floodplain. Of the current floodplain land uses,

- 55% (110 acres) is designated as park,
- 31% (60 acres) as private developable open space, and
- 14% (27 acres) as low-density single-family housing (see Figure 5.1). [21]

Among the four plans, only the comprehensive plan includes policies that support more development in the floodplain in this district. These include zoning policies that allow "granny flats" in existing single-family homes and designate privately owned open spaces for low-density development. However, the plans place more attention on avoidance of future development in the floodplain, especially in the Clear Creek riparian area that runs along the southern boundary of the district (see Figure 5.1).

Several prominent themes of policies work together to reduce new floodplain development vulnerabilities:

Land use regulations aimed at reducing vulnerability in undeveloped floodplains:

- The comprehensive plan proposes new floodplain development with buffer regulations to enhance preservation of floodplain riparian lands.
- The comprehensive plan proposes subdivision regulations that require clustering and open space dedication standards for setting aside natural areas that include floodplains.
- The implementation elements of the hazard mitigation plan and parks plan explicitly indicate that the city revise ordinances to be consistent with the proposed changes in the comprehensive plan.

Public spending for land acquisition in proposed conservation areas in undeveloped floodplains:

- The comprehensive plan, parks plan, and hazard mitigation plan all specify that land acquisition funds be used to target riparian areas and wetlands that serve to mitigate flood impacts, provide recreation and water conservation benefits, as well as create trails that link open spaces.

Public facility investments aimed at reducing impacts of flooding:

- The comprehensive plan and parks plan support investment in stormwater management facilities (e.g., rain gardens and swales) in parks to provide flood mitigation and other environmental benefits to surrounding neighborhoods.
- The parks plan and hazard mitigation plan propose a string of flood detention lakes connected by trails for a regional drainage corridor.
- The mitigation plan prohibits construction of government buildings and special needs facilities (medical facilities, nursing homes) in floodplains.

Development limits are tied to evacuation times for new developments:

- The hazard mitigation plan and comprehensive plan support setting density limit standards due to the impacts of new development on evacuation times along emergency routes.

4.3.3 Little Attention to High Vulnerability Areas

The W. Main St. District (or District 10; see Figure 5.2) offers of an example of how the network of plans gives far less attention to reducing vulnerability in districts that are physically vulnerable. The district has the fourth lowest policy score (+12), but has the sixth highest of physical vulnerability among 21 districts in the city. About 46% (100 acres) of the district is located in the 100-year floodplain, with limited opportunity for new development. Roughly,

- 71% (71 acres) of the floodplain land is used as low-density single-family housing,
- 5% (5 acres) in commercial use
- 2% (2 acres) as park land (see Figure – annotated google map).
- The remaining floodplain land use includes private undevelopable open space (22%, 22

21 GIS Datasets by Houston-Galveston Area Council: http://www.h-gac.com/rds/gis-data/gis-datasets.aspx

acres), but none of the private open space land is developable.

Policies in the comprehensive plan support increased development in the 100-year floodplain in this district, including zoning policies that support infill development by allowing a "granny flat" into any existing single family home, and design guidelines that support infill on large lots currently occupied by a residential unit that can be subdivided. W. Main St. district (District 10) does not include a high priority conservation district like Clear Creek riparian areas. As a result, many of the conservation protection policies that are relevant to the Challenger Seven Memorial Park district (District 7) are not applicable in District 10. Despite this, **a few policies deal with reducing vulnerability to existing development:**

Figure 5.2: District 10, League City, Texas

- Public facility investment policies aimed at reducing impacts from flooding appear in comprehensive plan, hazard mitigation plan, and parks plan. Examples include best practices for stormwater mitigation (e.g., pervious pavement for parking lots, detention ponds, rain gardens, and vegetative swales), and purchase of drainage easements in the floodplain.
- Affordable housing includes a stormwater drainage infrastructure policy aimed at an existing underserved, low-income neighborhood in floodplain areas, but this policy is not coordinated with other plans.
- The hazard mitigation plan includes a land acquisition program for repetitive flood loss properties in existing neighborhoods, but the targeting of properties is not coordinated with the future land use policies in the comprehensive plan or other local plans.

Task 2: Identify best strategies for built-out areas

City (State)		Fort Lauderdale (FL)
Area of Hazard Zone (%)	100-yr*	16.9 sq.mi (46.9%)
	2100 SLR**	15.8 sq.mi (43.9%)
Population in Hazard Zone (%)	100-yr	66,514 (40.0%)
	2100 SLR	84,981 (51.1%)
Standardized Parcel Value	100-yr	$22.0/ sq.ft (44.9%)
	2100 SLR	$22.0/ sq.ft (48.3%)

*: 100-year floodplain

**: Estimated sea level rise change in 2100 (Excludes 100-year floodplain); League City: 6.29 ft.

Many communities already fully-developed or built-out and exposed to hazards may fear there are limited options to reduce vulnerability. Here, we focus on Fort Lauderdale, Florida, one of the most vulnerable cities in the United States. Carefully read through the case study and identify strategies that may be applicable to areas in your community that are already developed.

The Plan Integration Story in Fort Lauderdale, FL: A Case Study

Fort Lauderdale is the largest city in Broward County, Florida. Located along the state's southeastern coast and nicknamed the "Venice of America" due to its many canals, the city offers 337 miles of coastline. It is a principle city of the Miami metropolitan area, which is home to 5,564,635 people (2010 U.S. Census Bureau) and is considered one of the world's most vulnerable urban areas with respect to climate change and hazard events. Fort Lauderdale faces significant flooding, thunderstorm, tornado, and hurricane hazards (Broward County 2012). The city is almost entirely built out, with only four percent remains vacant (City of Fort Lauderdale 2008). As a high-amenity location, however, much potential exists for redevelopment—including in the 100-year floodplain, which encompasses approximately 44% of the city. Land use in Fort Lauderdale is a mix of:

- 55% residential (41%),
- utility (34%),
- commercial (12%),
- industrial (6%), and
- institutional (3%) uses.

4.4.1 Overview of Network of Plans

The city of Fort Lauderdale's network of eight plans (city comprehensive plan; local mitigation strategy; county comprehensive plan; city consolidated plan; downtown master plan; downtown new river master plan; Davie Boulevard corridor plan; South Andrews Avenue plan) is well-integrated and generally reduces vulnerability to hazards. The Coastal Management Element of the city's comprehensive plan essentially satisfies the requirements of Chapter 163, Florida Statutes that

> "local coastal governments plan for [and] restrict development where development would damage or destroy coastal resources and protect human life and limit public expenditures in areas that are subject to destruction by natural disaster"(Fort Lauderdale 2008, p. 4-1).

The county's hazard mitigation plan places high priority on mitigating floodplain development in highly vulnerable areas. Throughout the city's network of plans, however, much attention is paid to development or redevelopment of areas that are of regional significance, known as Regional Activity Centers (RACs).

The following sections dive deeper into one best practice planning district. The district (Lauderdale Beach/Dolphin Isles or District 27), is almost entirely developed and highly vulnerable, yet the city has managed to fully integrate plans and pursue innovative policies to reduce vulnerabilities.

4.4.2 High vulnerability and high score

The Lauderdale Beach/Dolphin Isles district (or District 27; Figure 5.3) is a largely residential neighborhood located between the Intracoastal Waterway and the Atlantic Ocean in eastern Fort Lauderdale. It is entirely within the state-designated Coastal High Hazard Area (CHHA; City of Fort Lauderdale 2008), an overlay zone. It ranks in the top ten of Fort Lauderdale's districts in physical vulnerability and is among the highest overall in terms of policy score (+45), ranking 3rd out of 111 districts. As Figure 5.31 shows, about 61.7 % (99 acres) of the district is located in the 100-year floodplain. Within this hazard zone, land uses are:

- low-density single-family housing (58%, 58 acres),
- multi-family housing (25%, 25 acres),
- community facility (5.4%, 5 acres),
- hotel (0.3%, 0.3 acres),
- commercial (4.9%, 5 acres),
- office (1%, 1 acre), and
- open space (0.3%, 0.3 acres).

Plans Evaluated:

- 2008 Fort Lauderdale Comprehensive Plan
- 2012 Enhanced Local Mitigation Strategy for Broward County
- 2014 Broward County Comprehensive Plan
- The City of Fort Lauderdale 2010–2015 Consolidated Plan
- 2007 Downtown Master Plan
- 2008 Downtown New River Master Plan
- 2007 Davie Boulevard Corridor Master Plan
- 2004 South Andrews Avenue Master Plan

Lauderdale Beach/Dolphin Isles serves as a best practice example because Fort Lauderdale's network of plans gives much more attention to reducing vulnerability than to increasing development in this highly physically vulnerable district.

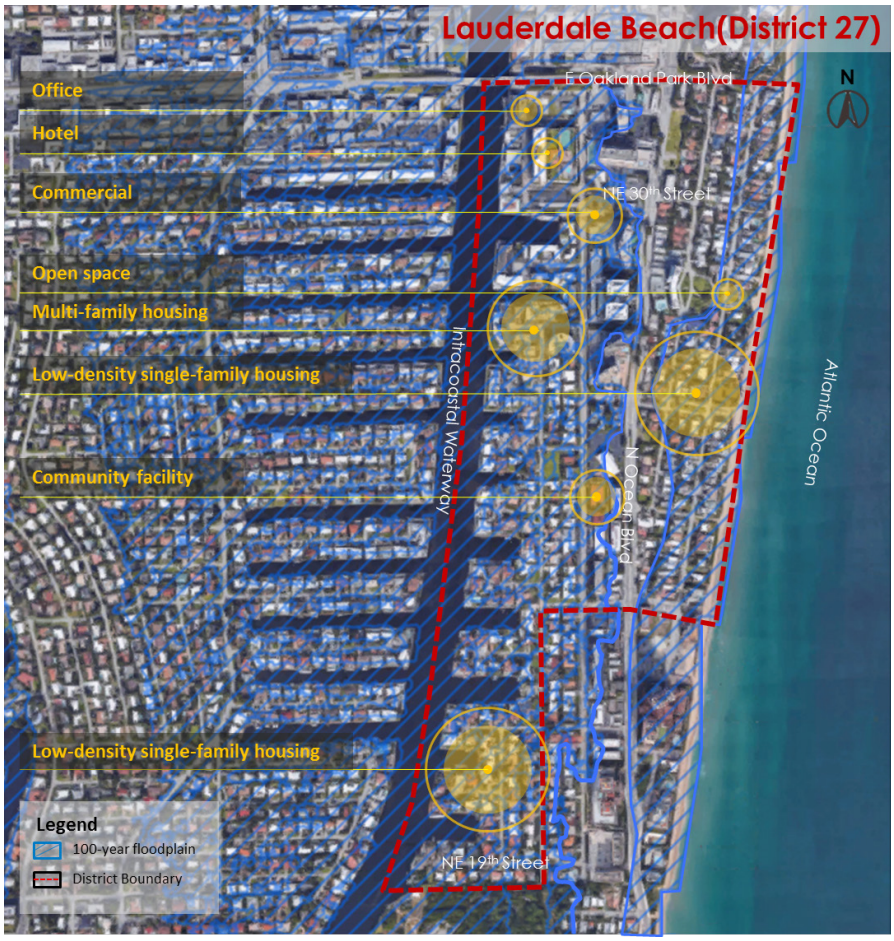


Figure 5.3: Satellite view of the Lauderdale Beach/Dolphin Isles neighborhood (District 27) in Fort Lauderdale, FL, with 100-year floodplain extent (blue hatch)

Fifty-three polices across three plans (city comprehensive plan; county local mitigation strategy; county comprehensive plan) affect Lauderdale Beach/Dolphin Isles. Only four polices are likely to increase vulnerability by promoting redevelopment and reuse, all four of which are located in the city comprehensive plan. Three are linked to development regulations and one is tied to post-disaster reconstruction decisions.

All three of Fort Lauderdale's plans focus more on vulnerability reduction. **Several prominent themes of policies work together to reduce existing vulnerability and to prevent vulnerability due to future development or redevelopment in Lauderdale Beach/Dolphin Isles:**

Development regulations aimed at protecting coastal and hazard-prone areas:

- Policies throughout the city and county comprehensive plans encourage protection and conservation of existing natural beaches or berm areas, wetlands, and other types of open space in coastal and hazard-prone areas.
- Policies propose to regulate inappropriate development and limit land use densities and intensities within the CHHA overlay zone in sensitive areas such as floodplains (short-term focus on the 100-year floodplain and long-term focus on the 500-year floodplain).
- Enforcement and monitoring are also encouraged with respect to compliance with the regulations of the Florida Department of Environmental Protection's Coastal Construction Control Line (CCCL), a statewide program to protect the state's beaches and dunes.
- Several polices suggest an inventory of hazard-prone properties throughout the city, which may result in the implementation of development regulations, such as setback provisions and other site controls, to reduce future property damages and losses.

Land acquisition and land use guidelines aimed at reducing vulnerability for new development and redevelopment in coastal and hazard prone-areas:

- Fort Lauderdale's comprehensive plan contains policies suggesting that undeveloped land in the CHHA overlay zone should be considered for acquisition as recreation, open space, or restoration to its natural state.
- All new construction along the beachfront should be consistent with design guidelines and criteria established during the designation of the CCCL.
- The impacts of development or redevelopment are to be limited with respect to wetlands, water quality and quantity, wildlife habitat, living marine resources, and beach dune system. Similarly, drainage and stormwater management in new developments should follow designated standards to mitigate future impacts.

Directing capital funding related to coastal and hazard-prone areas:

- Policies in Broward County's comprehensive plan and the hazard mitigation plan direct public expenditures to improve public infrastructure in the CHHA overlay zone, including existing wellfields, surface or subsurface storage facilities, control structures, water and wastewater treatment plants, and transmission infrastructure.
- Several policies in the county's comprehensive plan propose that capital improvement funds focus on projects which restore the dune system and enhance natural resources, such as beach nourishment.
- Policies in the hazard mitigation plan require that hazard mitigation considerations link to the capital improvement funding process.

4.4.3 Strategies to Further Increase Resilience and Plan Integration

Like much of Fort Lauderdale, the Lauderdale Beach/Dolphin Isles neighborhood (or District 27) is almost fully built out and much of it is in the 100-year floodplain. Options are therefore limited with respect to reducing future physical vulnerability. Rather than directing new development to less hazardous areas, which is a good option for cities that have yet to reach build-out and/or have substantial lands outside the hazard zone, the Lauderdale Beach/Dolphin Isles district (and Fort Lauderdale as a whole) must build resilience and plan integration through measures that can be applied in situ. T**he themes described above may be complemented through several additions:**

- In addition to requiring new development in the CHHA overlay zone to meet certain criteria, Fort Lauderdale's network of plans could focus on elevation requirements for existing structures, directing grants and funding to preventative elevation of single-family and multi-family structures above current flood safety standards.
- To enhance the land acquisition strategy in Fort Lauderdale's

comprehensive plan, density transfer or transfer-of-development programs could be encouraged that include hazard-prone coastal neighborhoods like Lauderdale Beach/Dolphin Isles.

- In addition to protecting the coastal ecology through conservation, overlay regulations, and beach nourishment, vulnerability could be reduced by directing capital funds to more holistic vegetation-based approaches, such as encouraging reforestation and vegetated dunes on the seaward side and mangrove areas in the canals.

GLOSSARY

Term	Definition	Source
100-year Floodplain	Land area predicted to flood during a 100-year storm event, which by definition has a 1 % chance of occurring in a given year.	http://www.fema.gov
2010 Sea Level Rise	The new 100-year floodplain in 2100 due to sea level rise	http://www.fema.gov
Acquire Land & Property	Purchase land/property in hazard area	North Carolina Division of Emergency Management, 1998
Built Environment	The built environment is a material, spatial and cultural product of human labor that combines physical elements and energy in forms for living, working and playing. It has been defined as "the humanitarian-made space in which people live, work, and recreate on a day-to-day basis.	Roof, K; Oleru N. (2008). "Public Health: Seattle and King County's Push for the Built Environment.". J Environ Health 71: 24–27.
Capital Improvement Programming (CIP)	Capital improvements programs are timetables that define when, where, and what level of municipal services a government will supply. Typically a part of the comprehensive plan, the CIP sets public spending on improvements for the ensuing five to ten years. Timetables can be effective at managing growth because it is rarely feasible for a developer to provide water, sewer and other services without a public subsidy.	North Carolina Division of Emergency Management, 1998
Central Business District	The commercial and business center of a city. In larger cities, it is often synonymous with the city's "financial district"	www. scalloway.org.uk
Cluster Development	Provision requiring clustering of development away from hazardous areas, such as through conservation subdivisions	North Carolina Division of Emergency Management, 1998
Coastal High-hazard Areas	An area of special flood hazard extending from offshore to the inland limit of a primary frontal dune along an open coast and any other area subject to high velocity wave action from storms or seismic sources. The coastal high hazard area is identified as Zone V on Flood Insurance Rate Maps (FIRMs). Special floodplain management requirements apply in V Zones including the requirement that all buildings be elevated on piles or columns.	http://www.fema.gov

Comprehensive Plan	Comprehensive plans identify how a community should be developed and where development should not occur. They govern the rate, intensity, form and quality of physical development. A thorough comprehensive plan will also address economic development, environmental, social and hazard mitigation concerns.	North Carolina Division of Emergency Management, 1998
Density Bonuses	Density bonuses such as ability to develop with greater density in return for dedication or donation of land in areas subject to hazards	North Carolina Division of Emergency Management, 1998
Density of Land Use	Provision regulating density (e.g. units per acre); may be tied to zoning code	North Carolina Division of Emergency Management, 1998
Design/ Construction Guidelines/ Requirements	Guidelines or requirements that apply to the design or construction of developments in hazard areas	North Carolina Division of Emergency Management, 1998
Development Moratorium	Provision imposing a moratorium on development for a set period of time after a hazard event to allow for consideration of land use change	North Carolina Division of Emergency Management, 1998
Disaster Mitigation Act of 2000 (DMA)	The Disaster Mitigation Act of 2000 (DMA) requires all local governments to adopt hazard mitigation plans approved by FEMA to be eligible for federal pre and post-disaster mitigation funds. For the first time, federal policy shifted to a more proactive approach- hazard mitigation planning.	North Carolina Division of Emergency Management, 1998
Drainage Improvements or Flood Control	Provision that pertains to drainage or flooding issues within the community	North Carolina Division of Emergency Management, 1998
Ecosystem Enhancement	Provision that seeks to improve or preserve the functioning of the natural environment within the community	North Carolina Division of Emergency Management, 1998
EDA	U.S. Economic Development Administration	https://www.eda.gov
Elevating	Provision pertaining to the physical elevation of structures in hazard zones	North Carolina Division of Emergency Management, 1998
Emergency Management	The creation of plans through which communities reduce vulnerability to hazards and cope with disasters.	"Maine Emergency Management Agency" (2007). "What is Emergency Management?" Drabek, Thomas (1991). Emergency Management: Principles and Practice for Local Government. Washington, D.C.: International City Management Association. pp. xvii.

EPA	U.S. Environmental Protection Agency	https://www3.epa.gov
FEMA	Federal Emergency Management Agency	http://www.fema.gov
Floodplain Management	Floodplain management addresses the hazard risk of communities partially or entirely located in a floodplain. The term also refers to the application of structural mitigation measures and codes to existing or proposed buildings in the floodplain.	North Carolina Division of Emergency Management, 1998
Functional Plan	The planning that is made to ensure smooth working of the organization taking into account of the needs of each and every department.	http://www.yourarticlelibrary.com/planning/planning-types-corporate-operational-functional-and-proactive-planning/25637/
Future Land Use Plan	Urban planning encompassing various disciplines which seek to order and regulate land use in an efficient and ethical way, thus preventing land-use conflicts. Governments use land-use planning to manage the development of land within their jurisdictions.	Young, A., 2003
Hazard Exposure	Hazard exposure is a state of being in which a person or a group of people remain in an imminent risk of danger. Such dangers are related to the workplace health safety and environment or day to day life.	https://www.safeopedia.com/definition/681/hazard-exposure-safety
Hazard Mitigation Plan	Hazard mitigation is the practice of reducing risks to people and property from natural disasters. A hazard mitigation plan specifies actions a community will take to reduce its vulnerability to natural hazards or to minimize the impact of a hazard event.	North Carolina Division of Emergency Management, 1998
Hazard Zones	In the guide book, hazard zones equal to flood zones. Flood zones are geographic areas that the FEMA has defined according to varying levels of flood risk. These zones are depicted on a community's Flood Insurance Rate Map (FIRM) or Flood Hazard Boundary Map. Each zone reflects the severity or type of flooding in the area.	http://www.fema.gov
Historic District	A historic district is a group of buildings, properties, or sites that have been designated by one of several entities on different levels as historically or architecturally significant. Buildings, structures, objects and sites within a historic district are normally divided into two categories, contributing and non-contributing.	"History of Local Historic Districts". Establishing Local Historic Districts. Massachusetts Historical Commission.

HUD	U.S. Department of Housing and Urban Development	http://portal.hud.gov/hudportal/HUD
Impact / Special Study /Protection Fees	Provision requiring impact fees, special study fees, or protection fees for development in hazardous areas; fees could cover costs of structural protection	North Carolina Division of Emergency Management, 1998
Infrastructure	Infrastructure refers to structures, systems, and facilities serving a country, city, or area, including the services and facilities necessary for its economy to function. It typically characterizes technical structures such as roads, bridges, tunnels, water supply, sewers, electrical grids, telecommunications, and so forth, and can be defined as "the physical components of interrelated systems providing commodities and services essential to enable, sustain, or enhance societal living conditions.	Sullivan, Arthur; Steven M. Sheffrin (2003). Economics: Principles in action. Upper Saddle River, New Jersey 07458: Pearson Prentice Hall. p. 474. ISBN 0-13-063085-3. Fulmer, Jeffrey (2009). "What in the world is infrastructure?". PEI Infrastructure Investor (July/August): 30–32.
Infrastructure "Hardening" or Weatherproofing	Provision encouraging or requiring development in hazard zones to increase structural resilience to hazards	North Carolina Division of Emergency Management, 1998
Land Suitability	Hazards are one of the criteria used in analyzing and determining the suitability of land for development	North Carolina Division of Emergency Management, 1998
Mappable Areas	An area in the community that can be mapped or is place-specific. Such areas can include, existing neighborhoods, existing commercial centers, natural areas, floodplain, native habitats, wetlands, primary conservation area, secondary conservation area, structures that frequently flood, and existing community facilities. Area/place: neighborhood, park; line: river, bike path, road; Point: critical infrastructure (school, fire department).	
National Research Council (NRC)	The National Research Council (NRC) is a private, nonprofit institution in the United States founded in 1916, which produces reports that shape policies, inform public opinion, and advance the pursuit of science, engineering, and medicine.	"ARTICLES OF ORGANIZATION OF THE NATIONAL RESEARCH COUNCIL Approved June 15, 2007". National Research Council. Retrieved 22 March 2014.
NIST	National Institute of Standards and Technology	http://www.nist.gov
Open Space or Easement Requirement/ Purchase	Provision encouraging open space purchase by the community or open space easements as an element of development approval	North Carolina Division of Emergency Management, 1998

Permitted Land Use	Provision regulating the types of land use (e.g. residential, commercial, industrial, open space, etc.) permitted in areas of community; may be tied to zoning code	North Carolina Division of Emergency Management, 1998
Physical Vulnerability	Physical Vulnerability is determined by aspects such as population density levels, remoteness of a settlement, the site, design and materials used for critical infrastructure and for housing (UNISDR).	http://www.odpm.gov.tt/node/162
Place-specific term	An area in the community that can be mapped or is place-specific. Such areas can include, existing neighborhoods, existing commercial centers, natural areas, floodplain, native habitats, wetlands, primary conservation area, secondary conservation area, structures that frequently flood, and existing community facilities. Area/place: neighborhood, park; line: river, bike path, road; Point: critical infrastructure (school, fire department).	
Post-Disaster Capital Improvements	Provision related to adjusting capital improvements to public facilities following a hazard event	North Carolina Division of Emergency Management, 1998
Post-Disaster Land Use Change	Provision related to changing land use regulations following a hazard event; may include redefining allowable land uses after a hazard event	North Carolina Division of Emergency Management, 1998
Public facility siting	Provision to site public facilities, including municipal buildings and public housing, out of hazard areas	North Carolina Division of Emergency Management, 1998
Public facility sizing/capacity	Provision limiting capacity of public facilities, including public housing, in hazard areas to cap amount of development	North Carolina Division of Emergency Management, 1998
Resilience	the ability to prepare and plan for, absorb, recover from, and more successfully adapt to adverse events)	National Academies, 2012, p.1
RPC/EDD	Employment Development Department	
Setbacks or Buffer Zones	Provision requiring setbacks or buffers around hazardous areas (e.g. riparian buffers and ocean setbacks)	North Carolina Division of Emergency Management, 1998
Site Review	Provision requiring addressing hazard mitigation in process of reviewing site proposals for development	North Carolina Division of Emergency Management, 1998

Slope/Dune Stabilization	Provision that pertains specifically to stabilization of slopes or dunes or seeks to control erosion	North Carolina Division of Emergency Management, 1998
Small Area Plans	Small-area plans apply to a range of situations and therefore come in a variety of forms. Some focus on redevelopment within built-up parts of the planning jurisdiction. Others apply to new urban and suburban development on the urban fringe. Still others address not development, but the protection of natural resources form development. Some are part of a whole constellation of similar small-area plans, more or less covering the planning jurisdiction in a systematic manner, following unified guidelines on content and process. Others are single shot attempts to address issues in special areas in a more or less opportunistic manner. The more common types of plans include the following: district or sector plan, transportation corridor plan, neighborhood plan, business center revitalization plan, redevelopment area plan, transit station area plan, historic or appearance district plan, facilities complex plan, natural resource area plan, specific development plan.	Berke et al (2006). Urban land use planning 5th ed, Urbana: University of Illinois Press, ISBN:0252030796.
Social Vulnerability	Social vulnerability has been defined in terms of people's "capacity to anticipate, cope with, resist and recover from the impacts of a natural hazard". Social Vulnerability refers to the inability of people, organizations and societies to withstand adverse impacts to hazards due to characteristics inherent in social interactions, institutions and systems of cultural values. It is linked to the level of well-being of individuals, communities and society. It includes aspects related to levels of literacy and education, the existence of peace and security, access to basic human rights, systems of good governance, social equity, positive traditional values, customs and ideological beliefs and overall collective organizational systems (UNISDR).	Wisner, Blakie, Canon & Davis, 2004, p. 11 http://www.odpm.gov.tt/node/162

Subdivision Ordinance	Local municipal ordinances specifying the conditions under which a tract of land can be subdivided. The ordinances may include layout and construction, street lighting and signs, sidewalks, sewage and storm water systems, water supply systems, and dedication of land for schools, parks, etc.	http://www.dictionaryofconstruction.com/definition/subdivision-regulations.html
Subdivision Regulations	Provision controlling the subdivision of parcels into developable units and governing the design of new development (e.g. site storm water management)	North Carolina Division of Emergency Management, 1998
Tax Abatement	Tax breaks offered to property owners and developers who use mitigation methods for new development	North Carolina Division of Emergency Management, 1998
Transfer/Purchase of Development Rights	Provision for transferring development rights to control density; may be transfer of development rights or purchase of development rights	North Carolina Division of Emergency Management, 1998
US Census Block Groups	Block Groups (BGs) are statistical divisions of census tracts, are generally defined to contain between 600 and 3,000 people, and are used to present data and control block numbering. A block group consists of clusters of blocks within the same census tract that have the same first digit of their four-digit census block number. Most BGs were delineated by local participants in the Census Bureau's Participant Statistical Areas Program. The Census Bureau delineated BGs only where a local or tribal government declined to participate, and a regional organization or State Data Center was not available to participate.	https://www.census.gov/geo/reference/gtc/gtc_bg.html
USACE	United States Army Corps of Engineers	http://www.usace.army.mil
USDA	U.S. Department of Agriculture	http://www.usda.gov/wps/portal/usda/usdahome
Vulnerability (disaster)	The degree to which a person, system or unit is likely to experience harm due to exposure to perturbations or stresses. Vulnerability describes the characteristics and circumstances of a community, system or asset that make it susceptible to the damaging effects of a hazard. There are many aspects of vulnerability, arising from various physical, social, economic, and environmental factors.	Kasperson, et al. (2002) http://www.odpm.gov.tt/node/162

Zoning Ordinance	Written regulations and laws that define how property in specific geographic zones can be used. Zoning ordinances specify whether zones can be used for residential or commercial purposes, and may also regulate lot size, placement, bulk (or density) and the height of structures. Zoning ordinances are lengthy documents describing not only the acceptable use for specified areas of land, but also the procedures for handling infractions (including any penalties), granting variances and hearing appeals.	http://www.investopedia.com/terms/z/zoning-ordinance.
Zoning Overlays	Provision to use zoning overlays that restrict permitted land use/density in hazardous areas; may be special hazard zones or sensitive open space protection zones	North Carolina Division of Emergency Management, 1998

APPENDIX

APPENDIX A

Other Resilience Indicators and Scorecards

Measure name	Type
ASPIRE (World Bank 2015)	Tool
BRIC (Cutter et al. 2010, 2014)	Index
CART (Pfefferbaum et al. 2011, 2013)	Tool
CCRAM (Cohen et al. 2013)	Tool
CDRI (Peacock et al. 2010)	Index
Coastal Resilience Index (Sempier et al. 2010)	Score-card
CoBRA (UNDP 2014)	Tool
Community Resilient System (CARRI 2013; White et al. 2015)	Tool
Community Resilience Index (Sherrieb et al. 2010)	Index
CREAT (USEPA 2015)	Tool
DFID Resilience (Twigg 2009)	Tool
FAO Livelihoods (Alinovi et al. 2010)	Index
Financial System Resilience (Berry et al. 2015)	Index
FM Global Resilience (Oxford Metrica 2015)	Index
NIST (NIST 2015)	Tool
Oxfam GB (Hughes and Bushell 2013)	Index
PEOPLES (Renschler et al. 2010)	Tool
RCI (Pendall et al. 2010)	Index
ResilUS (miles and Chang 2011)	Tool
RMI (Fisher et al. 2010; Petit et al. 2013)	Index/tool
Rockefeller 100 resilient cities (ARUP and Rockefeller 2014	Tool
RRI (Cox and Hamlen 2015)	Index
SPUR (San Francisco Planning 2009)	Score-card
Surging Seas (Climate Central 2015)	Tool
TNC Coastal Resilience (TNC 2015)	Tool
UNISDR Resilient Cities (UNISDR 2013, 2015a, b)	Tool
USAID Resilience (USAID 2013)	Tool

Adapted from Cutter 2016

Cutter, Susan. 2016. The landscape of disaster resilience indicators in the USA. Natural Hazards. 80: 741-758.

APPENDIX B

Aligning with Other Initiatives

Consolidated Housing Plan (CHP) and Annual Action Plans (AAP)- Data- and dialogue-driven assessment of community affordable housing and development needs; aligns and focuses funding from multiple federal block grant programs (e.g. CDBG); carried out through Annual Action Plans and monitored via annual performance reports

Align: Align resilience strategies with housing and poverty prevention strategies to expand housing stability; High-vulnerability areas are mapped, may overlap with hazard zones; policies and action steps sometimes contain place-specific terms (which allow us to map their influence); policies/actions might be amended to reduce flood exposure of vulnerable population

Agency: Department of Housing and Urban Development (HUD), http://portal.hud.gov/hudportal/HUD?src=/program_offices/comm_planning/about/conplan

Hazard Mitigation Plan [Preparedness Grants, Hazard Mitigation Grant Program, Pre-disaster Mitigation Grants, Flood Mitigation Assistance]- State, tribal, and local governments identify risks, vulnerabilities, or natural disasters and develop long-term strategies to protect people and property as a condition for receiving types of non-emergency disaster assistance

Align: Community risk assessment often includes maps and descriptions of areas affected by hazards; mitigation actions are included, many of which contain place-specific terms; aligning hazard mitigation with other community goals is rarely considered

Agency: Federal Emergency Management Agency (FEMA), within the Department of Homeland Security (DHS), https://www.fema.gov/hazard-mitigation-planning-process

Community Rating System (CRS)- a program which provides up to 45% reduction of flood insurance premiums for policyholders when communities invest and plan for flood mitigation and other floodplain management activities.

Align: Communities can enhance their CRS score within Activity 510, Floodplain Management Planning by using the Plan Integration for Resilience Scorecard, which reveals and supports tasks within the activity.

Agency: National Flood Insurance Program (NFIP) within the Federal Emergency Management Agency (FEMA), https://www.fema.gov/national-flood-insurance-program

Community Resilience Planning Guide- The NIST Community Resilience Planning Guide for Buildings and Infrastructure Systems (Guide) provides a practical and flexible approach to help all communities improve their resilience by setting priorities and allocating resources to manage risks for their prevailing hazards.

Align: Communities can first conduct the Plan Integration for Resilience Scorecard to understand plan consistencies as a direct input into the Community Resilience Planning Guide, which is a part of step one.

Agency: National Institute for Science and Technology (NIST), https://www.nist.gov/topics/community-resilience/community-resilience-planning-guide

Habitat Management Plan (HMP) and Annual Habitat Work Plans (AHWP)- Wildlife-Refuge-scale documents that guide analysis, management, and decision-making according to a long-term vision, emphasizing continuity and consistency; plans stress the role of refuge habitat in international, national, regional, tribal, State, ecosystem, and refuge goals and objectives

Align: National Wildlife Refuge System lands that exist in communities or in their extra-territorial jurisdiction (ETJ) may be within or may affect hazard zones; their management therefore impacts vulnerability; opportunities to preserve or expand such areas would likely have benefits for hazard mitigation and preventing increased exposure of people and infrastructure

Agency: United States Fish and Wildlife Service (USFWS), within

the Department of the Interior (DOI), https://www.fws.gov/policy/620fw1.html

State Wildlife Action Plans (SWAP), aka Comprehensive Wildlife Conservation Strategies [Wildlife Conservation and Restoration Program (WCRP) funds; State and Tribal Wildlife Grants (SWG) program]-States are required to develop a strategic plan for wildlife and habitat conservation to be eligible for funds

Align: Overlap between wildlife areas and hazard zones in communities; planners and decision makers can partner on projects of mutual interest[1]

Agency: Congress by the Conservation and Reinvestment Act of 2000, "http://teaming.com/state-wildlife-action-plans-swaps, http://teaming.com/swap-overview"

Coastal Zone Management Program (CZMP) [Coastal Zone Enhancement Program; Coastal Nonpoint Pollution Control Program]- Voluntary partnership between federal government and coastal states; tasked with helping to responsibly manage coastal communities; issues addressed include coastal development, water quality, public access, habitat protection, energy facility siting, ocean governance and planning, coastal hazards, and climate change; federal funding matched with state and local funding

Align: Coastal flood risk and resilience are key aspects of the CZMP, and related studies and actions are frequent recipients of funding from the program; the PIRS method may improve targeting of such funds to the most vulnerable areas (and may further justify expenditures)

Agency: National Oceanic and Atmospheric Administration (NOAA), within the Department of Commerce via the Coastal Zone Management Act (CZMA) of 1972, https://coast.noaa.gov/czm/about/, https://coast.noaa.gov/czm/media/funding-summary.pdf"

Forest Plan (Land Management Plan)- Every national forest or grassland managed by the United States Forest Service must develop and maintain a management plan, revised at a minimum every 15 years; plans consider multiple-use goals and objectives, management standards and prescriptions, and ¬monitoring requirements; proposed projects inconsistent with the plan cannot proceed (unless the plan is amended, which requires preparation of an EIS and public participation)

Align: The management of national forests and grasslands located within or adjacent to community is likely to affect its flood vulnerability; the forest managers that create Forest Plans are therefore important stakeholders and potential allies in help to shape the resilience of a community

Agency: United States Forest Service (USFS), within the Department of Agricultulre (USDA) via the National Forest Management Act (NFMA) of 1976, http://www.fs.usda.gov/main/planningrule/101, http://www.fs.usda.gov/Internet/FSE_DOCUMENTS/stelprdb5110094.pdf"

Endangered Species Recovery Plan- All species considered threatened or endangered must have a recovery plan as a foundation for a recovery effort; contents include a description of what is needed to return the species to a healthy state, specific criteria for this 'healthy state', and estimates of time and cost requirements

Align: Habitat conservation is an important element of most species recovery plans. Opportunities exist to leverage policies designed to protect species and help them recover to improve neighborhood-level and citywide resilience, especially in riparian areas.

Agency: National Marine Fisheries Service of NOAA, within the Department of Commerce and the USFWS, within the Department of the Interior via the Endangered Species Act of 1973, https://en.wikipedia.org/wiki/Endangered_species_recovery_plan, http://www.nmfs.noaa.gov/pr/recovery/"

empower local communities, organizations, and individuals to action.

Align: State Historic Preservation plan policies and actions are necessarily place-specific. Preventing (re)development in/near historic structures and lands may reduce exposure, and therefore vulnerability, to flooding. Preservation policies/actions may potentially have the opposite effect, though, protecting and encouraging the continued use of buildings (or entire districts) in flood-vulnerable parts of a community.

Agency: Nation Park Service (NPS) within the USDA via the National Historic Preservation Act of 1966, https://www.nps.gov/preservation-planning/, https://www.nps.gov/preservation-planning/stateplanning.html"

National Conservation Innovation Grants- The purpose of CIG is to stimulate the development and adoption of innovative conservation approaches and technologies, while leveraging the Federal investment in environmental enhancement and protection in conjunction with agricultural production.

Align: PIRS might be a useful analytical tool with respect to some of the 'innovative conservation approaches' funded by National Conservation Innovation Grants

Agency: Natural Resources Conservation Service (NRCS), within the USDA, http://www.grants.gov/search-grants?html?fundingCategories%3DENV%7CEnvironment

NOAA Climate Program Office: Regional Integrated Sciences and Assessments (RISA) Program- CPO funds a network of RISA teams which are a model for interdisciplinary science and assessment and work to inform improvements in resilience and preparedness in diverse socio-economic regions and sectors throughout the US and abroad through the use of climate knowledge and information; research advances the nation's understanding of climate-related risks and vulnerabilities across sectors and regions, and the development of tools to foster more informed decision making.

Align: The PIRS methodology might be used to assess or better integrate many of the innovations produced by the interdisciplinary RISA teams; further development of the method may even be eligible for funding from the RISA program

Agency: NOAA, within the Department of Commerce, http://cpo.noaa.gov/ClimatePrograms/ClimateandSocietalInteractions/RISAProgram.aspx, http://cpo.noaa.gov/sites/cpo/RISA/UPDATED%20RISA-2pager-11-02-16.pdf"

Resilience AmeriCorps- A program that builds capacity for climate resilience planning and implementation in low-income communities. The program provides technical assistance to local communities.

Align: PIRS can be utilized as part of the tools and training; The engagement team of the PIRS can work with the program to engage the community.

Agency: Corporation for National and Community Service (CNCS) with NOAA, EPA, DOE, and non-federal partners, http://www.nationalservice.gov/programs/americorps/americorps-initiatives/resilience-americorps

Resilience Dialogues- A program to address the need for training and technical assistance for communities. It provides a platform for communities to discuss issues related to climate change and to take steps to become more resilient.

Align: PIRS can be utilized as part of the tools and training; The engagement team of the PIRS can work with the program to engage the community.

Agency: USGCRP, http://www.resiliencedialogues.org/

Regional Integrated Sciences and Assessments- Regional teams that leverages a trusted network of research teams around the country to advance the knowledge base, provide expertise to support

responses to extreme events.

Align: RISA can work with already established relationships, such as managers and planners, and use PIRS to advance a regional approach to plan integration.

Agency: NOAA, http://cpo.noaa.gov/ClimatePrograms/ClimateandSocietalInteractions/RISAProgram/AboutRISA.aspx

Landscape Conservation Cooperatives- Regional teams that work collaboratively to identify best practices, connect efforts, identify science gaps, and avoid duplication through conservation planning and design.

Align: LCC can use PIRS to integrate planning efforts to reduce vulnerabilities to climate change.

Agency: DOI, https://lccnetwork.org

Regional Climate Hubs- A program that develops and delivers science-based, region-specific information and technologies for rural producers.

Align: When conducting PIRS, communities should engage with the RCH and extension professionals; rural communities can utilize data from the RCH for data for physical vulnerabilities, etc.

Agency: USDA, https://www.climatehubs.oce.usda.gov/

Climate Adaptation Community of Practice- A network of practitioners that share tools, information, and best practices and work to develop federal government-wide goals and strategies for climate change training.

Align: The network can train and share best practices of plan integration.

Agency: USGCRP

Clean Water State Revolving Fund (CWSRF)- A financial assistance program that can be used for a variety of water infrastructure projects.

Align: PIRS can be used as an analytical tool to justify projects funded by the program; PIRS can be used to identify physically and socially vulnerable areas across a community's network of plans.

Agency: EPA, https://www.epa.gov/cwsrf

Fostering Advancements in Shipping and Transportation for the Long-term Achievement of National Efficiencies (FASTLANE)- Funds critical freight and highway projects and includes climate resilience considerations.

Align: PIRS can be used as an analytical tool to justify transportation projects funded by the program.

Agency: DOT, https://www.transportation.gov/buildamerica/FASTLANEgrants

Sustainable Communities Initiative- Provides grants to improve regional and local planning efforts that integrate housing and transportation decisions, and increase the capacity to improve land use and zoning to support market investments that support sustainable communities.

Align: PIRS can be used as an analytical tool to justify projects funded by the program; PIRS can be used to identify physically and socially vulnerable areas across a community's network of plans.

Agency: HUD, http://portal.hud.gov/hudportal/HUD?src=/hudprograms/sci

APPENDIX C

Detailed Policy Tools: Land Use Policy categories and sub-categories (continued from table 2.4)

Land Use Approach	Description	Example of measurements	S* / NS**
Development Regulations			
Permitted Land Use	Provision regulating the types of land use (e.g. residential, commercial, industrial, open space, etc.) permitted in areas of community; may be tied to zoning code	- Bonus and incentive zoning - Mandatory low-income housing construction ordinance - Rolling easement - Coastal construction control line (CCCL)	N N N N
Density of Land Use	Provision regulating density (e.g. units per acre); may be tied to zoning code	- Cumulative substantial improvement - Lower substantial improvement threshold	S S
Subdivision Regulations	Provision controlling the subdivision of parcels into developable units and governing the design of new development (e.g. site storm water management)	- Strict conformance with development regulations	N
Zoning Overlays	Provision to use zoning overlays that restrict permitted land use/density in hazardous areas; may be special hazard zones or sensitive open space protection zones	- Velocity zone regulations to Coastal "A" zones	N
Setbacks or Buffer Zones	Provision requiring setbacks or buffers around hazardous areas (e.g. riparian buffers and ocean setbacks)	- Coastal forests - Dunes, shore physical barriers (debris, logs, etc.) - Floodplain storage - Shore vegetation - Detention and Retention within watershed	N S N N S
Cluster Development	Provision requiring clustering of development away from hazardous areas, such as through conservation subdivisions	- Setting development caps / population limits - Maintaining public infrastructure for clustering development intensity away from hazard areas	N N
Land Acquisition			
Acquire Land & Property	Purchase land/property in hazard area	- Eminent domain - Acquiring vacant riverfront parcels	N N
Open Space or Easement Requirement/Purchase	Provision encouraging open space purchase by the community or open space easements as an element of development approval	- Conservation easement	N

Density Transfer Provisions			
Transfer/Purchase of Development Rights	Provision for transferring development rights to control density; may be transfer of development rights or purchase of development rights	- Density/intensity credits	N
Financial Incentives and Penalties			
Density Bonuses	Density bonuses such as ability to develop with greater density in return for dedication or donation of land in areas subject to hazards	- CBD periphery Bonus	N
Tax Abatement	Tax breaks offered to property owners and developers who use mitigation methods for new development	- Development exactions - Land gains taxation - Special assessment districts	N N N
Impact / Special Study / Protection Fees	Provision requiring impact fees, special study fees, or protection fees for development in hazardous areas; fees could cover costs of structural protection	- Impact fees and system development charges	N
Land Use Analysis and Permitting Process			
Land Suitability	Hazards are one of the criteria used in analyzing and determining the suitability of land for development		
Site Review	Provision requiring addressing hazard mitigation in process of reviewing site proposals for development	- Site specific surveys and field documentation	N
Design/Construction Guidelines/Requirements	Guidelines or requirements that apply to the design or construction of developments in hazard areas	- Requiring specific building standards - Seismic retrofitting and design - Setting environmental performance standards	S S N
Public Facilities (including Public Housing)			
Siting	Provision to site public facilities, including municipal buildings and public housing, out of hazard areas	- Preserving hazard areas for new road alignments - Limiting public expenditures for infrastructure	N N
Sizing/Capacity	Provision limiting capacity of public facilities, including public housing, in hazard areas to cap amount of development	-	

Post-Disaster Reconstruction Decisions			
Development Moratorium	Provision imposing a moratorium on development for a set period of time after a hazard event to allow for consideration of land use change	- Limit redevelopment	N
Post-Disaster Land Use Change	Provision related to changing land use regulations following a hazard event; may include redefining allowable land uses after a hazard event	- Eliminating unsafe conditions and inappropriate uses	N
Post-Disaster Capital Improvements	Provision related to adjusting capital improvements to public facilities following a hazard event	- Relocating city infrastructure	S
Capital Improvements			
Infrastructure "Hardening" or Weatherproofing	Provision encouraging or requiring development in hazard zones to increase structural resilience to hazards	- Levees and dikes - Underground utility lines	S S
Elevating	Provision pertaining to the physical elevation of structures in hazard zones		
Drainage Improvements or Flood Control	Provision that pertains to drainage or flooding issues within the community	- Flood walls / Sediment control structures - Stormwater treatment improvements	S S
Ecosystem Enhancement	Provision that seeks to improve or preserve the functioning of the natural environment within the community	- Retaining ponds - River channel changes - Restoring vegetated shorelines on public lands	S S N
Slope/Dune Stabilization	Provision that pertains specifically to stabilization of slopes or dunes or seeks to control erosion	- Shoreline protection	S/NS

* S: Structural / **NS: non-structural

PLAN NAME: **EVALUATOR :**

DEVELOPMENT REGULATIONS - **Permitted Land Use**												
	District	01	02	03	04	05	06	07	08	Total	Feasibility	Notes
	Current Hazard Zone											
	Future Hazard Zone											
	Current Hazard Zone											
	Future Hazard Zone											
	Current Hazard Zone											
	Future Hazard Zone											
	Current Hazard Zone											
	Future Hazard Zone											
	Current Hazard Zone											
	Future Hazard Zone											
Policy Category Total	Current Hazard Zone											
	Future Hazard Zone											

PLAN NAME: **EVALUATOR :**

DEVELOPMENT REGULATIONS **-Density of Land Use**												
	District	01	02	03	04	05	06	07	08	Total	Feasibility	Notes
	Current Hazard Zone											
	Future Hazard Zone											
	Current Hazard Zone											
	Future Hazard Zone											
	Current Hazard Zone											
	Future Hazard Zone											
	Current Hazard Zone											
	Future Hazard Zone											
	Current Hazard Zone											
	Future Hazard Zone											
Policy Category Total	Current Hazard Zone											
	Future Hazard Zone											

PLAN NAME: **EVALUATOR :**

DEVELOPMENT REGULATIONS - **Subdivision Regulations**												
	District	01	02	03	04	05	06	07	08	Total	Feasibility	Notes
	Current Hazard Zone											
	Future Hazard Zone											
	Current Hazard Zone											
	Future Hazard Zone											
	Current Hazard Zone											
	Future Hazard Zone											
	Current Hazard Zone											
	Future Hazard Zone											
	Current Hazard Zone											
	Future Hazard Zone											
Policy Category Total	Current Hazard Zone											
	Future Hazard Zone											

PLAN NAME: **EVALUATOR :**

DEVELOPMENT REGULATIONS **-Zoning Overlays**												
	District	01	02	03	04	05	06	07	08	Total	Feasibility	Notes
	Current Hazard Zone											
	Future Hazard Zone											
	Current Hazard Zone											
	Future Hazard Zone											
	Current Hazard Zone											
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	Current Hazard Zone											
	Future Hazard Zone											
Policy Category Total	Current Hazard Zone											
	Future Hazard Zone											

PLAN NAME: **EVALUATOR :**

DEVELOPMENT REGULATIONS - **Setbacks or Buffer Zones**												
	District	01	02	03	04	05	06	07	08	Total	Feasibility	Notes
	Current Hazard Zone											
	Future Hazard Zone											
	Current Hazard Zone											
	Future Hazard Zone											
	Current Hazard Zone											
	Future Hazard Zone											
	Current Hazard Zone											
	Future Hazard Zone											
	Current Hazard Zone											
	Future Hazard Zone											
Policy Category Total	Current Hazard Zone											
	Future Hazard Zone											

PLAN NAME: **EVALUATOR :**

DEVELOPMENT REGULATIONS **-Cluster Density**												
	District	01	02	03	04	05	06	07	08	Total	Feasibility	Notes
	Current Hazard Zone											
	Future Hazard Zone											
	Current Hazard Zone											
	Future Hazard Zone											
	Current Hazard Zone											
	Future Hazard Zone											
	Current Hazard Zone											
	Future Hazard Zone											
	Current Hazard Zone											
	Future Hazard Zone											
Policy Category Total	Current Hazard Zone											
	Future Hazard Zone											

PLAN NAME: **EVALUATOR :**

LAND ACQUISITION- **Aquire Land & Property**												
	District	01	02	03	04	05	06	07	08	Total	Feasibility	Notes
	Current Hazard Zone											
	Future Hazard Zone											
	Current Hazard Zone											
	Future Hazard Zone											
	Current Hazard Zone											
	Future Hazard Zone											
	Current Hazard Zone											
	Future Hazard Zone											
	Current Hazard Zone											
	Future Hazard Zone											
Policy Category Total	Current Hazard Zone											
	Future Hazard Zone											

PLAN NAME: **EVALUATOR :**

LAND ACQUISITION **-Open Space or Easement Requirement/Purchase**												
	District	01	02	03	04	05	06	07	08	Total	Feasibility	Notes
	Current Hazard Zone											
	Future Hazard Zone											
	Current Hazard Zone											
	Future Hazard Zone											
	Current Hazard Zone											
	Future Hazard Zone											
	Current Hazard Zone											
	Future Hazard Zone											
	Current Hazard Zone											
	Future Hazard Zone											
Policy Category Total	Current Hazard Zone											
	Future Hazard Zone											

PLAN NAME: **EVALUATOR :**

DENSITY TRANSFER PROVISIONS- **Transfer/Purchase of Development Rights**												
	District	01	02	03	04	05	06	07	08	Total	Feasibility	Notes
	Current Hazard Zone											
	Future Hazard Zone											
	Current Hazard Zone											
	Future Hazard Zone											
	Current Hazard Zone											
	Future Hazard Zone											
	Current Hazard Zone											
	Future Hazard Zone											
	Current Hazard Zone											
	Future Hazard Zone											
Policy Category Total	Current Hazard Zone											
	Future Hazard Zone											

PLAN NAME: **EVALUATOR :**

FINANCIAL INCENTIVES AND PENALITIES **-Density Bonuses**												
	District	01	02	03	04	05	06	07	08	Total	Feasibility	Notes
	Current Hazard Zone											
	Future Hazard Zone											
	Current Hazard Zone											
	Future Hazard Zone											
	Current Hazard Zone											
	Future Hazard Zone											
	Current Hazard Zone											
	Future Hazard Zone											
	Current Hazard Zone											
	Future Hazard Zone											
Policy Category Total	Current Hazard Zone											
	Future Hazard Zone											

PLAN NAME: **EVALUATOR :**

FINANCIAL INCENTIVES AND PENALITIES **-Tax Abatement**												
	District	01	02	03	04	05	06	07	08	Total	Feasibility	Notes
	Current Hazard Zone											
	Future Hazard Zone											
	Current Hazard Zone											
	Future Hazard Zone											
	Current Hazard Zone											
	Future Hazard Zone											
	Current Hazard Zone											
	Future Hazard Zone											
	Current Hazard Zone											
	Future Hazard Zone											
Policy Category Total	Current Hazard Zone											
	Future Hazard Zone											

PLAN NAME: **EVALUATOR :**

FINANCIAL INCENTIVES AND PENALITIES **-Impact/Special Study/ Protection Fees**												
	District	01	02	03	04	05	06	07	08	Total	Feasibility	Notes
	Current Hazard Zone											
	Future Hazard Zone											
	Current Hazard Zone											
	Future Hazard Zone											
	Current Hazard Zone											
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	Future Hazard Zone											
Policy Category Total	Current Hazard Zone											
	Future Hazard Zone											

PLAN NAME: **EVALUATOR :**

LAND USE ANALYSIS AND PERMITTING PROCESS **- Land Suitability**												
	District	01	02	03	04	05	06	07	08	Total	Feasibility	Notes
	Current Hazard Zone											
	Future Hazard Zone											
	Current Hazard Zone											
	Future Hazard Zone											
	Current Hazard Zone											
	Future Hazard Zone											
	Current Hazard Zone											
	Future Hazard Zone											
	Current Hazard Zone											
	Future Hazard Zone											
Policy Category Total	Current Hazard Zone											
	Future Hazard Zone											

PLAN NAME: **EVALUATOR :**

LAND USE ANALYSIS AND PERMITTING PROCESS - **Site Review**												
	District	01	02	03	04	05	06	07	08	Total	Feasibility	Notes
	Current Hazard Zone											
	Future Hazard Zone											
	Current Hazard Zone											
	Future Hazard Zone											
	Current Hazard Zone											
	Future Hazard Zone											
	Current Hazard Zone											
	Future Hazard Zone											
	Current Hazard Zone											
	Future Hazard Zone											
Policy Category Total	Current Hazard Zone											
	Future Hazard Zone											

PLAN NAME: **EVALUATOR :**

LAND USE ANALYSIS AND PERMITTING PROCESS - **Design/Construction Guidelines/Requirements**												
	District	01	02	03	04	05	06	07	08	Total	Feasibility	Notes
	Current Hazard Zone											
	Future Hazard Zone											
	Current Hazard Zone											
	Future Hazard Zone											
	Current Hazard Zone											
	Future Hazard Zone											
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	Future Hazard Zone											
	Current Hazard Zone											
	Future Hazard Zone											
Policy Category Total	Current Hazard Zone											
	Future Hazard Zone											

PLAN NAME: **EVALUATOR :**

PUBLIC FACILITIES (including Public Housing) - **Siiting**												
	District	01	02	03	04	05	06	07	08	Total	Feasibility	Notes
	Current Hazard Zone											
	Future Hazard Zone											
	Current Hazard Zone											
	Future Hazard Zone											
	Current Hazard Zone											
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	Future Hazard Zone											
	Current Hazard Zone											
	Future Hazard Zone											
Policy Category Total	Current Hazard Zone											
	Future Hazard Zone											

PLAN NAME: **EVALUATOR :**

PUBLIC FACILITIES (including Public Housing) - **Sizing/Capacity**												
	District	01	02	03	04	05	06	07	08	Total	Feasibility	Notes
	Current Hazard Zone											
	Future Hazard Zone											
	Current Hazard Zone											
	Future Hazard Zone											
	Current Hazard Zone											
	Future Hazard Zone											
	Current Hazard Zone											
	Future Hazard Zone											
	Current Hazard Zone											
	Future Hazard Zone											
Policy Category Total	Current Hazard Zone											
	Future Hazard Zone											

PLAN NAME: **EVALUATOR :**

POST-DISASTER RECONSTRUCTION DECISIONS - **Development Moratorium**												
	District	01	02	03	04	05	06	07	08	Total	Feasibility	Notes
	Current Hazard Zone											
	Future Hazard Zone											
	Current Hazard Zone											
	Future Hazard Zone											
	Current Hazard Zone											
	Future Hazard Zone											
	Current Hazard Zone											
	Future Hazard Zone											
	Current Hazard Zone											
	Future Hazard Zone											
Policy Category Total	Current Hazard Zone											
	Future Hazard Zone											

PLAN NAME: **EVALUATOR :**

POST-DISASTER RECONSTRUCTION DECISIONS - **Post-Disaster Land Use Change**												
	District	01	02	03	04	05	06	07	08	Total	Feasibility	Notes
	Current Hazard Zone											
	Future Hazard Zone											
	Current Hazard Zone											
	Future Hazard Zone											
	Current Hazard Zone											
	Future Hazard Zone											
	Current Hazard Zone											
	Future Hazard Zone											
	Current Hazard Zone											
	Future Hazard Zone											
Policy Category Total	Current Hazard Zone											
	Future Hazard Zone											

PLAN NAME: **EVALUATOR :**

POST-DISASTER RECONSTRUCTION DECISIONS - **Post-Disaster Capital Improvements**												
	District	01	02	03	04	05	06	07	08	Total	Feasibility	Notes
	Current Hazard Zone											
	Future Hazard Zone											
	Current Hazard Zone											
	Future Hazard Zone											
	Current Hazard Zone											
	Future Hazard Zone											
	Current Hazard Zone											
	Future Hazard Zone											
	Current Hazard Zone											
	Future Hazard Zone											
Policy Category Total	Current Hazard Zone											
	Future Hazard Zone											

PLAN NAME: **EVALUATOR :**

***CAPITAL IMPROVEMENTS* - Infrastructure "Hardening" or Weatherproofing**												
	District	01	02	03	04	05	06	07	08	Total	Feasibility	Notes
	Current Hazard Zone											
	Future Hazard Zone											
	Current Hazard Zone											
	Future Hazard Zone											
	Current Hazard Zone											
	Future Hazard Zone											
	Current Hazard Zone											
	Future Hazard Zone											
	Current Hazard Zone											
	Future Hazard Zone											
Policy Category Total	Current Hazard Zone											
	Future Hazard Zone											

PLAN NAME: **EVALUATOR :**

***CAPITAL IMPROVEMENTS* - Elevating**												
	District	01	02	03	04	05	06	07	08	Total	Feasibility	Notes
	Current Hazard Zone											
	Future Hazard Zone											
	Current Hazard Zone											
	Future Hazard Zone											
	Current Hazard Zone											
	Future Hazard Zone											
	Current Hazard Zone											
	Future Hazard Zone											
	Current Hazard Zone											
	Future Hazard Zone											
Policy Category Total	Current Hazard Zone											
	Future Hazard Zone											

PLAN NAME: **EVALUATOR :**

***CAPITAL IMPROVEMENTS* - Drainage Improvements or Flood Control**												
	District	01	02	03	04	05	06	07	08	Total	Feasibility	Notes
	Current Hazard Zone											
	Future Hazard Zone											
	Current Hazard Zone											
	Future Hazard Zone											
	Current Hazard Zone											
	Future Hazard Zone											
	Current Hazard Zone											
	Future Hazard Zone											
	Current Hazard Zone											
	Future Hazard Zone											
Policy Category Total	Current Hazard Zone											
	Future Hazard Zone											

PLAN NAME: **EVALUATOR :**

***CAPITAL IMPROVEMENTS* - Ecosystem Enhancement**												
	District	01	02	03	04	05	06	07	08	Total	Feasibility	Notes
	Current Hazard Zone											
	Future Hazard Zone											
	Current Hazard Zone											
	Future Hazard Zone											
	Current Hazard Zone											
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	Future Hazard Zone											
	Current Hazard Zone											
	Future Hazard Zone											
Policy Category Total	Current Hazard Zone											
	Future Hazard Zone											

PLAN NAME: **EVALUATOR :**

***CAPITAL IMPROVEMENTS* - Slope/Dune Stabilization**												
	District	01	02	03	04	05	06	07	08	Total	Feasibility	Notes
	Current Hazard Zone											
	Future Hazard Zone											
	Current Hazard Zone											
	Future Hazard Zone											
	Current Hazard Zone											
	Future Hazard Zone											
	Current Hazard Zone											
	Future Hazard Zone											
	Current Hazard Zone											
	Future Hazard Zone											
Policy Category Total	Current Hazard Zone											
	Future Hazard Zone											

PLAN NAME: **EVALUATOR :**

Policy Total			
		Total	Notes
Development Regulations	Current Hazard Zone		
	Future Hazard Zone		
Land Acquisition	Current Hazard Zone		
	Future Hazard Zone		
Density Transfer Provisions	Current Hazard Zone		
	Future Hazard Zone		
Financial Incentives and Penalties	Current Hazard Zone		
	Future Hazard Zone		
Land Use Analysis and Permitting Process	Current Hazard Zone		
	Future Hazard Zone		
Public Facilities (including Public Housing)	Current Hazard Zone		
	Future Hazard Zone		
Post-Disaster Reconstruction Decisions	Current Hazard Zone		
	Future Hazard Zone		
Capital Improvements	Current Hazard Zone		
	Future Hazard Zone		
Total	Current Hazard Zone		
	Future Hazard Zone		

APPENDIX D

Engagement Team Worksheet

Negative Scoring Policies Worksheet

Plan: _____ Responsible department:_____

District	Policy	Physical Vulnerability	Social Vulnerability	In conflict with which plan?	Suggested amendments (in meeting)	Investment level (in meeting)
Ex. 23		High	High	Hazard Mitigation plan		

Districts with Few Resilience Policies Worksheet

Plan: _____ Responsible department:_____

District	Physical Vulnerability	Social Vulnerability	Suggested policy tools (in meeting)
Ex. 4	High	High	

Engage Elected and Appointed Officials

Negative Scoring Policies Worksheet

Plan: _____ Responsible department:_____

District	Policy	Physical Vulnerability	Social Vulnerability	In conflict with which plan?	Suggested amendments	Investment level	Political opposition? (in meeting)
Ex. 23		High	High	Hazard Mitigation plan			