

Florida Adaptation Planning Guidebook



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Acronyms

AAA	Adaptation Action Area	EDP	Economic Development Plan
ADAPT	Adaptation Database for Planning Tool	EPA	United States Environmental Protection Agency
ADCIRC	ADvanced CIRCulation Model	ESR	Expedited State Review
ARPA	Archaeological Resources Protection Act	EWP	Emergency Watershed Protection
CAKE	Climate Adaptation Knowledge Exchange	FCMP	Florida Coastal Management Program
C-CAP	Coastal Change Analysis Program	FDOT	Florida Department of Transportation
CDBG	Community Development Block Grant	FEMA	Federal Emergency Management Agency
CDBG-DR	Community Development Block Grant-Disaster Recovery	FERR	Florida Estuarine Research Reserve
CFR	Code of Federal Regulations	FGDL	Florida Geodatabase Library
CHHA	Coastal High Hazard Area	FIRM	Flood Insurance Rate Map
CIP	Capital Improvement Plan	FMA	Flood Mitigation Assistance
CLG	Certified Local Government	FNAI	Florida Natural Areas Inventory
COAST	Coastal Adaptation to Sea Level Rise Tool	FS	Florida Statute
CoP	Gulf of Mexico Climate Resilience Community of Practice	FWC	Florida Fish and Wildlife Conservation Commission
CPA	Community Planning Act	GATOR	Geospatial Assessment Tool for Operations and Response
CRS	Community Rating System	GCM	Global Climate Model
CCVI	Climate Change Vulnerability Index	GDP	Gross Domestic Product
CVI	Coastal Vulnerability Index	GI	Green Infrastructure
DEM	Digital Elevation Model	GIS	Geographic Information Systems
DEO	Florida Department of Economic Opportunity	GOMA	Gulf of Mexico Alliance Resilience Team
DEP	Florida Department of Environmental Protection	Gulf TREE	Gulf Tools for Resilience Exploration Engine
DOT	Department of Transportation	HMGP	Hazard Mitigation Grant Program
DSAS	Digital Shoreline Analysis System	HPP	Historic Preservation Plan
EAR	Evaluation and Appraisal Review	HUD	United States Housing and Urban Development
EBM	Ecosystem-Based Management		

IFAS	University of Florida Institute of Food and Agricultural Sciences	SMP	Stormwater Management Plan
InVEST	Integrated Valuation of Environmental Services and Tradeoffs	SoVI	Social Vulnerability Index
IPCC	Intergovernmental Panel on Climate Change	SSC	Northern Gulf of Mexico Sentinel Site Cooperative
LCP	Local Comprehensive Plan	STAPLEE	Social, Technical, Administrative, Political, Legal, Economic, Environmental
LID	Low Impact Development	SWOT	Strengths, Weaknesses, Opportunities, and Threats
LMS	Local Mitigation Strategy	TDR	Transfer of Development Rights
MPO	Metropolitan Planning Organization	THPO	Tribal Historic Preservation Officer
NAI	No Adverse Impact	USACE	United States Army Corps of Engineers
NFIP	National Flood Insurance Program	USDA	United States Department of Agriculture
NOAA	National Oceanic and Atmospheric Administration	USGS	United States Geological Survey
NOEP	National Ocean Economics Program	VAST	Vulnerability Assessment Scoring Tool
NRCS	Natural Resources Conservation Service	WEMo	Wave Exposure Model
NRHP	National Register of Historic Places	WFPO	Watershed Protection and Flood Prevention
PDM	Pre-Disaster Mitigation		
PDRP	Post-Disaster Redevelopment Plan		
SAMP	Special Area Management Plan		
SFHA	Special Flood Hazard Area		
SHPO	State Historic Preservation Officer		
SimCLIM	Simulator of Climate Change Risks and Adaptation Initiatives		
SLAMM	Sea Level Affecting Marshes Model		
SLOSH	Sea, Lake, and Overland Surges from Hurricanes		
SLR	Sea Level Rise		

Glossary

Adaptation: Adjustment in natural or human systems in response to actual or expected stimuli or their effects, which moderates harm or exploits beneficial opportunities.

Coastal flooding: Flooding which occurs when water is driven onto land from an adjacent body of water. This generally occurs when there are significant tropical storm events, such as hurricanes.

Flood: An overflow of water onto normally dry land. The inundation of a normally dry area caused by rising water in an existing waterway, such as a river, stream, or drainage ditch. Flooding is a longer-term event than flash flooding – it may last days or weeks.

Flash flood: A flood caused by heavy or excessive rainfall in a short period of time, generally less than 6 hours. Flash floods are usually characterized by raging, quick-moving water after heavy rains.

King tide: The highest predicted high tide of the year at a coastal location.

Mean sea level: The height of the sea surface averaged over all stages of the tide over a period of time, typically computed over a 19-year period.

Sea level rise: An observed increase in the average local sea level or global sea level trend. The two major causes of global sea level rise are thermal expansion caused by the warming of the oceans (since water expands as it warms) and the loss of land-based ice (such as glaciers and polar ice caps) due to melting.

Storm surge: An abnormal rise of water generated by a storm over and above the predicted astronomical tides. Storm surge should not be confused with storm tide, which is defined as the water level rise due to the combination of storm surge and the astronomical tide.

Stormwater runoff: Is generated when precipitation flows over land or impervious surfaces and does not percolate into the ground. As the runoff flows over the land or impervious surfaces (paved streets, parking lots, and building rooftops), it accumulates pollutants that could adversely affect water quality if the runoff is discharged untreated.

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Executive Summary

This Adaptation Planning Guidebook is a compilation of more than 5 years of stakeholder involvement and research during the Community Resiliency Initiative (CRI) directed by the Florida Department of Environmental Protection (DEP) and the Florida Department of Economic Opportunity (DEO) as part of the Florida Coastal Management Plan. Research began in 2011 and continued through 2017. During this time, upwards of 30 documents that focus on many aspects of adaptation planning and are specific to Florida were created. The documents are available online [<https://floridadep.gov/fco>], and many are directly referenced in this guidebook.

This guidebook is scalable and intended to be used by local government planners in cities and counties of any size, providing a framework to develop an initial or update an existing Adaptation Plan based on current Florida laws, requirements, and recommendations. Not all communities will experience sea level rise in the same way or within the same timeframes. Once **Context** for your specific location is established ([Chapter 1](#)), a **Vulnerability Assessment** ([Chapter 2](#)) can follow. This assessment will guide your community to then establish **Adaptation Strategies** ([Chapter 3](#)) for the specific challenges that face your community in a timeframe that is applicable and realistic. The last component is to determine how to **Implement Strategies** into your plan ([Chapter 4](#)) with existing resources and into other existing planning products and processes. Additional recommendations for periodic updates to review refined climate change and sea level rise science are included as well as recommendations on how to include adaptation in other planning processes as they are updated.

The appendix of this guidebook contains specialty topics such as impact on cultural and natural resources that may be relevant to your individual community. It also contains a list of funding sources that are directly applicable to funding adaptation strategies. There is also an example Vulnerability Analysis and Adaptation Plan for reference, both of which were completed during the CRI.

The goal of this guidebook is to assist Florida communities in preparing for and dealing with the effects of sea level rise, especially coastal flooding, erosion, and ecosystem changes. Using this guidebook, communities can move along the steps of Vulnerability Assessment, Adaptation Planning, and Implementation as outlined on the next page in the Steps to Create Adaptation Plans road map. The unique challenges that sea level rise will pose within jurisdictions will require patience and diligence in the face of constantly changing conditions and information. Using the process outlined in this guideline will help define timeframes within which those changes are likely to occur and provide a springboard for continued discussion on how to protect our quality of life in the face of dynamic environmental changes.

Steps to Create Adaptation Plans

CONTEXT

- Assemble a steering committee
- Set guiding principles and motivations
- Establish planning area and describe geographic context
- Define public outreach approach and opportunities for community participation

VULNERABILITY ASSESSMENT

- Conduct an exposure analysis
- Conduct a sensitivity analysis
- Assign focus areas

ADAPTATION STRATEGIES

- Assess adaptive capacities
- Prioritize adaptation needs
- Identify adaptation strategies
- Integrate into existing plans

IMPLEMENTATION STRATEGIES

- Assess implementation capabilities
- Create a schedule of activities, actions, and actors
- Monitor and evaluate

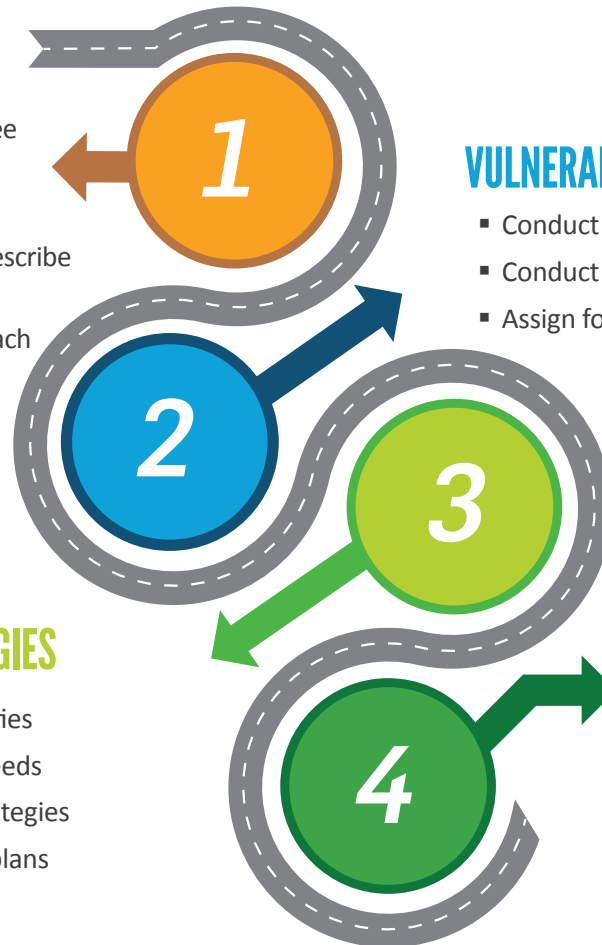


Figure 1. Communities can follow this roadmap of steps to create an adaptation plan.

Introduction

1,350 miles of Florida coastline sustain and enchant both visitors and residents of the state. The coast's relationship to the state's economy is vital. Lined with wetlands, inlets, and rivers, Florida's coast spans 35 coastal counties containing 76% of Florida's population and contributing \$584 billion dollars in economic activity—79% of the state's total economy as of 2012. The direct contribution of ocean and coastal resources is around \$18 billion dollars annually and supports hundreds of thousands of jobs. According to state compiled research in 2011, Florida's key ocean legacy industries supported over 228,000 employees. When indirect effects are considered, the number of jobs exceeds 440,000. (Florida's Oceans and Coasts: An economic and cluster analysis, Florida Ocean Alliance, 2013.) In 2014, Florida's coastal counties contributed over \$647 billion to the state's Gross Domestic Product (GDP) and employed more than 6.5 million people who earned \$255 billion in wages and salaries (National Ocean Economics Program (NOEP), 2016). While the coast may be the State's greatest asset, Florida's communities are at significant risk from coastal hazards including the slow moving, steady, and arguably irreversible threat of sea level rise. Within the area at risk from one foot of projected sea level rise sits more than 65,000 homes and as many as 121,909 people (Climate Central, 2014). The ability to adapt to and with a changing coastline is vital for the state's sustainability and continued prosperity over the next century.

A sea level rise adaptation plan is a sound and sensible method for Florida's coastal communities to develop and enhance their strategies for protecting coastal populations and infrastructure. This guidebook prepared by Florida Department of Environmental Protection provides many resources and offers a reasonable framework for developing an adaptation plan. It includes four recommended components that break down the action steps needed to build an effective plan and additional information to address special considerations like historic and natural resources. The components are:



These components, discussed in greater detail in the following chapters, interact and build upon one another to create an approach to sea level rise planning for the community. However, this guidance avoids a prescriptive formula to follow, recognizing that each community is different and unique. Rather, it provides a process to follow with enough latitude to allow for different approaches to reaching the same goal. There are sample sections from existing adaptation plans around the state to help guide communities developing a plan for the first time or looking to update their plan.

An adaptation plan does not require all the components described in this guide to be developed at once. The process is incremental, meaning that the community and the planning team may assemble a component, or all components relative to a specific aspect of sea level rise, and then return to the plan process when convenient. In addition, the outcomes of this planning process are meant to be incorporated into other on-going community plans and decision-making processes. Adaptation plan strategies may be adopted on a schedule that conforms to the community's existing or projected schedule of adoption and implementation of actions and policies from other plans.

This guidance approaches sea level rise adaptation planning through both participatory and science-based methods. Through participatory methods, input is sought from stakeholders in the community to take advantage of local knowledge and to tailor a strategy that aligns with the local needs, culture, and capacity. Through science-based methods, the guidebook provides references to tools that have been devel-

oped by respected agencies that depict the likely future impacts of our changing climate. With the overlap of these two methods, communities may gain access to a broad range of local perspectives to be balanced with the best available science to chart a path forward to a more resilient future (Adaptation Plan Components Guide (Post peer-review)).

a. Adaptation Planning Basics

The four (4) essential components of the adaptation plan, and where they are found, are:

- Context, [Chapter 1](#)
- Vulnerability Assessment, [Chapter 2](#)
- Adaptation Strategies, [Chapter 3](#)
- Implementation Strategies, [Chapter 4](#)

Context refers to the preliminary actions that a community should take to facilitate an inclusive planning process in addressing the remaining three components. The Vulnerability Assessment draws from the Risk Assessment framework described in the Code of Federal Regulations for Hazard Mitigation Plans (Title 44 CFR 201.6 (c)(2)), which measures the hazard exposure of a community and its sensitivity – e.g., population, built environment, natural environment – to the identified hazards. Adaptation Strategies are the toolkit of responses for a community to address sea level rise as well as the steps taken to decide which

Adaptation Planning: Road to Implementation

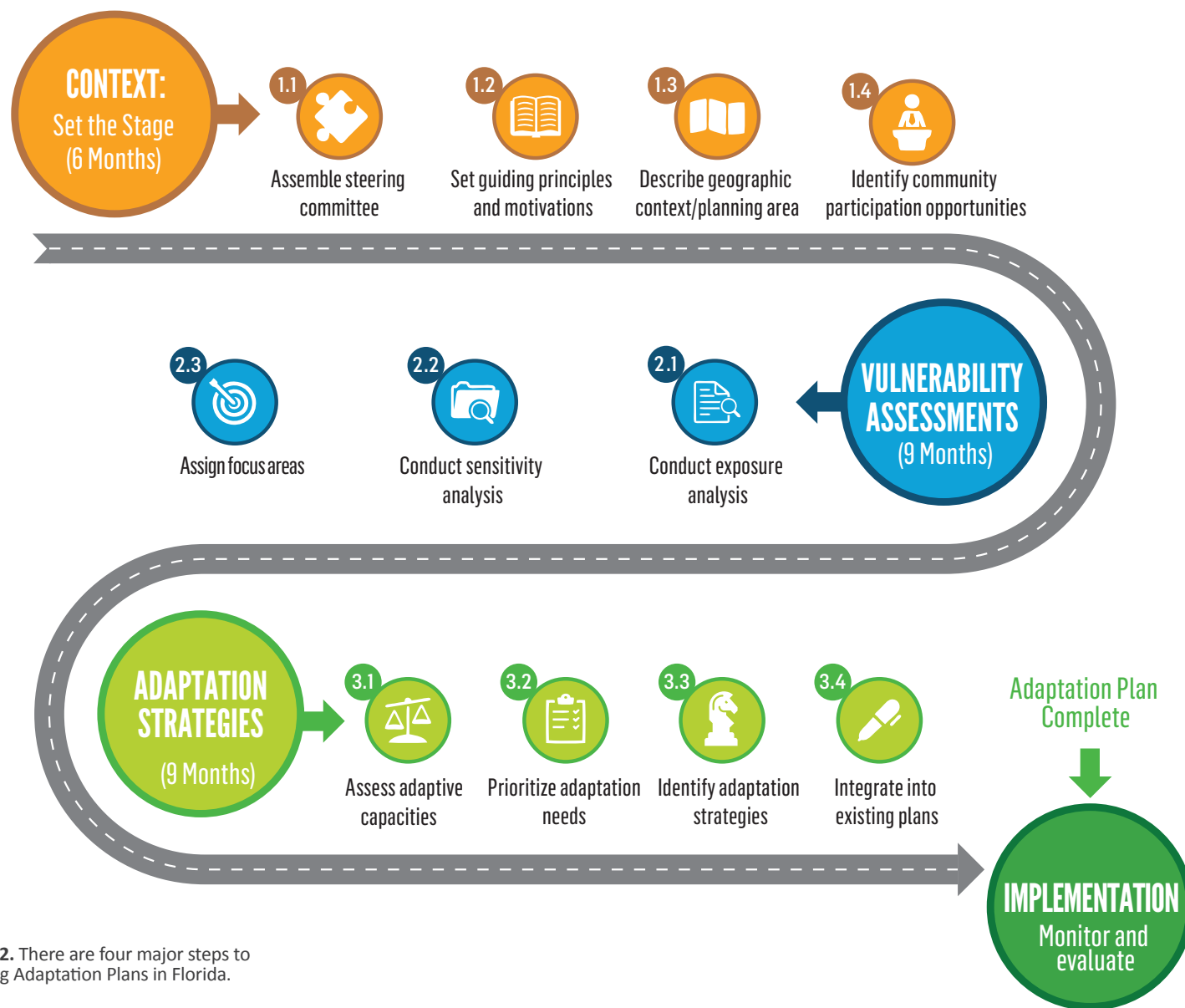


Figure 2. There are four major steps to creating Adaptation Plans in Florida.

adaptation strategies are the best fit based on the needs of individual communities. Finally, the Implementation Strategies component outlines a process for communities to move their plan into action considering available funding for adaptation activities, describes the need to assign groups/individuals to complete tasks, and suggests mechanisms to evaluate how effectively strategies are being accomplished.

As shown in the diagram above, within these four main components are many supporting tasks (i.e., sub-components) that provide further work breakdown. From establishing a steering committee, to assigning focus areas, to monitoring and evaluating, the chapters in this guide will describe each component and subcomponent in more detail. Different approaches will be illustrated using examples from pilot projects around the state.

The four components and their associated actions are mostly a sequential process to be completed in the order that they are presented in this guidebook (i.e., Context first, then Vulnerability Assessment, etc.). However, flexibility is key in getting new planning processes, including sea level rise adaptation, off the ground. Steps that occur further along in the process may identify some fatal flaws that will require revisiting a previous step. It is also recommended that this process be revisited periodically to assess its relevancy and need for updating (e.g., more accurate sea level rise data becomes available).

The other parts of the guidebook include:

- Executive Summary
- Summary
- Appendices with the following subsections:
 - Specialty Topics
 - The Economic Value of Sea Level Rise Adaptation Planning
 - The Community Rating System and Sea Level Rise Adaptation
 - Protecting and Preserving Historic and Cultural Resources
 - Adaptation Action Areas to Protect Natural Resources
 - Funding Opportunities
 - References
 - Example Adaptation Plan
 - Example Vulnerability Analysis

b. History of Adaptation Planning in Florida and Enabling Legislation

One of the state's first sustained adaptation planning efforts was the Southeast Florida Climate Leadership Summit, first held in Fort Lauderdale in 2009 and then annually ever since. The focus of the summit is to facilitate climate-related collaboration and knowledge sharing. In January 2010, Broward, Miami-Dade, Monroe, and Palm Beach Counties formed the Southeast Florida Regional Climate Change Compact to coordinate mitigation and adaptation activities across county lines.

In 2011, the Florida legislature passed the Community Planning Act (CPA). Within this legislation, local governments are given the option of developing an Adaptation Action Area (AAA) within their jurisdiction to help address the impacts of sea level rise. In 2013, the National Oceanic and Atmospheric Administration (NOAA) approved the Florida Coastal Management Program's (FCMP) Section 309 Strategy, including an initiative to be conducted by the Florida Department of Economic Opportunity (DEO) titled: "Community Resiliency: Planning for Sea Level Rise." This five-year initiative examined the statewide framework and best practices for integrating adaptation into the existing planning processes as well as how to coordinate adaptation efforts across Florida.¹

The City of Fort Lauderdale was selected by DEO as an initial pilot project in 2013. The City evaluated and incorporated an AAA into its existing comprehensive plan. In 2014, the City Commission approved the AAA and its 14 policies. In 2016, three additional pilot projects were conducted in Escambia County, the City of Clearwater, and the City of St. Augustine. These local communities each created Adaptation Plans as a result of a Coastal Vulnerability Assessment and Workshop that was conducted by DEO and funded by NOAA.

On May 21, 2015, Governor Rick Scott signed SB 1094 into law, which is known as the "Peril of Flood" Statute. This law requires the consideration of future flood risk from storm surge and sea level rise in certain parts of local government comprehensive plans. As a result of SB 1094, Florida Statute Section 163.3178(2)(f)1 now includes sea level rise as one of the causes of flood risk that must be addressed in the "redevelopment principles, strategies, and engineering solutions" to reduce flood risk.

The law also changes requirements of flood insurance offered by insurance carriers, requires local governments to include a redevelopment component oriented towards flood risk reduction when drafting comprehensive coastal management plans, and requires surveyors and mappers to submit elevation certificates to the Division of Emergency Management within 30 days after completion of the certificate.²

¹ Adaptation Clearinghouse website: "Florida's Community Resilience Initiative – Planning for Sea Level Rise". Accessed May 31, 2018.

² Adaptation Clearinghouse website: "Florida SB 1094: "An act relating to the peril of flood". Accessed May 31, 2018.

21st Century Adaptation Planning in Florida

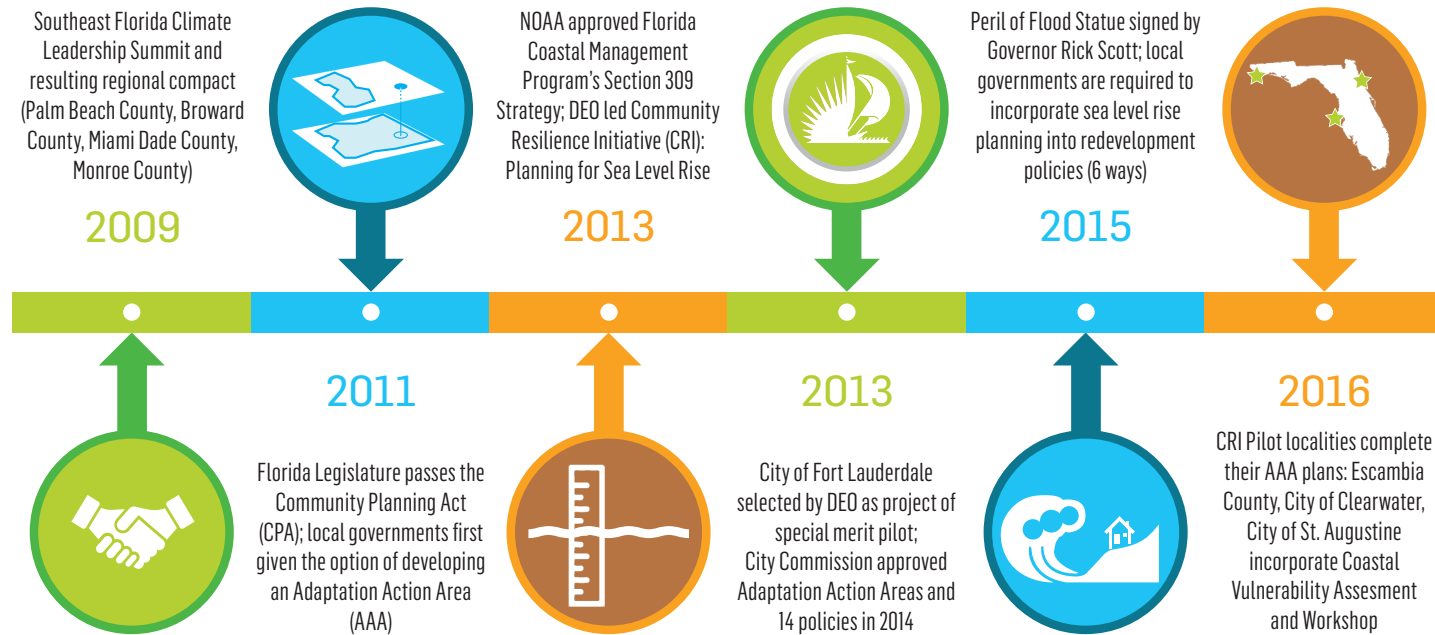


Figure 3. Adaptation Planning is new subject matter in Florida, beginning in 2009.

c. Benefits of Adaptation Planning

As mentioned earlier, the coastline of Florida is a huge contributor to the State's economy and warrants protection. There is significant value in exploring adaptation actions that mitigate potential future impacts of sea level rise and help to maintain a productive and thriving economy. A study by the National Institute of Building Sciences, called Natural Hazard Mitigation Saves: 2017 Interim Report, determined that there is a savings of \$6 for every \$1 spent on hazard mitigation efforts, and there is an additional savings of \$4 for every \$1 spent surpassing

building codes. According to FEMA, higher building standards adopted by 20,000 communities across the country are saving the nation more than \$1.1 billion a year in prevented flood damages.

When communities participating in FEMA's National Flood Insurance Program (NFIP) implement activities that exceed the minimum NFIP criteria, they receive credits by participating in FEMA's Community Rating System (CRS). These credits provide a reduction in flood insurance premiums for community residents. The higher the CRS rating, the deeper the insurance premium discount.

Adaptation planning benefits society by reducing loss of life and property damage thus creating safer communities. Communities across Florida are already engaged in hazard mitigation planning and the actions taken by these communities to reduce their vulnerability to coastal flooding are very similar to those actions Florida communities may choose to implement for adaptation. The main difference is that adaptation assumes a longer time frame for impact and, therefore, a longer time frame for planning and implementation.

Communities should view adaptation as an investment that may save them money in the long term. Actions taken to reduce risk may lead to a reduction in storm-related business interruption across a variety of important coastal industries such as the tourism, recreation, sea-ports and ocean transportation, marine, and fishing/living resources industries. By supporting a resilient business and community environment, workforces can return to work more quickly after coastal hazard events, customers will return more quickly with limited interruptions in service delivery, and suppliers will be able to continue to provide the level of service that businesses need.

Sea level rise has the potential to alter a variety of key Florida industries:

- Ocean tourism;
- Recreation;
- Water transportation;
- Marine; and,
- Fishing/living resources.

To maximize returns and benefits, Florida communities are considering the impacts of sea level rise on coastal infrastructure and environments.

Another important reason to address the impacts of climate change and sea level rise is that bond credit rating agencies like Moody's Investors Service, Standard & Poor's, and Fitch Group are beginning to consider using this more in their ratings. For example, Moody's now lists six indicators it uses "to assess the exposure and overall susceptibility of U.S. states to the physical effects of climate change." They include the share of economic activity that comes from coastal areas, hurricane and extreme-weather damage as a share of the economy, and the share of homes in a floodplain.³ States that are listed at the highest risk from climate change by Moody's include Florida along with other coastal states like Texas, Georgia, and Mississippi.

The impacts of sea level rise and climate change, such as flooding from the ocean and extreme precipitation, will increasingly impact a community's finances. For example, as sea level rise encroaches into neighborhoods and business districts, property values will likely go down, emergency service costs will increase, and business disruption costs will escalate. These consequences will both reduce revenue as home owners abandon properties or sales taxes go down in areas prone to increased flood and increase costs as communities deal with the aftermath.

These negative financial trends make it more difficult for communities to pay back bonds. Recurring events drain local coffers and reduce financial ability to pay back bonds as funds are diverted or revenues

³ "Moody's Warns Cities to Address Climate Risks or Face Downgrades" by Christopher Flavelle from a November 29, 2017 article in Bloomberg News (on-line)

Adaptation Planning Steps for Local Florida Communities

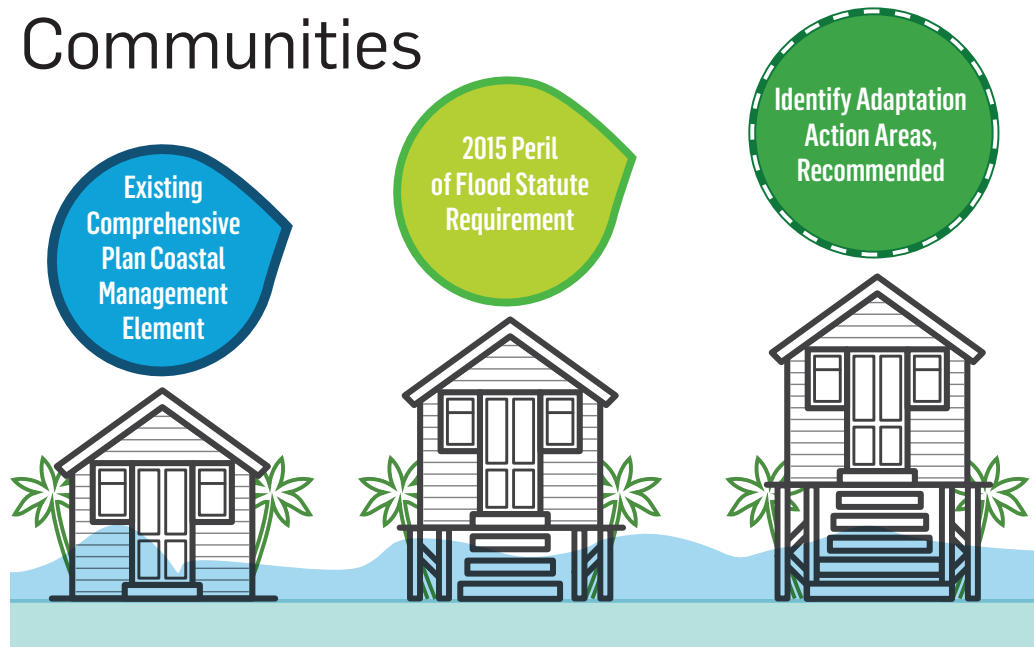


Figure 4. Many Florida communities already have a Coastal Management Element in their Comprehensive Plan. The addition of the requirements in the 2015 Peril of Flood Statute is required upon its update, and, though not required, it is highly recommended to also identify Adaptation Action Areas.

lessened. Financial factors like these are weighed by bond rating agencies, and when they become substantial, the cost to borrow money increases. As a result, a downgrade in the bond rating could force communities to pay more to borrow money for projects like building, maintaining, and rebuilding facilities and infrastructure including even the type of measures needed to adapt to sea level rise. The resulting increased cost of borrowing may then be passed on to residents and businesses as communities struggle to cope. Developing an adaptation plan is a step in the right direction to identify the areas at greatest risk and identify a tangible process for addressing the impacts.

The Florida Department of Environmental Protection is committed to marshalling resources to prepare Florida's communities and habitats for changes resulting from sea level rise. Our vision is that Florida's coastal communities are resilient and prepared for resulting coastal flooding, erosion, and ecosystem changes. With our partners at the Florida Department of Economic Opportunity, we provide this guidebook to further our mission of synergizing community resilience planning, natural resource protection tools, and funding to prepare Florida's coastline for the effects of climate change, especially rising sea levels.

1. Context

For the first part of an adaptation planning process, communities are encouraged to consider factors typical of all planning exercises, with a focus on how each factor relates to sea level rise adaptation. This is referred to as the planning context and includes a survey of existing geographic, social, infrastructural, and environmental conditions. It also entails the creation of principles (e.g., goals, objectives, and policies) to guide the planning process, which are distinct from prioritized needs set during the Adaptation Strategies analysis phase. The sub-components in the Context component include: 1) Assemble a Steering Committee; 2) Set Guiding Principles and Motivations; 3) Describe the Geographic Context; and 4) Identify Opportunities for Community Participation.

By addressing the Context, communities can better guide the adaptation planning process as it unfolds in their individual community. These sub-components are where the planning environment – politically, socially, and geographically – should be tailored to respond effectively through the next three components (Vulnerability Assessment, Adaptation Strategies, and Implementation Strategies) in a manner that creates meaningful stakeholder engagement. Establishing the Context early in the planning process also helps provide working knowledge of the participants and area to optimize the other activities later in the process, such as deciding on Focus Areas after the Sensitivity Analysis (see [Chapters 2.2](#) and [2.3](#)) or setting priority Adaptation Needs (see [Chapter 3.2](#)).

1.1. *Assemble a Steering Committee*

To develop an effective sea level rise adaptation plan that reflects the expertise and interests of the community's local stakeholders, a steering committee should be assembled to assist the organization responsible for writing the plan. Steering committees have the ability to enhance all ensuing activities in the adaptation planning process. Because they have a large role in providing data and implementing actions, local government officials or champions are the best candidates to chair or lead the steering committee or working group for the planning process. However, steering committees can accomplish their ultimate purpose, to engage the whole community, if they also include non-governmental representation with strong ties to the community (e.g., businesses, non-profits, and neighborhood groups).

It is recommended that the planning team recruit a steering committee whose composition is a blend of community champions, knowledgeable community development officials, and technical experts that understand flooding and coastal dynamics. In addition to guidance, steering committee members may work directly with the adaptation planning team to write the adaptation plan so that components such as the Vulnerability Assessment and Adaptation Strategies follow professional standards. Because sea level rise adaptation planning is an emerging topic, DEP and NOAA urge communities to think of sources of technical assistance in organizations that routinely address the subject. Universities and their cadres of graduate students, Florida Sea Grant agents, regional planning council staff, and NOAA Coastal Management Fellows are some examples.

The planning team is encouraged to look to the private sector (e.g., green building contractors, engineering firms experienced with flood issues), non-profits (e.g., 1000 Friends of Florida, The Nature Conservancy), and universities for potential steering committee members. Coastal biologists, geologists, engineers, public finance specialists, researchers, and residents with local knowledge may all be able to support adaptation planning endeavors. By strategically populating the steering committee, the ensuing activities in the adaptation planning process may benefit from creative ideas. Another source for steering committee members can be local mitigation steering committees, floodplain management planning committees, and other similar groups. Participation by these committees in adaptation planning may even earn the community a bonus in their respective planning processes. The Community Rating System (CRS) Activity 412.d (Higher study standards) awards additional credits if the community shows areas that are predicted to be susceptible to flooding in the future because of climate change or sea level rise. For this activity, the community must use an estimate of the anticipated sea level rise that is at least as high as the NOAA “intermediate-high” projections for 2100. Thus, involving local floodplain managers may result in earning CRS points.

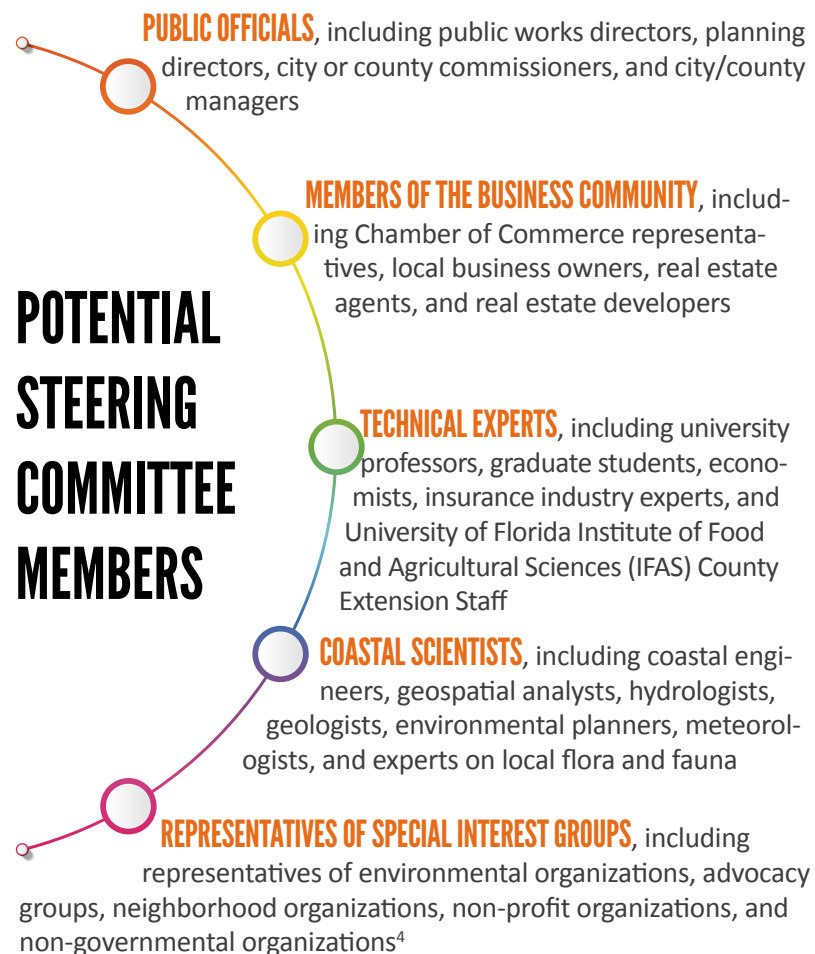


Figure 5. Potential steering committee members.

⁴Adaptation Planning Stakeholder Outreach & Engagement, pg. 15.

The steering committee is not the only guiding force behind the planning process. As discussed later in this chapter, stakeholders provide additional support in the planning process that includes even wider representation than the steering committee. Individuals considered for the steering committee that were not part of the final roster should be involved as stakeholders.

1.2. Set Guiding Principles and Motivations

By determining guiding principles and motivations, the community can establish its compass for navigating through the remaining components of the planning process. The guiding principles and motivations are one of the plan's most interactive sub-components and should assist decision-making activities in the subsequent components (i.e., Vulnerability Assessment, Adaptation Strategies, and Implementation Strategies).

The community's guiding principles and motivations for sea level rise adaptation planning should be set by the plan development team and the steering committee. The principles and motivations examine how the community operates and set its vision for the future which leads to planning goals. Convening a group to set the overarching goals is one primary method for identifying and organizing guiding forces into a single planning process. The principles may align well with goals, and motivations can be aligned as objectives to meet one or more goals. Setting goals is also a part of the comprehensive planning process and Local Mitigation Strategy process (see 44 CFR 201.6 (c)(3)(i)), which are

both recognized at the state and federal level as an important step in facilitating hazard planning efforts. Communities should ensure that the goals of their adaptation plan fit well within the goals set by other planning mechanisms such as their Local Mitigation Strategy, Post-Disaster Redevelopment Plan, Comprehensive Plan, Historic Preservation Plan, and others if applicable. If the goals from different plans conflict, then the implementation phase will likely be difficult and may reach an impasse.

1.3. Describe the Geographic Context

Describing the geographic context delineates the boundaries of the planning area and the assets, buildings, and structures contained therein.

It is important for the planning team to contextualize the physical location for which a community is planning. Describing the geographic context should include maps with the location of the community within the larger region as well as topographical, hydrological, and zoning layers that indicate current limitations and opportunities for development activities.

The maps and information developed in this plan sub-component should support the activities within the Vulnerability Assessment component. As presented in the Exposure Analysis (see [Chapter 2.1](#)) and Sensitivity Analysis (see [Chapter 2.2](#)), maps of the community showing potential sea level rise are a crucial piece of information for the adaptation planning process.

1.4. *Identify Opportunities for Community Participation*

Community members beyond the steering committee should participate to shape the outcome of the planning process. Examples of targeted participation opportunities include holding focus group meetings, conducting workshops, and addressing the topic during neighborhood gatherings, home owner association meetings, and town hall (general public) meetings as well as multi-media events such as broadcasts and surveys. An effective example of Community Participation in a sea level rise planning effort is to walk through a Strengths, Weaknesses, Opportunities, and Threats (SWOT) analysis to outline issues more systematically. Participation activities such as these can help to build and strengthen stakeholder and community support for the project as well as serve to highlight concern areas that the planning team may not have previously considered or addressed.

1.4.1. Stakeholder Identification

Stakeholders, those local individuals from a variety of organizations with interest in community planning and the shaping of the future, are best identified by determining who and what the planning efforts will affect. This can include additional governmental entities (other than the lead), community organizations and leaders, businesses, and the general public. Utilizing a community outreach strategy, as described further below, will pull in the most appropriate stakeholders.



Figure 6. Public meetings help the general population envision projects, their location, the alternatives, and their expected impacts. This public meeting was an informal neighborhood gathering style, with information presented graphically on large format boards and impromptu discussions were facilitated by project staff with members of the public in Manatee County, FL.

For a sea level rise adaptation plan to be designed for a particular community and its distinctive population, input from a wide range of stakeholders is required. By involving stakeholders in the overall process as additional community representation, local government officials and the steering committee are able to communicate messages and results, identify local priorities, and scope and implement projects and planning actions.

It is the responsibility of the local government officials and the steering committee to lead the efforts of stakeholder engagement by determining the appropriate organizations and individuals to take part in the overall process. They must decide on the best option for promoting and fostering engagement based on the target audience. Individuals and groups from all levels of government, including federal, state, and tribal groups, as well as representative groups from across the community should be offered the opportunity to participate. Outreach to vulnerable populations should also be a priority, so they have the opportunity to participate in the planning process and become vested in activities that could directly affect them.

Local Government Officials⁵

Stakeholder engagement should include local executive-level staff like elected officials, other local departments with a role in adaptation, and/or neighboring communities. Local executive staff can bring political awareness to the planning process that can be a boost to public engagement. Other departments may have technical or project experience in fields related to adaptation like coastal flooding. In addition, the planning, zoning, stormwater, and public works departments may create project scope and manage implementable projects that result from the planning effort. This guidance during strategic development will assist future project implementation. Neighboring community stakeholders may be able to enlighten the community by sharing their own adaptation or mitigation experience.

⁵ When working with public officials, please consult with the local government attorney about compliance with Florida Sunshine Law requirements.

Community Organizations and Leaders

Community organizations and leaders comprise an additional stakeholder group to engage. Connections can be made by reviewing their event calendars and meeting agendas to find a time and way to introduce the adaptation planning process and enlist their involvement. Potential partners may include church groups, rotary clubs, civic organizations, homeowners' associations, and specific interest groups. Community partnerships can provide support and local buy-in to adaptation and resiliency planning efforts. To increase stakeholder engagement, it is well served to utilize existing community activities and forums where individuals are already involved.

Major Businesses

The local business community has a vested interest in the long-term success of the overall community and is a natural stakeholder to the forward-looking adaptation planning process. These businesses may be directly impacted by sea level rise or work in an industry like real estate where their book of business may be impacted. Local businesses, especially those that are water dependent or benefit from coastal proximity, can provide an additional support dimension and help spread the word as well as provide resources. The insurance industry is often absent from these discussions but also has a very valuable perspective.

General Public

Often, members of the public have had experiences in the past that can significantly contribute to discussions of vulnerabilities and adaptation possibilities. The wealth of knowledge in the local community should not be discounted, and every effort should be made to gather it and use it.

The first step is education and awareness, allowing individuals to truly understand the threats of sea level rise and flooding based on the effects of total water level. Efforts to educate local stakeholders on current and future flood hazards can be enhanced by directly engaging the public using nontraditional outreach techniques, such as social media and interviews.

Looking ahead, today's youth will be the ones inheriting the full brunt of sea level rise, greater storm surge events, and extreme precipitation that leads to devastating floods. Future generations will continue the task of addressing these climate issues, and some individuals will likely embrace involvement. Youth can help contribute their skill with things like social media to enhance the outreach effort. They also can bring energy, a fresh perspective, dedication to shaping their future, and willingness to think 'outside the box' to help find innovative ideas and concepts to advance adaptation planning.

Figure 7. When local ideas, concerns, and preferences are considered, adaptation strategies can be tailored to meet community needs and desires



1.4.2. Public Outreach Approach

Public participation is important for identifying social, cultural, economic, and physical factors, which need to be considered during the establishment of guiding principles used to develop community adaptation strategies. It is also the appropriate avenue for 'socializing' the plan. When local ideas, concerns, and preferences are considered, adaptation strategies can be tailored to meet community needs and desires. Plans and policy that are developed with broad stakeholder participation are more likely to be well-received and gain public support when residents have participated in the process from the start. While some members of the public may not welcome the process initially, walking them through the various components generally helps establish valid and urgent reasons why sea level rise adaptation is needed.

Community conversations to identify goals should be centered on topics including:

- Background information and critical risks.
- The steps that can be taken to reduce risks.
- Why adaptation planning efforts are important for the community.
- How the proposed strategies will impact the community.
- Which proposed strategies the community prefers.
- Steps residents can take to assist in community adaptation efforts.

In doing so, an informed set of stakeholders may be equipped to add great value to the critical thinking behind Focus Area prioritization (see [Chapter 2.3](#)).

Outreach Strategies

The success of adaptation strategies largely depends upon confidence in the idea that reductions in long-term risk exposure, combined with present day mitigation efforts, will be sustained. Outreach is an important activity that can help build this confidence and lead to future action; however, each community's outreach strategy will be unique to reflect local conditions. To ensure that adaptation is well received in the community, simply posting information on the city's website is a first step although it will not be adequate on its own. Positive public information efforts that outline what people can do are more likely to impact behavior. It is not enough that people know they are in a hazardous area; they need to want to do something about it. Community members must understand the effects each strategy will have on them and what actions they can take. Therefore, messaging is very important.

A key public engagement approach is to shift from “telling” towards “asking” about what should be done. Residents are deeply connected to where they live, and crowdsourcing information can add a new layer to components like the Vulnerability Assessment (e.g., allow citizens to tell their personal experiences of how their homes, streets, or the businesses they frequent have been impacted by king tides and pinpoint these locations on a map with a tag describing the impact).



Figure 8. Overarching concepts pulled from individuals' ideas resulting in crowdsourcing information can provide valuable input when engaging the community.



It is important to prepare for outreach and create specific content areas. A community with a proactive outreach strategy that speaks to specific community social and political views will have a greater chance of moving beyond “informing” to “prompting community members to act.” Determining the different stakeholder views will lend itself to a more tailored and appropriate outreach strategy, a challenging task. As part of an early outreach strategy, it is recommended to incorporate a chart of the recorded sea levels for the nearest NOAA tide gauge over the last 50 to 75 years to represent the historic sea level rise trend. This action should help establish evidence-based reasons for approaching adaptation, help get beyond personal opinions, and start a process of deeper community conversations about what to do about sea level rise.

Figure 9. Each community’s outreach strategy will be unique to reflect local conditions.



Figure 10. Effective messages explain how sea level rise impacts everyday life.

Community Conversations

Messaging is at the center of effective public outreach efforts. Messages are specific statements of directions that the community considers important for its audience. Messages need to be repeated many times and through different means before people hear and absorb their meaning. Messages are more likely to be accepted if they are delivered by trusted stakeholders or at least visibly supported by them. Partnerships in message delivery are more effective than a single agency (and they can be less expensive when local governments combine resources). It is very important to recognize that various outreach and messaging approaches bring different results among distinct audiences (e.g., the various age and population groups within a community). Therefore, outreach programs need to be constantly monitored, evaluated, and revised for effectiveness. It is also important to be on the lookout in social media, neighborhood bulletins, and the news for false rumors and to address these quickly with facts.

Effective messages address why citizens should become knowledgeable and involved. They should explain how sea level rise impacts everyday life, which should cultivate a call to action. Applicable and engaging messages consider the target audience and not just systems for information distribution. Communication focuses on how the issue affects people where they live, work, shop, access key services such as health care, and conduct other necessary day-to-day activities. Factors considered during the development of messaging include:



HEALTH – the health impacts of sea level rise are diverse and they can be based on three impacts: higher storm surge – causes physical and social issues resulting from property damage, displacement, or injury and accidents; increased flooding – causes waterborne disease vectors, housing displacement, limited health care access, nutrition/food supply, exposure to mold, and drowning; and raised water table – causes contaminated water supply (from landfill/brownfield seepage, sewage and toxic pollutants release, and saltwater intrusion) and unstable foundation from saturated soil.



SAFETY – storm surge heightened by sea level rise can increase damage. Disruptions at emergency response centers such as fire and police stations, emergency shelters, and health-care facilities located in high-risk areas could prevent effective response and have public safety risks.



WHERE PEOPLE LIVE – this includes damage to homes and entire neighborhoods as well as disruptions to essential services like utilities.



PEOPLE'S LIVELIHOODS – impacts on employment centers as well as employees' access to jobs via roads and transit.



SOCIALLY VULNERABLE (UNDERSERVED) POPULATIONS – populations such as renters, non-English speakers, persons with health or physical mobility constraints, and others who face greater barriers and fewer resources in planning for and responding to impacts.



NATURAL RESOURCES – consequences to ecosystems, habitats, and public spaces such as beaches, parks, and other highly valued recreation opportunities.

All of these factors can be tied back to adaptation options and the benefits that will arise from addressing each issue. The linkages tie together financial, socioeconomic, and environmental risks and the corresponding opportunities for resilience. Mitigating areas affected by sea level rise could lead to creative repurposing of land use to include recreational areas that serve both the residents and bring in more tourism.

1.5. Data Sources, Tools, and Resources

The Context component of the adaptation planning process includes defining the specific points at which public participation should occur. Six public participation points during the adaptation planning process have been highlighted in [Figure 11](#).

Adaptation Planning: Road to Implementation

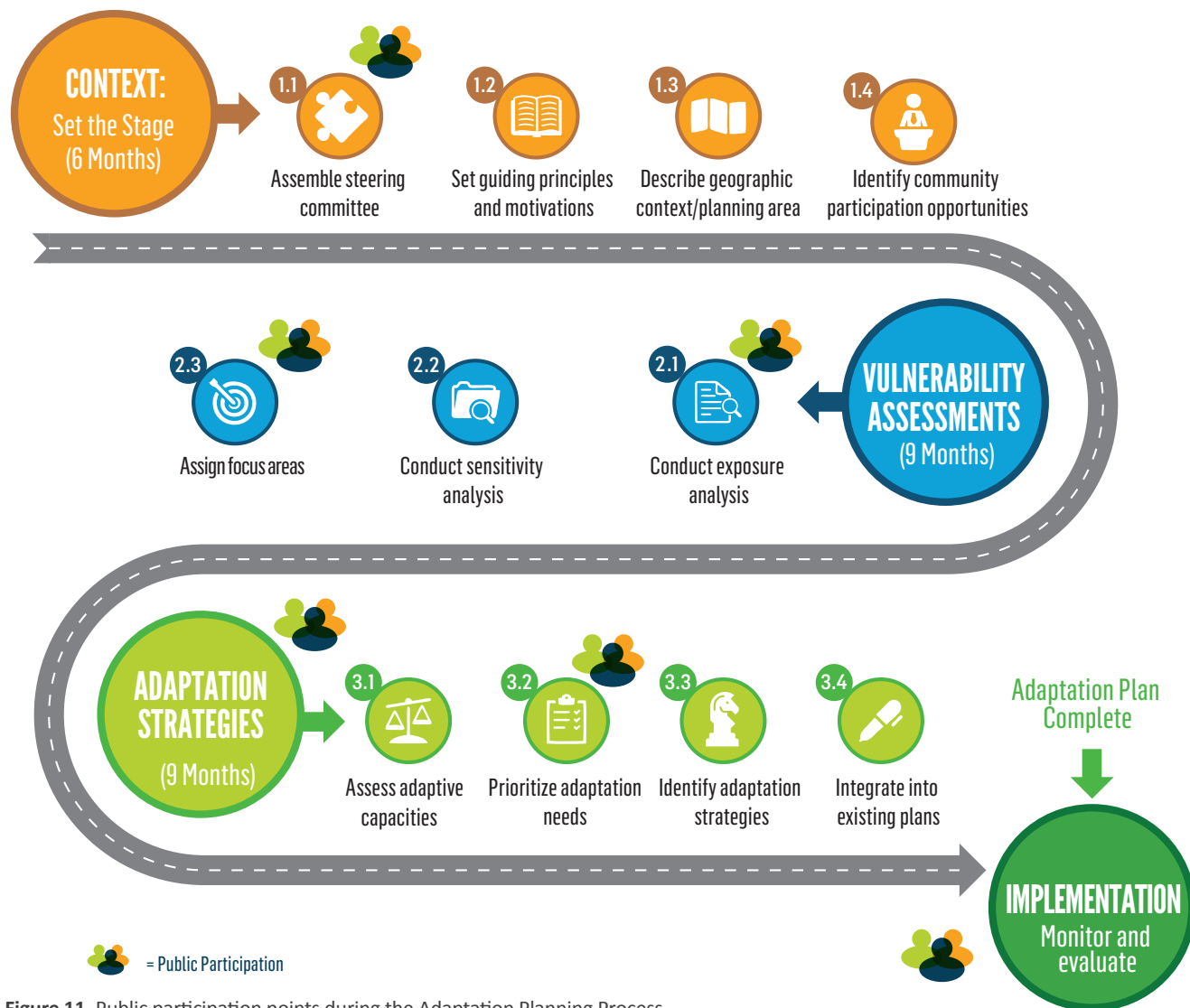


Figure 11. Public participation points during the Adaptation Planning Process.

The following table details a spectrum of stakeholder participation methods, ranging from in-person to internet communication. The planning team is encouraged to evaluate which method may work best at each of the six public participation points of the adaptation planning process.

Method	Description
Advisory group/task force	Small group of people representing various interests set up to give advice on programs or actions. In this planning process, an advisory group of more technically oriented individuals may be appropriate for something like Exposure Analysis.
App	A program that operates on a smartphone. Could be used to poll, disseminate information, or provide services.
Charrette	Intense, single or even multi-day effort to design something or solve a problem.
Field trip	Trip to specific location organized so that participants can match mental images to real conditions.
Focus group	Small discussion group led by a facilitator who draws out in-depth stakeholder input on specific questions.
Hotline	Widely advertised telephone number that directs callers to someone who can answer questions and collect input.
Interview	Face-to-face or telephone interaction with stakeholders conducted by the agency or by a third-party representative.
Large group/small group meeting	Opening presentation then division into smaller groups to discuss an issue or complete a task.
Open house	Event in which the public is invited to visit a location with staffed booths or stations. These stations could include areas with maps (either paper maps or computer stations) facilitated by the meeting organizers staffed with various subject matters experts.
Poll or Survey	Written or oral lists of questions to solicit community impressions/facts about issues at a specific moment in time.
Public hearing	Formal, single meeting where stakeholders present official statements and positions that are recorded.
Public meeting	Large public comment meeting where comments are made to entire audience.
Referendum	A direct vote by the whole electorate on its support of specific proposals.
Retreat	Concentrated, informal meeting that emphasizes social interaction as well as issue discussion.
Social media	Information and interactive event and issue marketing carried out through web and app platforms such as Facebook, Twitter, and Instagram.
Story map	An interactive, web-based map that provides enhanced information about locations.
Town hall meeting	Less formal public hearing where stakeholders have the opportunity to speak and/or vote.
Website	An online resource center that may provide (on the front end) information, interactive data, feedback mechanisms, and (on the back end) analytics to administrators.
Workshop	Small stakeholder gathering, typically fewer than 25 people, designed to complete a specific assignment in a short time period.

Adapted from NOAA's Introduction to Stakeholder Participation (2007).

1.6. *Best Practices in Stakeholder Involvement*

Best practices in stakeholder involvement and participation are determined by the principles established at the beginning of the planning process and are the preferred end result of the chosen strategy. Depending on the type of audience and engagement, the best possible techniques for stakeholder involvement will vary. All of the best practice strategies may not be applicable for each stage in the adaptation planning process, but all are factors that can shape how community involvement may be designed. However, key best practices typically include all of the elements below:

- Opportunity for input
- Motivated participants
- Influence over the final decision
- Best available information exchange
- Constructive dialogue
- Adequate analysis
- Transparency
- Representative participation
- Cost-effectiveness
- Accessibility
- Limited influence of sponsor
- Positive social conditions
- Social learning

Specifications for each best practice element are matched with the medium of communication and the stakeholders that are involved. Best practice activity examples are outlined below to include the description, format, preparation, duration, approach, outcome, potential barriers, and how to overcome barriers.



Figure 12. Successful adaptation and cleanup efforts are a result of coordinated planning, which stems from the inclusion of several viewpoints from multiple stakeholders.



Identify Opportunities for Public Participation

OPEN HOUSE

Activity Description: Public awareness outreach

Format: Open house

Preparation, Pre- Activity:

- **General Public** – None
- **Local Representative** – Choose a sea level rise visualizer and database of resources to present, and peruse it. (1 hour)
- **Meeting facilitators** – Prepare salient visualizations of the community available through the visualizer and “talking points” about the upcoming process.

Length: 2 – 4 hours

Approaches: In this activity, community members will be solicited by the project team to attend an informational meeting in which issues will be presented and attitudes gauged. A theme used in a Ft. Lauderdale open house, “This is happening, let’s do something about it,” helped avoid speculation on the causes or reality of coastal changes (See [Chapter 4.5](#) for examples).

Outcome: To engage a segment of the public in person, to spread word about the process, and to attend future decision meetings.

Barriers to Desired Outcome: Poor attendance of event, “Position” attendees who want to debate existence and causes of sea level rise, and lack of participant buy-in to proposed planning effort.

How to Overcome Barriers:

- Ensure that event advertising is widespread and occurs in advance to the scheduled open house. Hold the open house in a prime community location. Have a Facebook event with RSVP tracking (i.e., “going”, “not going”, “maybe”).
- **Avoid “position”, focus on “interest”** – ask participants to clarify their values rather than their position. This will help reach an explanation that is satisfying to all parties.
- **“Bridge and pivot”** – acknowledge comments posed by disruptive attendees, and re-orient the dialogue by segueing back to the topic at hand.

Techniques to engage buy-in:

- **Co-benefits of adaptation planning** – making assets and populations more equipped to deal with flooding will make them more productive and healthier today.
- **Sustainability principles** – satisfy the needs of the present without compromising the ability of future generations to meet their needs.
- **Cutting edge planning** – helping the community to leverage the best planning mechanisms available to improve quality of life.
- **Hazard Planning** – communities already plan for hazards; this set of activities represents an elaboration of flood-based resiliency planning.



Set Motivations and Guiding Principles LARGE GROUP/SMALL GROUP MEETING

Activity Description: Citizen empowerment via goal-setting process

Format: Large group/small group meeting

Participant Preparation, Pre-Activity:

- **General Public** – Visit a selection of sea level rise related resources and consider local impacts. (1 hour)
- **Local Representative** – Review local regulatory documents and assess gaps in goals related to coastal flood planning. (2 hours)
- **Meeting facilitators** – Review local regulatory documents and assess gaps in goals related to coastal flood planning. Create sample goal templates for Infrastructure, Real Estate, Environmental, and Social issues related to coastal flood planning.

Length: 2 – 4 hours

Approaches: Through this activity, community stakeholders, steering committee members, and representatives will work to create new motivations for undertaking adaptation planning. These will guide the planning process and possibly even future policy language. From a general assembly, small groups will break out and create their own sets of goals for various topic areas. Smaller groups should also include steering committee members and representatives.

Outcome: Increased stakeholder buy-in. Coastal Flooding Adaptation Plan Goals.

Barriers to Desired Outcome: Poorly understood meeting objective, belief that planning effort lacks importance, contradictory goals, and lack of diversity in stakeholder participant opinion in goals.

How to Overcome Barriers:

- Publicize the meeting through proven methods.
- Target multiple different demographics for invitation to the meeting.
- Clarify, during the invitation phase, the meeting objective.
- Include links to information about saliency of adaptation planning before meeting, and briefly address saliency at beginning of meeting.
- Plan for multiple large group/small group meetings in different locations.



Choose Projection Tools and Method

FOCUS GROUP

Activity Description: Stakeholder input and plan-guiding process

Format: Focus group with stakeholder representatives from a diverse group of community interests (i.e., chamber of commerce, conservation groups, HOA groups, utilities representatives, other major group representatives) and Steering Committee members.

Participant Preparation, Pre-Activity:

- **Stakeholder representatives:** study a selection of sea level rise projection visualizers and tools and various information about the local sea level rise context. (2 hours)
- **Local Representatives:** same as above, and additionally: review future land use maps and tide gauge data for the nearest location, IPCC sea level rise and emissions scenario information, and historic tidal flooding records in the community. (3 hours)
- **Meeting Facilitators:** same as above, and additionally: prepare 3 model and scenario options for participants to choose from, that include horizon year, amount of rise based on scenario, and other coastal flooding effects and model outputs.

Length: 4 hours

Approaches: Through the focus group selection exercise, a variety of interests may bring value to the projection and model selection. By involving diverse groups in a more intensive activity, it is likely that more issues may arise concerning a final solution. However, through good facilitation techniques, decisions can be made that will ripple back into the respective areas of the community from where focus

group members came. In turn, greater understanding from community groups may result.

Outcome: A projection method and model through which to project future impacts. Model output will affect decisions related to strategies, which will in turn affect regulatory mechanisms such as the future land use map, or current zoning maps, in addition to other documents.

Barriers to Desired Outcome: Non-participation of stakeholder representatives from diverse community backgrounds, disagreement over projection method and tool selection, excessive discussion prohibits decision making, and participant confusion or non-comprehension of topic.

How to Overcome Barriers:

- Ensure diverse stakeholders are approached and RSVP for the event.
- Assist participants to obtain the information recommended in “pre-activity” above.
- Pro-actively ensure that stakeholders comprehend some of the material before the event.
- Apply good meeting facilitation techniques.



Focus Area Assignment Based on Projection

LARGE GROUP/SMALL GROUP MEETING

Activity Description: Information sharing and empowerment through focus area choice

Format: Large group/small group meeting

Participant Preparation, Pre-Activity:

- **General Participant:** Familiarize with project and model being utilized. (1 hour)
- **Community Representative:** Consider projection output as it relates to land uses, assets, and other community features. (3 hours)
- **Facilitators:** prepare all model outputs into large and medium-sized maps. (6 hours)

Length: 2 – 4 hours

Approaches: Through a large group/small group meeting, the planning team may enhance focus group participation from the prior community engagement. More stakeholders may attend, and smaller groups may be partitioned to include a mix of different stakeholder backgrounds. By examining the model outputs, groups may then collaboratively vote on where they would like to see adaptation efforts focused.

Outcome: Categorical and spatial descriptions of key community assets on which adaptation strategy creation will be focused. Community anticipation and interest in development of adaptation strategies, and the role of resilience, in planning the future for the community.

Barriers: Belief that personal/business rights may be infringed upon (e.g., eminent domain), anxiety to promote something as a focus area because of perceived changes to the current state in which the area or asset exists, and disagreement over location/categories of focus areas.

How to Overcome Barriers:

- Include strong evidence within the presentation to indicate co-benefits of adaptation planning.
- Develop a plan to show that ‘property rights infringement’ is not an adaptation strategy.
- Practice good facilitation techniques.



Poll Community-Preferred Adaptation Strategies SURVEY

Activity Description: Community member consultation for desired adaptation strategies, which will integrate preferences expressed according to costs and benefits. Costs and benefits may include dollar values and/or other non-monetized preferences.

Format: Survey (e.g., online poll or mail-out)

Participant Preparation, Pre-Activity:

- **Participants:** None
- **Community Representatives:** Identify ways to communicate the proposed strategies. (1 hour)
- **Facilitators:** Develop the survey format and questions. Create the survey in the desired medium (e.g., printed, surveymonkey.com, etc.). (8 hours)

Length: Open response period – 1 week; time to complete 15-30 min.

Approaches: A survey will allow a great number of people to experience the pro-active planning effort, perceive co-benefits, and express their preferences for interventions that represent the main outcomes of adaptation planning.

Outcome: To have a solid foundation of community opinion registered, in an “informal referendum” format, and to fold into the implementation step of the process.

Barriers: Lack of response participation, misunderstanding of survey goals, and lack of response diversity.

How to Overcome Barriers:

- Assess which survey medium will garner the most results (e.g., online, paper).
- Target community stakeholders and assist them in answering the survey.
- Clearly define the process steps taken to date and the current task at the beginning of the survey.

2. Vulnerability Assessment

The Vulnerability Assessment represents the second component in the sea level rise adaptation planning process. It consists of measuring the impact of sea level rise and identifying the people, infrastructure, and land uses that may be affected. Vulnerability is often used interchangeably with risk when measuring hazard impacts. NOAA provides a useful definition of vulnerability that informs the follow-on actions described later in this chapter (2010):

“The potential for loss of or harm/damage to exposed assets largely due to complex interactions among natural processes, land use decisions, and community resilience.”⁶

There is sometimes confusion related to whether a community is conducting a “risk analysis,” “vulnerability analysis,” or some combination of both. For this guide, risk and vulnerability overlap in their inputs and outputs. The main difference is that risk analyses are outlined for use in local hazard mitigation strategies by the Code of Federal Regulations (44 CFR §201.6). Risk analysis entails determining the extent to which any hazard may impact a community. Because the focus of this adaptation guide is on sea level rise, communities can devote more resources to projecting their specific hazard impact, including a more extensive inquiry into affected land uses and populations than is outlined as a minimum requirement in the Code of Federal Regulations for a general risk assessment (44 CFR §201.6).

Benefits of performing a vulnerability assessment extend beyond the ultimate goal of an adaptation plan. For example, a vulnerability assessment fulfills a statutory requirement for designating Adaptation Action Areas. The recommended analyses also form the basis for complying with the “Peril of Flood” comprehensive plan requirements as found in Section 163.3178(2)(f)(1-6), Florida Statutes. By integrating the best available scientific methods and developing a keen awareness of different structural and social assets that may be vulnerable to future coastal flooding, the community may ensure that the most useful basis for planning is established.

A variety of supporting analyses may be contained within the scope of the Vulnerability Assessment component. Recommendations in this chapter draw from the California Adaptation Guide (2012)⁷ and a review of adaptation plans across Florida. As such, the Vulnerability Assessment component is broken down into the following sub-components: **Exposure Analysis, Sensitivity Analysis, and Focus Area** identification and mapping.

Why do you need a Vulnerability Assessment?

A Vulnerability Assessment helps a community determine which structural and social assets are likely to be impacted by future coastal flooding and sea level rise.

⁶ NOAA Office of Ocean and Coastal Resource Management. (2010). Adapting to Climate Change: A Planning Guide for State Coastal Managers. Silver Spring: National Oceanic and Atmospheric Administration.

⁷ California Emergency Management Agency. (2012). California Adaptation Planning Guide. Mather.

These three sub-components function as a powerful medium of understanding sea level rise for the planning team as well as the community in general. This is a step-by-step methodology presented in a logical sequence that will help lead a community to priority actions and priority areas. The **Exposure Analysis** visually represents the potential encroachment of the sea into land areas, and the **Sensitivity Analysis** illustrates the variety of entities that may be affected by a rise. Each community may adapt the Exposure and Sensitivity Analyses to suit their own priorities. With these analyses in hand, the community can turn its decision making toward assigning Focus Areas. **Focus Areas** constitute the selected locations where the Adaptation Strategies component will direct its attention.

To ultimately write an adaptation plan that reflects the expertise and interests of the community's local stakeholders, public involvement should be included at each step. Community members need to know about the potential threat of coastal flooding, and they need to know concrete information about the planning being done to confront it. Early introduction of sea level rise visualization tools can indicate the great level of detail that scientists have already committed to projecting and mapping future change and can be very tangibly felt when shown in a specific community. Integrating testimonials of those who have perceived experience with sea level rise can contribute to the authenticity and local focus of the process. Longtime residents of an area may contribute valuable information about lost barrier islands or coastal areas where they once recreated or did business. Often vulnerabilities are brought out by community members that are not evident from mapping and studies.

See [Appendix 6.1](#) for Economic Development, Historic and Cultural Resources, and Natural Resources special considerations.

2.1. Conduct an Exposure Analysis

An Exposure Analysis uses a sea level rise projection to answer the question “where” qualified by two factors – when (what time horizon – e.g., 10 years, 25 years) and how much (which sea level rise scenario – e.g., 1-foot inundation). The “where” will depend

Exposure Analysis

An Exposure Analysis identifies baseline risk and allows a community to understand risk in terms of spatial extent and level of exposure.

on which computer model is used (e.g., Sea Level Affecting Marshes Model (SLAMM); Sea, Lake, and Overland Surges from Hurricanes (SLOSH)) to produce the sea level rise projection. The analysis can depict which areas in the community are likely to be susceptible to the chosen sea level rise scenario on a map.

There are a variety of methods that can be used to project sea level rise. These methods range from extrapolating a straight line into the future based upon historically recorded sea level heights from the nearest NOAA gauge station to predicting a curve of accelerating sea level heights based upon Global Climate Model projections. To consolidate these methods and projections, a number of sea level rise viewing tools have been created to help visualize the effects of sea level rise on communities. Examples of these tools are described and categorized below in [Chapter 2.4](#) and Best Practices are identified in [Chapter 2.5](#).

Figure 13

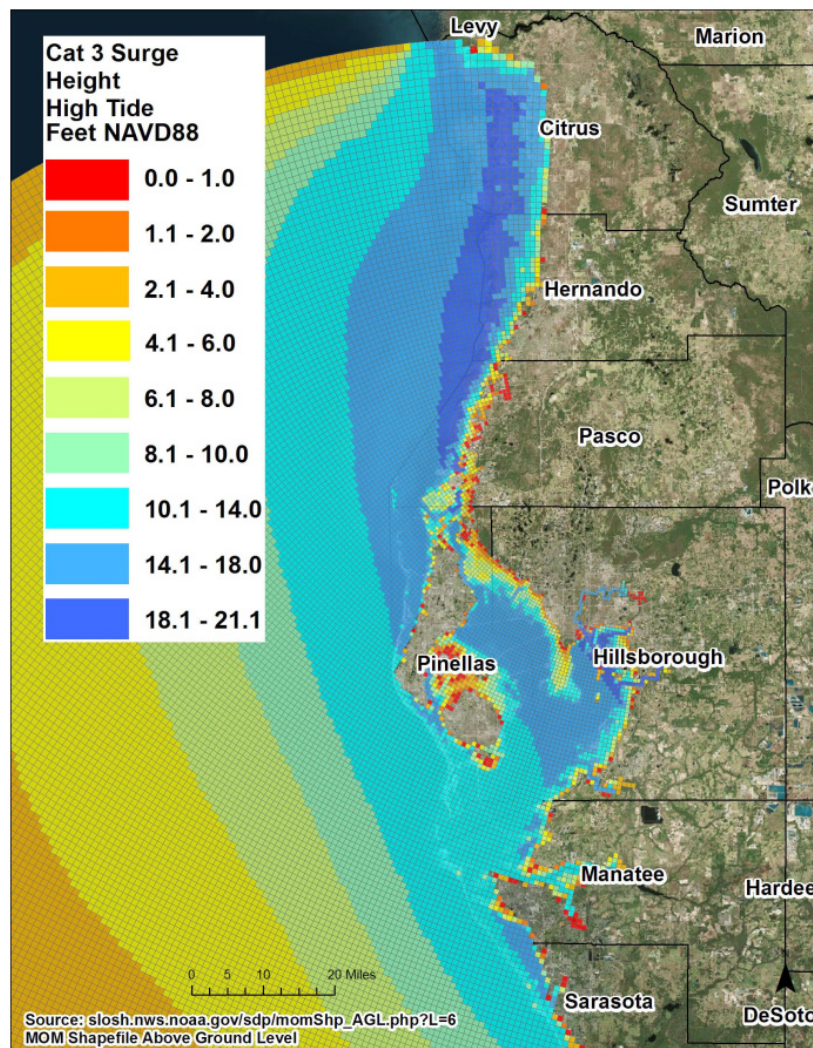


Figure 13. Tampa Bay SLOSH Grid showing maximum wave heights above ground for a category 3 hurricane at high tide. This figure used SLOSH modeling to show that a category 3 hurricane at high tide would produce a maximum surge of 21.1 feet above ground in the Tampa Bay Region.

South Florida Regional Council. (2016). Assessment Report of Regional Differences within Florida: Within the Context of the Trainers and Tools Project: Building Coastal Flood Hazard resiliency in Florida's Regional Planning Council Communities. Hollywood.

Figure 14

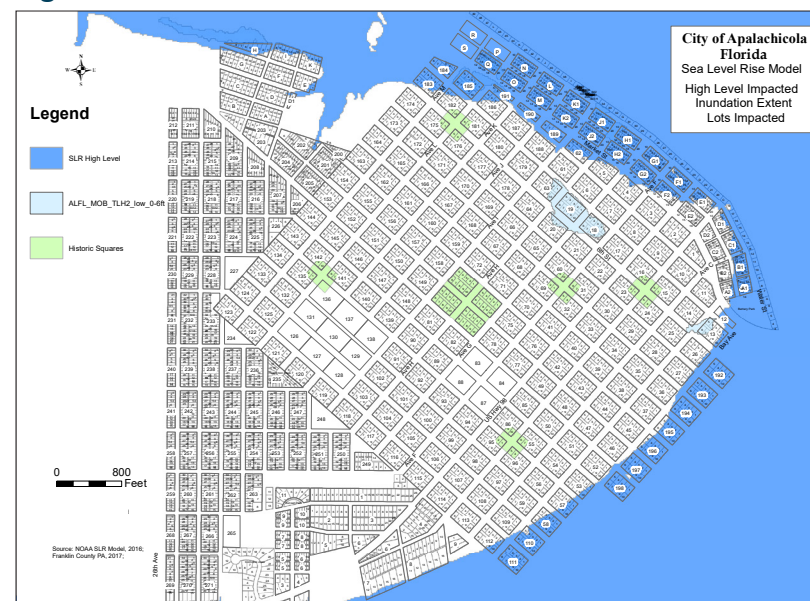


Figure 14. High projected inundation – City of Apalachicola. This map reflects the acreage affected by high level inundation, or 6-feet of sea level rise. NOAA sea level rise inundation model datasets for 1- to 6-foot increments were imported into the city's GIS map to illustrate the potential inundation of floodwaters to the city. In addition to identifying the number of acres that would be impacted, the map also identifies the historic resources that would be impacted from the inundation.

Florida Department of Economic Opportunity. (2017). Vulnerability Analysis: City of Apalachicola, Tallahassee.

Sea level rise viewing tools generally employ different projection data and levels of resolution (the grid cell size of Digital Elevation Model; e.g., 2 feet x 2 feet versus 20 feet x 20 feet) to generate a visual exposure projection. This projection shows the areas that will be inundated by future sea level rise. The tools may also measure impacts on different categorizations of land. The tools function using different software. If available, the planning team and community would benefit from Geographic Information Systems (GIS) software when generating its own exposure map.

Planning teams are encouraged to use the tool that has the highest resolution (e.g., most elevation readings per unit-area of land) to increase accuracy. Previous Florida sea level rise assessments have shown that achieving the highest resolution in a sea level rise tool may require in-house or contracted specialist GIS work to produce a map of exposure specific to the community. The team is also encouraged to use a software program that meshes well with the way in which the community currently plans (for instance, when the community prepares to do a Sensitivity Analysis, leveraging assets already mapped in a GIS layer from past planning projects saves time and increases accuracy).

2.2. Conduct a Sensitivity Analysis

This Sensitivity Analysis sub-component builds upon the Exposure Analysis and is usually conducted utilizing the same tool that was used to make the exposure map. Conducting a Sensitivity Analysis helps the community to identify natural resources, structures, populations, and other features located in areas that are at risk in the sea level rise scenario projected during Exposure Analysis.

Sensitivity Analysis

A Sensitivity Analysis provides an inventory of community assets, such as populations, structures, and economic functions, and quantifies and measures the impacts of sea level rise on those assets.

Sensitivity can be defined as the responsiveness of a system to hazard impacts.⁸ The Sensitivity Analysis serves as the opportunity for the planning team and its steering committee to identify the land uses, buildings, resources, and people affected by the potential sea level rise projected by the Exposure Analysis. By mapping all entities in the community's jurisdiction, the planning team develops a basic representation of which entities have the potential to be affected by sea level rise.

⁸ B.L. Preston, M. S.-S. (2009). Framing Vulnerability and Adaptive Capacity Assessment: Discussion Paper. CSIRO.

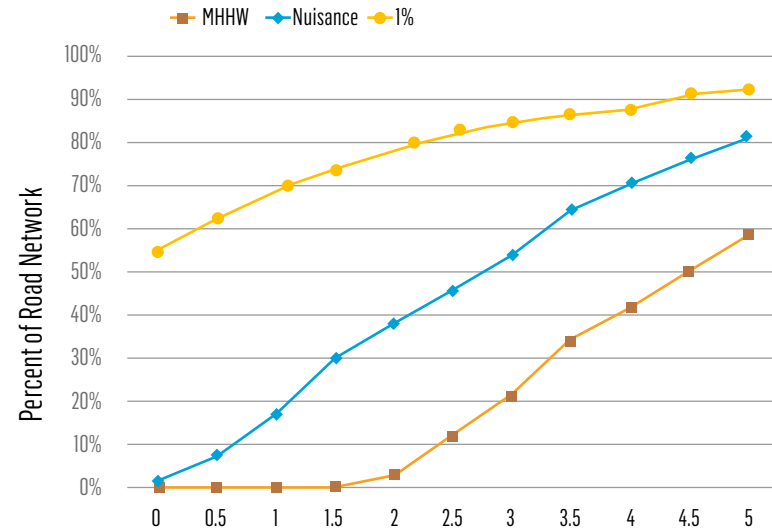
Figure 15. Summary of emergency facility exposure to each flood type and sea level rise scenario – Escambia County. Community infrastructure exposure to flooding was evaluated in order to identify impacts to critical community assets. This analysis determined exposure of police, fire, and emergency facilities to daily tidal flooding, 1% annual chance flooding, 0.2% annual chance flooding in 2045 and 2085 under low, medium, high, and highest sea level rise scenarios using GIS analysis.

Florida Department of Economic Opportunity. (2016). Coastal Vulnerability Assessment: Escambia County, Florida. Tallahassee.

Emergency Facilities	MHHW		1%		0.2%	
	2045	2085	2045	2085	2045	2085
Escambia County EMS Station 13		Highest	Today	Today	Today	Today
Escambia County EMS Station 14				Highest	High	Medium
Innerarity Point Fire Station 8				High		Medium
NAS Fire & EMS Station 1			High	Medium	Today	Today
NAS Fire & EMS Station 2			High	Medium	Today	Today
NAS Fire & EMS Station 3			High	Medium	Today	Today
NAS Fire & EMS Station 4			High	Medium	Today	Today
NAS Fire & EMS Station 5			High	Medium	Today	Today
Pensacola State College Police Dept.						High
Perdido Key Fire Department		Today	Today	Today	Today	Today
Warnington Fire District						Highest

Figure 16. Percent of road network affected by Mean Higher High Water (MHHW), nuisance, and the 1% flood level for each sea level rise increment – City of St. Augustine. In order to identify infrastructure impacted by sea level rise scenarios, the amount of roads subject to nuisance and flood frequency was determined by sea level rise increment. This was accomplished using GIS analysis, the mapped city road network, and the NOAA inundation tool.

Florida Department of Economic Opportunity. (2016). Coastal Vulnerability Assessment: City of St. Augustine County, Florida. Tallahassee.



The planning team may introduce and analyze new layers of structural and population sensitivity by including various characteristics in the Sensitivity Analysis mapping. For buildings, this may include physical characteristics that will better respond to sea level rise, such as raised, floodable, and anchored structures. For natural areas, this may include information about wildlife, ecosystems, floodplains, water tables, and industry-supporting habitats (such as oyster coves). For populations, this can include social demographics, such as household size and income by census tract. Examples of Best Practices are identified in [Chapter 2.5](#).

2.3. Assign Focus Areas

With the assistance of the steering committee and community stakeholders, the planning team may assign Focus Areas. This sub-component builds on the identification of sensitive entities in the previous step and assigns community preferences to areas that will receive a

majority of the adaptation strategy attention. The Focus Areas help the community designate areas to start their adaptation process and narrow the field to build a track record of implementation.

Deciding on Focus Areas is a step where the planning team engages the community to address the findings from the Exposure and Sensitivity Analyses. It is recommended that before the Vulnerability Assessment begins, criteria be established to guide the public's input (e.g., Focus Areas are established where critical facilities or infrastructure are located and/or where the highest affected population resides). To do this, it is important to convey information about the potential affected entities to both steering committee members and community stakeholders and to record their feedback about what should become a Focus Area and why. Preferential areas which receive steering committee and community attention may then be deemed Focus Areas that can benefit from adaptation strategies directed toward them using the following components.

Tools are key for the Vulnerability Assessment. There are a variety of tools available for different levels of technical background and to meet the needs of the community based on level of impact and size.

2.4. Data Sources, Tools, and Resources

The tools and resources listed in this section can be used by a planning team to project sea level rise and conduct an Exposure Analysis and Sensitivity Analysis. They are divided into three types: 1) visualization tools; 2) modeling tools; and 3) decision support tools.

Visualization tools can be used to create simulations and graphics of current and potential future conditions. These tools often perform analyses but generally require less user input and customization than other analytical tools. Often, they do not have the ability to run customized analyses with local data. These tools are generally easy to use and do not require specific software or hardware.

Modeling tools are computer software programs or GIS add-ins that can calculate future coastal flood scenarios and visualize current and potential conditions of geophysical, biological, and/or socioeconomic processes in a map-based, tabular, or graphic format. These tools are generally the most technically challenging to use and often require GIS software and appropriate hardware, technical expertise, and training. Modeling tools also generally require local data on the process being investigated.

Decision support tools help develop scenarios of future conditions resulting from potential sea level rise and management decisions.

These tools can integrate outputs from various methods, such as models, to help develop “what if” scenarios and investigate a wide variety of management outcomes. Decision support tools generally require at least a moderate degree of technical capacity such as GIS expertise.

A brief description of each tool is provided as well as a “ranking” of the level of resource commitment and/or degree of specialty required to use that tool. This ranges from **Minimum** (★) – requires limited or no experience/training, **Recommended** (★ ★) – requires at least basic experience using GIS software, and **Advanced** (★ ★ ★) – requires extensive technical modeling experience. The type of analysis each tool can be used to conduct is also identified as either **Exposure Analysis (E)**, **Sensitivity Analysis (S)**, or **Assign Focus Areas (F)**. Additional information on these tools and resources, including methodology, cost, transferability, precision, accuracy, capacity, and examples of use, can be found in the [*Sea level Rise Vulnerability Assessment Tools and Resources: A Guide for Florida’s Local Governments \(2015\)*](#).⁹

⁹Florida Department of Economic Opportunity. (2015). Sea level Rise Vulnerability Assessment Tools and Resources: A Guide for Florida’s Local Governments. Tallahassee.

Tool/Resource Name	Purpose	Ranking	Type of Analysis
Visualization Tools			
CanVis (NOAA)	This tool allows users to create photo-realistic simulations for visualizing the potential impacts from coastal development and sea level rise.	★	E
Climate Central's Surging Seas	This tool includes an interactive Risk Finder and Submergence Risk Map. The Risk Finder shows populations, infrastructure, and assets exposed to coastal flooding aggravated by different sea levels as determined by the user (i.e., 1 to 10 feet of rise). The Submergence Risk Map is a tool that depicts sea level rise scenarios.	★★	E
FDOT Sea Level Scenario Sketch Planning Tool	This tool allows for visualization of potentially inundated areas due to sea level rise, identification of transportation facilities potentially at risk from sea level rise inundation, report creation to summarize and prioritize impacted infrastructure, and the ability to create custom inundation surfaces.	★★	E
The Nature Conservancy Coastal Resilience Mapping Portal	This tool provides users with access to interactive tools to visualize future flood risks from sea level rise and storm surge.	★★	E
NOAA Sea Level Rise Viewer	This tool is an online viewer that allows users to visualize potential impacts from sea level rise.	★★	E
NOAA Sea Level Trends	This tool illustrates regional trends in sea level with arrows representing the direction and magnitude of change. This can be used to determine areas which have experienced the highest rates of change and may be most vulnerable to future sea level rise.	★	E
Social Vulnerability Index (SoVI) (University of South Carolina, Hazard and Vulnerability Research Institute)	This tool measures the social vulnerability of U.S. counties and census tracts to environmental hazards, including sea level rise.	★	E
USGS National Assessment of Coastal Vulnerability to Sea Level Rise: Coastal Vulnerability Index (CVI)	This tool maps the Coastal Vulnerability Index (CVI) data layer, which expresses the relative vulnerability of the coast to physical changes due to sea level rise, geomorphology, and shoreline erosion rates.	★	E
USGS Digital Shoreline Analysis System (DSAS)	This tool can be used to measure coastal erosion and accretion, which can help users determine the areas that have experienced the highest rates of change and may be most vulnerable to sea level rise.	★★	E

Tool/Resource Name	Purpose	Ranking	Type of Analysis
Modeling Tools			
ADvanced CIRCulation Model (ADCIRC) (University of North Carolina at Chapel Hill, University of Notre Dame, University of Texas at Austin)	This tool can be used to analyze the effects of sea level rise on storm surge. Future scenarios can consider a given rate of sea level rise and determine how much additional inundation is predicted during a storm event compared to that under initial conditions.	★★★	E, S
Hazus-MH (FEMA)	This tool is a risk assessment methodology for analyzing potential losses. Although it is not specifically designed for sea level rise planning applications, many communities have used it to assess potential losses due to sea level rise.	★★	E, S
Integrated Valuation of Environmental Services and Tradeoffs (InVEST) (Nature Capital Project)	This tool is a suite of software models that is used to map and model ecosystem services and their variation under different management and climate scenarios. The Coastal Vulnerability Model can be used to calculate a vulnerability index for the impacts of erosion and inundation on coastal communities that accounts for projected change in sea level rise.	★★★	E, S
NatureServe Climate Change Vulnerability Index (CCVI)	This is an Excel-based tool that identifies plant and animal species that are particularly vulnerable to the effects of climate change and can help assess the relative vulnerability of species of interest occurring on the coast that may be impacted by sea level rise.	★★	E, S
NOAA Wave Exposure Model (WEMo)	This is a free tool that estimates wave energy and its effects on ecosystem functions as well as on developed coastal and inland-water areas.	★★★	E, S
Sea Levels Affecting Marshes Model (SLAMM) (Warren Pinnacle Consulting, Inc.)	This tool simulates wetland conversion and shoreline modification resulting from long-term sea level rise. As such, the tool can be used for projecting the effects of sea level rise on the distribution of coastal wetlands and the geomorphic configuration of coastal areas.	★★★	E, S
Simulator of Climate Change Risks and Adaptation Initiatives (SimCLIM) (CLIMsystems Ltd.)	This tool can be used to model site-specific sea level rise. The tool can create scenarios and project impacts of sea level rise.	★★★	E, S
USACE Sea Level Change Curve Calculator	This tool can be used to calculate the amount of predicted sea level change for any location along the U.S. coast from 1992 forward. Results are shown as a graph.	★	E, S

Tool/Resource Name	Purpose	Ranking	Type of Analysis
Decision Support Tools			
Beach-fx (USACE)	This tool is a comprehensive analytical framework for evaluating the physical performance and economic benefits and costs of shore protection projects, including sea level rise adaptation projects.	★★★	S, F
Coastal Adaptation to Sea Level Rise Tool (COAST) (Developed at the University of Southern Maine with funds. EPA, and in collaboration with partners at Battelle, the Maine Geologic Survey, the University of New Hampshire, and Blue Marble Geographics)	This software helps users answer questions addressing the costs and benefits of actions and strategies to avoid damages to assets from sea level rise through 3D visualizations.	★★	S, F
CommunityViz (Placeways LLC)	This tool provides a means for visualizing and communicating possible future land use change scenarios driven by sea level rise.	★★★	S, F
NatureServe Vista	This tool enables users to create, analyze, implement, and monitor land use and resource management scenarios that achieve conservation goals.	★★	S, F
NOAA Inundation Analysis Tool	This is an online tool that can be used to create scenarios of increased sea level rise. The output may be used to compare how many high tides and total hours of inundation would have been experienced during a selected time period assuming a given amount of sea level rise versus the historical data.	★	S, F
U.S. DOT Vulnerability Assessment Scoring Tool (VAST)	This tool is intended for state DOTs, MPOs, and other agencies interested in assessing how components of their transportation system may be vulnerable to climate stressors, including sea level rise.	★★	S, F

2.5. *Best Practices and Funding Opportunities*

Recommended Tools and Resources

From the overall list of tools found in the table above, the tools highlighted in this section represent the ones with the most accessible features that can be used by a community when completing a vulnerability assessment during the sea level rise adaptation planning process. While considering this range of recommended tools, communities should keep in mind their own needs in terms of population, vulnerability, and capacity/capability (the community's access to administrative, technical, fiscal, and political capital).

NOAA's Sea Level Trends visualization tool is recommended for starting a generalized discussion on historical sea level trends across the globe. This visual can help users understand or communicate that sea level fluctuations are constantly occurring all over the globe at different rates and even in different directions – both up and down (e.g., Alaska's southern coast has been experiencing a significant sea level drop over the last 80 years due to geologic uplifting of the continental shelf).

U.S. Geological Survey's (USGS) National Assessment of Coastal Vulnerability to Sea Level Rise is helpful for expanding on NOAA's observed trends by providing a coastal vulnerability index for the entire U.S. coast, with risk rankings from low to very high. These risk rankings can be helpful for identifying and prioritizing planning for areas in a community that are at a higher risk to the exacerbated coastal impacts associated with sea level rise.

NOAA's Sea Level Rise Viewer is recommended for local governments to use for visualizing the local potential impacts of sea level rise. The tool shows how various levels of sea level rise will impact a coastal community through a "horizon year" slider bar that illustrates inundation levels based upon a future year, and it provides simulations of sea level rise at local landmarks. The tool can also communicate the spatial uncertainty of mapped sea levels, model potential marsh migration due to sea level rise, overlay social and economic data onto potential sea level rise, and examine how tidal flooding will become more frequent with sea level rise.

The Nature Conservancy Coastal Resilience Visualization Tool offers a richly layered analysis of the Florida Keys and some visualization for other parts of the State. As a visualizer, it may also be utilized as a tool to use as a foundation (i.e., emulate or copy) if a community wishes to create its own layered analysis of sea level rise within a GIS.

The Social Vulnerability Index (SoVI) is useful for examining a community's vulnerability to sea level rise because it ranks locations (census tracts) based upon 32-42 variables that are believed to affect a human population's ability to respond to disasters, such as household income, number of cars owned, and age of inhabitants. This type of analysis can be layered over the results from other tools that show areas to be affected by sea level rise. The results of this analysis will show where vulnerable populations within the affected areas.

The Florida Department of Transportation's (FDOT) Sea Level Scenario Sketch Planning Tool stands out for its commitment to directly addressing sea level rise impacts. Generally, however, it can be utilized for visualizing potential impacts of sea level rise. The tool can be used to visualize current risk to storm surge as well as to visualize which road segments are located in a FEMA flood zone. While the focus of the tool is on visualizing sea level rise impacts on transportation infrastructure, it can also be used for more general planning purposes.

Climate Central's Surging Seas offers a free, web-based visualization tool called Submergence Risk Map that communities can use to depict scenarios of sea level rise and identify vulnerable populations, infrastructure, and assets using its searchable data toolkit called Risk Finder. It provides an easily understood assessment of sea level rise, including a mapping of social vulnerability, and a calculator of the total value of impacted structures (e.g., based upon the viewing area, and the amount of sea level rise, "X" dollars of structural damage will result).

The Gulf Tools for Resilience Exploration Engine (Gulf TREE) is another resource that can be used by communities across the Gulf of Mexico to provide guidance in climate tool and model selection when completing a vulnerability assessment during the sea level rise adaptation planning process. Since it can be difficult to find the right tool and to know which tool to select, Gulf TREE was developed in partnership by the Northern Gulf of Mexico Sentinel Site Cooperative (SSC), the Gulf of Mexico Climate Resilience Community of Practice (CoP), and the

Gulf of Mexico Alliance Resilience Team (GOMA) to serve as an interactive decision-support tree to help users find the right climate tool. Gulf TREE allows users to walk through a series of questions to help them identify the best climate tool for their needs. Gulf TREE acts like a search engine in order to match users with the right tool or model for their climate resilience project with more confidence, less time, and greater ease than they could on their own.

Once the tools have been selected, it is useful to walk through how to use these tools for each of the three Vulnerability Assessment sub-components:

Exposure Analysis

As described earlier, the Exposure Analysis sets the parameters that will guide when and how much to find where sea level rise is likely to occur. The Exposure Analysis process may be defined in four steps. First, a sea level rise model is chosen. Secondly, horizon dates (e.g., 2040, 2070) are selected to guide the model's first output. Then the model calculates static sea level rise elevations (and can also predict other changes to local coastal landscapes) for "how much" sea level rise is probable at the chosen horizon time points. Finally, future inundation areas are located (typically within a GIS map window). The output of this step is important because it generates a listing or mapping of the coastal areas that are likely to be impacted. The Exposure Analysis includes assumptions regarding the manner in which the eustatic (the total volume of ocean water) and vertical changes in sea levels could affect a community.

The Statewide Vulnerability Assessment Report (2014)¹⁰ recommends utilizing the U.S. Army Corps of Engineers' (USACE) Sea Level Change Curve Calculator coupled with static point projection of inundation. Because point projection also generates attribute files, an accompanying table can be created that indicates sea level rise over the given time period (i.e., rise amount of each project year). FDOT's Sea Level Rise Scenario Sketch Planning Tool website includes an add-in download that calculates sea level rise in GIS software utilizing the USACE method. This recommendation may mean that coastal sea level rise will be projected along seven delineations that reflect the seven FDOT districts. For the planning horizon years, the report recommends that model years of 2020, 2040, 2060, 2080, and 2100 be projected to establish continuity with the FDOT tool. Future assessments may use Digital Elevation Models with a similar grid size, or 25 meters square to map exposure, which is the method employed by FDOT's Sketch Plan Tool.

Sensitivity Analysis

As described earlier, the Sensitivity Analysis builds on the findings from the Exposure Analysis to create a greater understanding of impacts. A Sensitivity Analysis is also important to include in a Vulnerability Analysis because it can answer the question: who and what will be affected by potential sea level rise? For such an analysis, additional GIS data layers are needed to assess where the projected inundation is likely to affect structures, populations, conservation areas, and other entities.

The Statewide Vulnerability Assessment Report (2014)¹¹ recommends pairing or overlaying the Exposure Analysis model outputs (i.e., GIS

data layer of coastal inundation) with all entities identified in the table below to determine which entities are sensitive to sea level rise. This list was compiled from two sensitivity analyses created by the Southeast Florida Regional Climate Change Compact (2012)¹² and Climate Central (2014).¹³

Sensitivity Analysis Elements	
Land	Sewage Plants
Property Value	Water Plants
Homes	Hospitals
Population	Evacuation Routes
High Social Vulnerability Population	Public Schools
Population of Color	Houses of Worship
EPA Listed Sites	Marinas
Roads	Ports and Airports
Railroads	Emergency Shelters
Passenger Stations	Acres of Future Land Use
Power Plants	Habitat Type

¹⁰ Florida Department of Economic Opportunity. (2014). Statewide Vulnerability Assessment: Second Report to Focus Group. Tallahassee.

¹¹ Florida Department of Economic Opportunity. (2014). Statewide Vulnerability Assessment: Second Report to Focus Group. Tallahassee.

¹² Southeast Florida Regional Climate Change Compact Inundation Mapping and Vulnerability Assessment Work Group. (2012). Analysis of the Vulnerability of Southeast Florida to Sea Level Rise. Southeast Florida Regional Climate Change Compact.

¹³ Climate Central. Florida and the Surging Sea: A Vulnerability Assessment with Projections for Sea Level Rise and Coastal Flood Risk. Princeton: Climate Central.

Beyond the entities listed, a Sensitivity Analysis may include mapping of more conservation areas (e.g., parks and open space), historic resources, archaeological resources, business locations by sector/size, agricultural facilities, university facilities, government services (such as municipal courthouses), and communications infrastructure. The array of data inputs may help to create a broad survey of affected structures, populations, and natural areas. This process is described in greater detail in [Appendix 6.1](#), which includes Historic and Cultural Resources and Natural Resources special considerations.

Focus Areas

Once the Exposure and Sensitivity Analyses have been conducted, a community may translate these findings into map-designated areas that constitute the boundaries of the Focus Areas. Focus Areas should be based upon the findings generated during the Exposure and Sensitivity Analyses. Focus Areas can be defined on a map according to the following characteristics: a specific geographic area (e.g., development along coastlines), certain vulnerable populations or communities (e.g., the elderly and climate-related health risks), natural and built systems (e.g., local stormwater drainage systems and infrastructure), and other assets identified and quantified during the Sensitivity Analysis.

Funding Opportunities

In addition to potential grants available through NOAA and other federal and non-profit agencies (see [Appendix 6.2](#) for examples of specific funding programs), funding opportunities to complete a vulnerability assessment may come in the form of partnerships. A vulnerability assessment can support many local planning efforts in addition to adaptation planning. As such, resources could be shared to support the development of a vulnerability assessment that could be integrated into multiple local plans. Integrating adaptation planning into existing local plans is discussed further, in [Chapter 3.4](#).

2.6. *Public Outreach Approach, Communicating Risk, and Opportunities for Community Participation*

Assigning the Focus Areas is an opportunity to conduct public outreach and seek community participation in the Vulnerability Assessment component as discussed in [Chapter 2.3](#). The Vulnerability Analysis public outreach, including sharing the results of the Exposure and Sensitivity Analyses, is an excellent forum to inform the public and stakeholders about the future risk of sea level rise and potential increased flooding. It also provides a basis for the next round of meetings which includes identifying mitigation strategies to address the vulnerability (see [Chapter 3](#)).

The public should be given the chance to provide input about what should become Focus Areas for the community. Information about the potential encroachment of the sea into land areas and the entities affected by a rise should be conveyed to the public during a workshop or public meeting. Based on the feedback received from the public, preferential areas can be determined that may be deemed Focus Areas. The completion of this round of public outreach sets the stage of who will be affected and to what degree to set up the adaptation strategies.

Figure 17. Public outreach sets the stage of who will be affected and to what degree to set up the adaptation strategies.



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3. Adaptation Strategies

Adaptation Strategies are the third component in the sea level rise adaptation planning process and provide a framework to respond to the findings in the Vulnerability Assessment. According to NOAA, an “adaptation plan identifies and assesses the impacts that are likely to affect the planning area, develops goals and actions to best minimize these impacts, and establishes a process to implement those actions. The ultimate goal is coastal states and communities that are organized to take action, have the tools to take action, and are taking action to plan for and adapt to the impacts of sea level rise climate change.”¹⁴ Decision making about applying specific adaptation strategies to the challenges outlined by the Vulnerability Analysis occurs in this step. This is where a wide range of engineering, political, and planning solutions come into play. Extensive collaboration and public input is needed to develop a strategy that is locally accepted.

Adaptation Strategies are the means by which a community can transform itself to reduce the negative impacts of sea level rise and climate change while finding co-benefits.

The Adaptation Strategies component is broken down into the following sub-components: **Assess Adaptive Capacities, Prioritize Adaptation Needs, Identify Adaptation Strategies, and Integrate into Existing Plans.** Adaptation Strategies themselves are classified according to their status as **Protection, Accommodation, Retreat, and Avoidance.**

3.1. Assess Adaptive Capacities

Adaptive capacity has been defined by the Intergovernmental Panel on Climate Change as “the ability of a system to adjust to climate change (including climate variability and extremes), to moderate potential damages, to take advantage of opportunities, or to cope with the consequences.” To assess community adaptive capacity, the planning team and steering committee are encouraged to develop a framework to evaluate the community’s capacity to address the impacts of sea level rise. This may include, but is not limited to, an assessment of:¹⁵

1. Regulatory and planning capabilities (e.g., protection of human life, development and redevelopment restrictions, coastal management regulations, hazard mitigation, sustainability, shoreline management, post-disaster recovery/emergency plans, infrastructure placement, and financial impacts);
2. Administrative and technical capabilities (e.g., the number of sea level rise experts, planners, engineers, GIS and mapping resources, and modeling capabilities);
3. Fiscal capacity (e.g., taxes, bonds, grants, impact fees, withholding spending in hazard zones, and insurance); and
4. Infrastructure (e.g., flood and erosion control structures, evacuation routes and redundant water, wastewater, and power systems).

¹⁴ NOAA Office of Ocean and Coastal Resource Management. (2010). Adapting to Climate Change: A Planning Guide for State Coastal Managers. Silver Spring: National Oceanic and Atmospheric Administration.

¹⁵ Adaptation Planning for Historic Properties; Reference 35 on page 32: Russell, N., & Griggs, G. (2012). Adapting to Sea Level Rise: A Guide to California’s Coastal Communities. Santa Cruz: University of California Santa Cruz.

The regulatory assessment provides an opportunity to catalogue capacities that are currently being used but are not yet known or recognized as sea level rise adaptation planning. In Florida, commonly developed plans dealing with flood hazards such as the local mitigation strategies, Local Comprehensive Plans, floodplain management plans, and/or master stormwater plans are often the best documents to turn to for identifying existing planning strategies that can be expanded upon in the adaptation planning effort. The adaptation planning effort should include both short-term and long-term strategies, so the adaptive capacity should reflect both.

Other questions to address in this step include: How much public support exists for adaptation strategy implementation? Does the knowledge base necessary to guide potential adaptation efforts already exist at the local agency or would they likely need to access consultant engineers, planners, and other experts? Have local ordinances been identified that can be modified or added to implement long term policy changes (especially for less urgent strategies)? What stage is the local community in – a) currently managing nuisance flooding, b) mostly vulnerable to major disaster events, or c) generally only anticipating impacts within a longer timeframe?

Assess Adaptive Capacities: Regulatory Assessment

The regulatory assessment provides an opportunity to catalogue capacities that are currently being used but are not yet known or recognized as sea level rise adaptation planning.

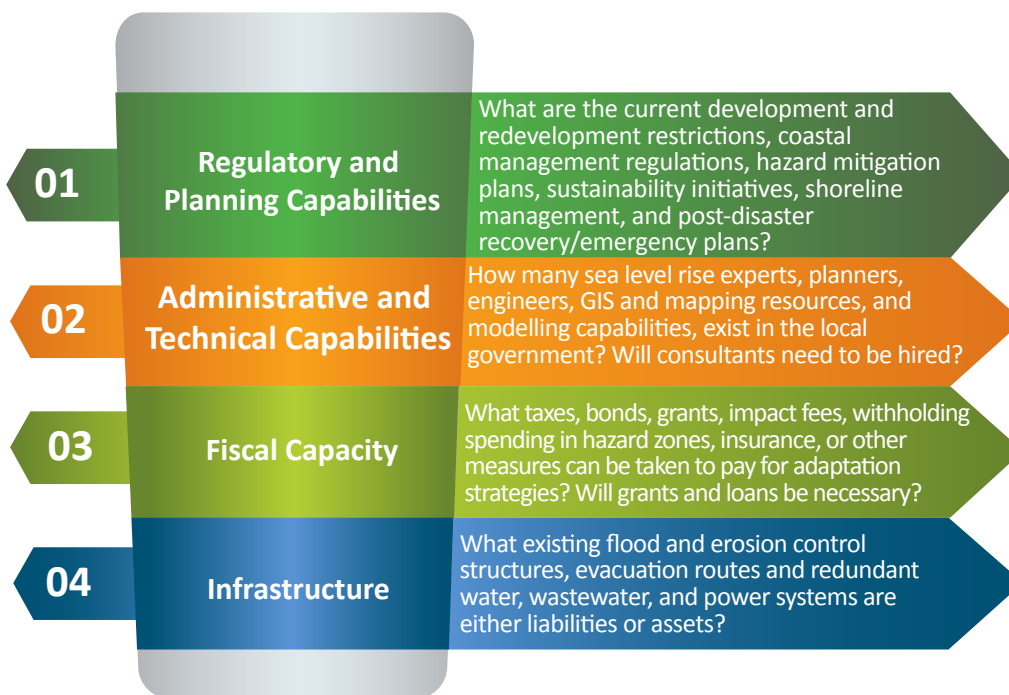


Figure 18. Assess Adaptive Capacities: Regulatory Assessment.

3.2. *Prioritize Adaptation Needs*

Once the adaptive capacities of the local community have been identified, a prioritization framework can follow. At this point in the planning process, the community should be aware of the impacts of potential sea level rise and inland flooding, have identified its focus areas to address the impacts, and/or have inventoried the capacity of the community to adapt. It is at this step that the community combines those findings and creates a short list of its biggest challenges to determine what can feasibly be done where and when.¹⁶

Articulating a community's biggest challenges to sea level rise is a necessary step in identifying adaptation needs. For example: "The most important challenge facing the local agency is adequately addressing the current state of the wastewater treatment plant which is at increased risk to flooding" or "Elevating the many bridges in the local agency's jurisdiction to withstand 2 feet of sea level rise is our highest priority." Prioritizing adaptation needs sets the stage for the next sub-component – creating specific adaptation strategies.

Prioritization can be as simple as selecting the needs that can be addressed currently (using capacities already identified as robust in the "Assess Adaptive Capacity" step or categorized as "low-hanging fruit") and saving the more involved solutions for later. Conversely, it may be more important for a local agency to tackle large-scale expected impacts first, regardless of cost and complication, due to urgency.

Whichever way the priorities are set, the amount of funding needed will likely determine the rate of implementation. However, it is not necessary for a local agency to immediately produce a large financial investment to show commitment to the process. A significant amount of work will have been completed to get this far in the adaptation planning process. Economic development projects also go through a lengthy initial planning process to line up the needs with the will to act before engaging in major implementation. It is perfectly acceptable for priorities to be defined and even phased so that, when funding becomes available, those projects can be implemented more quickly. In addition, it is important that the planning occur first so that if the community is affected by a major disaster, it can accelerate its adaptation program to leverage available disaster assistance resources.

The particularly cautious public agency can engage in pre-disaster planning for post-disaster policy changes by making the occurrence of a disaster a trigger for changes to land use restrictions or other requirements for vulnerable infrastructure segments. Disasters can "ground-truth" expected impacts, and if direct impacts are not anticipated in the short term, it is beneficial and prudent to allow infrastructure to utilize as much of its useful life as is. However, as the Escambia Adaptation Plan describes, "disasters scrape away the undue optimism that can cloud individuals' and communities' approach to valued but highly vulnerable places and structures."¹⁷ It is important to keep in mind that this approach of waiting to install solutions also raises the risk of incurring more damage when the expected disaster does occur. This can make the adaptation strategies more expensive in the long term.

¹⁶ Sea Level Rise Adaptation Plans, Guide to Components, page 15.

¹⁷ Escambia County Adaptation Plan, Page 29.

3.3. Identify Adaptation Strategies

Once major needs and priorities are defined, specific adaptation strategies can be developed, vetted, and defined. It is very important to note that many options are available when an area is projected to be flooded, either permanently or intermittently. A community can select from a wide range of adaptation strategies in the following categories: Protection, Accommodation, Retreat, and Avoidance.

Protection strategies involve both hard and soft (or “gray” and “green”) structurally defensive measures to mitigate impacts of rising seas while leaving the vulnerable structures behind these measures largely unaltered. Seawalls, revetments, and levees are examples of hard or gray protection strategies, while beach nourishment, oyster reef restoration, and living shorelines are all examples of green protection strategies.

Accommodation strategies alter physical design to allow the structure or land use to stay in place. Examples of this are floodable development, floating structures, and increased stormwater storage via implementation of Low Impact Development or Green infrastructure (LID/GI) in upstream locations. LID/GI upstream improvements reduce downstream flows by allowing more stormwater to infiltrate in place, thereby taking the pressure off the existing downstream stormwater infrastructure. In the Netherlands, a concept known as “Room for the River” helps dictate land use compatible with periodic flooding being designated adjacent to all major Dutch rivers.

TYPES OF ADAPTATION STRATEGIES



Once major needs and priorities are defined, specific adaptation strategies can be developed, vetted, and defined.



01 Protection

Protection strategies are structurally defensive measures that directly protect vulnerable structures, allowing them to be left largely unaltered.



02 Accommodation

Accommodation strategies alter physical design of vulnerable structures to allow the structure or land use to stay in place with modification.



03 Retreat

Retreat from areas or infrastructure where protection or accommodation will not be efficient or effective can be voluntary, incentivized, or done gradually.



04 Avoidance

Avoidance involves guiding new development away from areas that are subject to coastal hazards and can be done by implementing policy and/or offering of incentives.

Figure 19. Types of Adaptation Strategies.

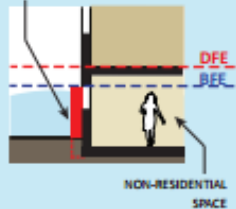
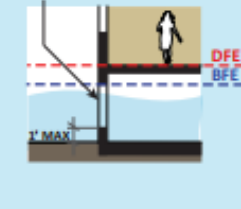
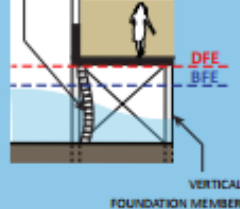
FLOOD PROTECTION STRATEGY	A ZONE		V ZONE
	DRY FLOODPROOFING WATERTIGHT STRUCTURE e.g. FLOOD SHIELDS	WET FLOODPROOFING WATER TO RUN-IN / RUN-OUT e.g. FLOOD VENTS	ELEVATED STRUCTURE VIRTUALLY OPEN STRUCTURE e.g. OPEN LATTICE
GROUND FLOOR CONFIGURATION	FLOOD SHIELDS PREVENT WATER FROM ENTERING  NON-RESIDENTIAL SPACE	1 INCH OF NET OPEN AREA PER 1 SQ. FT. OF ENCLOSED AREA  1' MAX	OPEN STRUCTURE  VERTICAL FOUNDATION MEMBER
PERMITTED USE BELOW DFE	LOWEST OCCUPIED FLOOR ALLOWED TO BE EXCAVATED BELOW GRADE NOT PERMITTED FOR ENTIRELY RESIDENTIAL BUILDINGS ✓ PARKING ✓ ACCESS ✓ STORAGE ✓ NON-RESIDENTIAL ✗ RESIDENTIAL	LOWEST OCCUPIED FLOOR TO BE AT OR ABOVE DESIGN FLOOD ELEVATION ✓ PARKING ✓ ACCESS ✓ STORAGE ✗ NON-RESIDENTIAL ✗ RESIDENTIAL	BOTTOM OF LOWEST STRUCTURAL MEMBER TO BE AT OR ABOVE DESIGN FLOOD ELEVATION ✓ PARKING ✓ ACCESS ✓ STORAGE ✗ NON-RESIDENTIAL ✗ RESIDENTIAL

Figure 21. Diagram of tidal backflow prevention insert. Flexible insert gives way to water flowing from one direction but blocks water flowing from the other. Tidal backflow prevention inserts are an example of protection strategies. Graphic from the Clearwater Adaptation Plan.

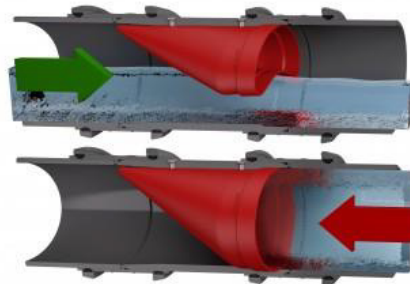


Figure 20. (right) Floodproofing options as an adaptation strategy. Dry floodproofing is an example of protection. Wet floodproofing and elevated structures are an example of accommodation. “BFE” indicates base flood elevation: “DFE” indicates design flood elevation, which is BFE plus freeboard requirements designated for particular areas and building types. Graphic from FEMA as referenced in the Clearwater Adaptation Plan.



Figure 22. Green infrastructure like this rain garden with curb cut is an example of Accommodation. Low impact development and Green infrastructure in upstream locations reduce downstream flows by allowing more stormwater to infiltrate in place, thereby taking the pressure off the existing downstream stormwater infrastructure. Photo by Atkins, 5th Street, Palmetto, Florida.

Retreat from areas or infrastructure where protection or accommodation will not be efficient or effective can be voluntary, incentivized, or done gradually. It can also involve new building designs in vulnerable areas to be altered or moved when appropriate in the future. Communities can also plan for an eventual retreat from barrier islands and coastal high hazard areas but, in the meantime, continue to invest in assets in a limited fashion based on that asset's expected lifetime and projected inundation. It is important to note that communication about retreat can be difficult. The language used to convey adaptation strategies can make a difference in how communities react to proposals. The term "retreat" often conveys a defeat, which can deter stakeholders from embracing the strategy. They may instead fight it. Other possible terms to use include "managed relocation" and "realignment." Home buyout programs, rolling easements, and land swaps are a few possible mechanisms that communities can investigate in order to implement managed retreat. There is also a growing body of case law in this arena.

Avoidance involves guiding new development away from areas that are subject to coastal hazards and can be done by implementing policy and/or offering of incentives. Since capital infrastructure is developed and maintained for a relatively long lifespan, planning for future changes in sea level should be a part of initial design or incorporated when plans are due for periodic update. City and County Land Development Regulations and Codes, as well as zoning regulations, can be used to direct development and redevelopment to more suitable areas

where flooding and erosion are less troublesome. See [Chapter 3.6](#) for information about Transfer of Development Rights (TDR), another strategy for avoidance.

Adaptation Action Areas – a State Planning Tool

The designation of Adaptation Action Areas (AAAs) is a comprehensive planning tool that has been available since 2011 with the passage of the Community Planning Act by the Florida legislature. An optional but highly recommended tool for adaptation strategies, AAAs lend themselves to a flexible form of zoning overlay that delineates the physical areas where certain measures, restrictions, or prioritized funding would apply. It is especially beneficial to designate AAAs now because local agencies currently have the option to devise criteria for their designation and the flexibility to edit them as circumstances change. In many instances the 2018 FIRM update expands FEMA-designated floodplains, however, in places where they are being reduced, the need for AAAs is especially urgent. These areas are still vulnerable to flooding, but property owners who have the option to drop flood insurance will likely do so.

Adaptation Action Areas are one or more areas that experience coastal flooding due to extreme high tides and storm surge and that are vulnerable to the related impacts of rising sea levels for the purpose of prioritizing funding for infrastructure needs and adaptation planning. F.S. 163.3164(1).

AAAs can complement the Coastal High Hazard Area (CHHA) footprint or expand it locally. FEMA defines the CHHA as 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 CHHA is identified as Zone V on FIRMs. Special floodplain management requirements apply in V Zones, including the requirement that all buildings be elevated on piles or columns. An AAA can be designed to apply the more stringent requirements of Zone V in other areas that are not part of the Zone V designation. In summary, AAAs are tools that allow communities to apply higher standards to help protect areas that are subject to increased vulnerability to sea level rise.

Selection of Strategies

In coordination with public input (which is described in greater detail in [Chapter 3.7](#)), the planning team assesses the relative merits and costs of each adaptation strategy within a given focus area to prioritize the preferred adaptation strategy. This may be accomplished through a benefit-cost analysis, alternatives analysis, stakeholder feedback, or even new output from a tool utilized during the Vulnerability Assessment.

Communities that have already gone through this process have also identified the value of doing a “business as usual” baseline assessment¹⁸ that will help compare the costs anticipated by the adaptation strategies. While adaptation strategies carry a cost, sometimes a significant one, in the long run a benefit-cost analysis may show that properly planned adaptation yields a tremendous savings as compared to doing nothing.

¹⁸ City of Clearwater Adaptation Plan, page ES-3.

3.4. Integrate into Existing Plans

Adaptation Planning outcomes are very effective when integrated into specific local planning products. Below is a list of eight planning products that may already exist in a local community that are appropriate to amend with adaptation planning strategies.¹⁹

A Local Comprehensive Plan (LCP) is required of all Florida counties and municipalities, guiding future growth and development. LCP policies generally influence a community’s day-to-day land use decisions and capital facilities expenditures. These policies play a major role in determining local development patterns, which in turn determine the degree to which people and property are exposed to natural hazards, injury, and damage. Examples of communities who have already incorporated AAAs in their LCP are included in [Chapter 3.6](#), Best Practices.

Florida local agencies are now required to integrate or add accommodations for the 2015 “Peril of Flood” Statute [163.3178(2)(f) 1-6] into their Local Comprehensive Plan. Signed into law by Governor Rick Scott on May 21, 2015, this requirement should be contained in a new or existing redevelopment component of their coastal management planning element. This component should eliminate inappropriate and unsafe development in the coastal areas when opportunities arise.

¹⁹ How to Incorporate Sea level Rise Adaptation Assessment Tools and Resources into Local Planning, pp 1-7.

The redevelopment component of the coastal management planning element must:

1. Include development and redevelopment principles, strategies, and engineering solutions that reduce the flood risk in coastal areas which results from high-tide events, storm surge, flash floods, stormwater runoff, and the related impacts of sea level rise.
2. Encourage the use of best practices development and redevelopment principles, strategies, and engineering solutions that will result in the removal of coastal real property from flood zone designations established by the Federal Emergency Management Agency.
3. Identify site development techniques and best practices that may reduce losses due to flooding and claims made under flood insurance policies issued in this state.
4. Be consistent with, or more stringent than, the flood-resistant construction requirements in the Florida Building Code and applicable flood plain management regulations set forth in 44 C.F.R. part 60.
5. Require that any construction activities seaward of the coastal construction control lines established pursuant to s. 161.053 be consistent with chapter 161.
6. Encourage local governments to participate in the National Flood Insurance Program Community Rating System administered by the Federal Emergency Management Agency to achieve flood insurance premium discounts for their residents.²⁰

Much of the data analysis and mapping performed for a robust response to the Peril of Flood requirement can also contribute to a Vulnerability Assessment.

The **Local Mitigation Strategy (LMS)** is usually developed at the county level and serves to reduce the risks associated with natural and man-made disasters, including sea level rise. It is a connection between the Local Comprehensive Plan, the emergency management plan, the capital improvements plan, land development regulations, building codes, and key ordinances such as those for floodplain management.

A **Special Area Management Plan (SAMP)** is a broad-reaching plan providing for natural resource protection and reasonable coastal-dependent economic growth and contains a detailed and comprehensive statement of policies, standards, and criteria to guide public and private uses of lands and waters as well as mechanisms for timely implementation in specific geographic areas within the coastal zone. SAMPs also provide for increased specificity in protecting natural resources, improved protection of life and property in hazardous areas, including those areas likely to be affected by sea level rise, as well as improved predictability in government decision making. 16 USCS § 1453 (17), [Title 16. Conservation; Chapter 33. Coastal Zone Management].

An **Economic Development Plan (EDP)** provides an overview of the economy, sets policy direction for economic growth, and identifies strategies, programs, and projects for improvement. These policies and strategies can guide future investment and economic growth or activities to areas that are safe and that have reduced exposure to hazard risks.

²⁰ Peril of Flood Statute. SB 1094, 2015. Florida 163.3178(2)(f) 1-6.

A **post-disaster redevelopment plan** (PDRP) is encouraged for all communities. A PDRP identifies policies, operational strategies, and roles and responsibilities for implementation that will guide decisions that affect long-term recovery and redevelopment of a community after a disaster. PDRPs emphasize seizing opportunities for hazard mitigation and community improvement consistent with the goals of the Local Comprehensive Plan and with full participation of the citizens.

A **capital improvements plan** (CIP) guides the scheduling of spending on public improvements, such as capital projects and equipment purchases. A CIP can serve as an important mechanism for guiding future investments and improvements away from identified hazard areas. It can be used to modify an existing project to add a mitigation/resilience component.

A **stormwater management plan** (SMP) is designed to address flooding associated with stormwater runoff. A stormwater management plan is typically focused on design and construction measures that are intended to reduce the impact of more frequently occurring but minor (from a flooding standpoint) urban flooding that impacts water quality.

A **historic preservation plan** (HPP) is intended to preserve historic structures or districts within a community. An often-overlooked aspect of the historic preservation plan is the assessment of buildings and sites located in areas subject to natural hazards and the identification of ways to reduce future damages.

3.5. Data Sources, Tools, and Resources

The following tools, many of which were described in more detail in [Chapter 2](#), can be used to support specific aspects of the eight local plans previously described in [Chapter 3.4](#). In the table below, if the tool outputs can directly support and enhance a given local planning effort, the tool was considered a “match” as indicated by a checkmark. Additional detail on how these tools support the local planning effort is included in the document [How to Incorporate Sea Level Rise Adaptation Assessment Tools and Resources into Local Planning](#) on pages 8 to 37. The assessment tools followed with an “*” are not tools that are able to produce outputs but are resources and reports.

Assessment Tool Name	Types of Plans							
	LCP	LMS	SAMP	EDP	PDRP	CIP	SMP	HPP
CanVis	✓	✓	✓	✓	✓	✓	✓	✓
Climate Central's Surging Seas	✓	✓	✓	✓	✓	✓	✓	✓
FDOT Sea Level Scenario Sketch Planning Tool	✓	✓	✓	✓	✓	✓	✓	✓
The Nature Conservancy Coastal Resilience Mapping Portal	✓	✓	✓	✓	✓	✓	✓	✓
NOAA Coastal Change Analysis Program (C-CAP) Land Cover Atlas and Coastal Comparison Tool	✓	✓	✓				✓	
NOAA Sea Level Rise Viewer	✓	✓	✓	✓	✓	✓	✓	✓
NOAA Sea Level Trends	✓	✓						
Social Vulnerability Index (SoVI)	✓	✓						
USGS National Assessment of Coastal Vulnerability to Sea Level Rise: Coastal Vulnerability Index (CVI)*	✓	✓	✓		✓	✓		
USGS Digital Shoreline Analysis System (DSAS)	✓	✓	✓		✓	✓		
ADvanced CIRCulation Model (ADCIRC)	✓	✓	✓	✓	✓	✓	✓	✓
Hazus-MH	✓	✓		✓	✓	✓	✓	✓
Integrated Valuation of Environmental Services and Tradeoffs (InVEST)	✓	✓	✓	✓				
NatureServe Climate Change Vulnerability Index (CCVI)	✓	✓	✓					
NOAA Wave Exposure Model (WEMo)	✓	✓	✓	✓	✓	✓	✓	✓
Sea Levels Affecting Marshes Model (SLAMM)	✓	✓	✓		✓	✓	✓	
Simulator of Climate Change Risks and Adaptation Initiatives (SimCLIM)	✓	✓	✓	✓	✓	✓	✓	✓

Assessment Tool Name	Types of Plans							
	LCP	LMS	SAMP	EDP	PDRP	CIP	SMP	HPP
USACE Sea Level Change Curve Calculator	✓	✓						
Beach-fx		✓			✓	✓		
Coastal Adaptation to Sea Level Rise Tool (COAST)	✓	✓			✓	✓		✓
CommunityViz	✓	✓	✓	✓	✓	✓		
NatureServe Vista	✓	✓	✓		✓			
NOAA Inundation Analysis Tool	✓	✓						
U.S. DOT Vulnerability Assessment Scoring Tool (VAST)	✓	✓		✓		✓		
Adaptation Database for Planning Tool (ADAPT)	✓	✓			✓			
Climate Adaptation Knowledge Exchange (CAKE)	✓	✓			✓			✓
Ecosystem-Based Management (EBM) Tools Network and Database	✓	✓	✓		✓			
FL DEP Map Direct Gateway	✓	✓	✓		✓			
Florida Natural Areas Inventory (FNAI)	✓	✓	✓		✓			
Georgetown Climate Center*	✓	✓	✓		✓		✓	
Geospatial Assessment Tool for Operations and Response (GATOR)	✓	✓		✓	✓	✓		
U.S. Climate Resilience Toolkit	✓	✓	✓	✓	✓	✓	✓	✓
weADAPT*	✓	✓			✓			

Florida Pilot Projects

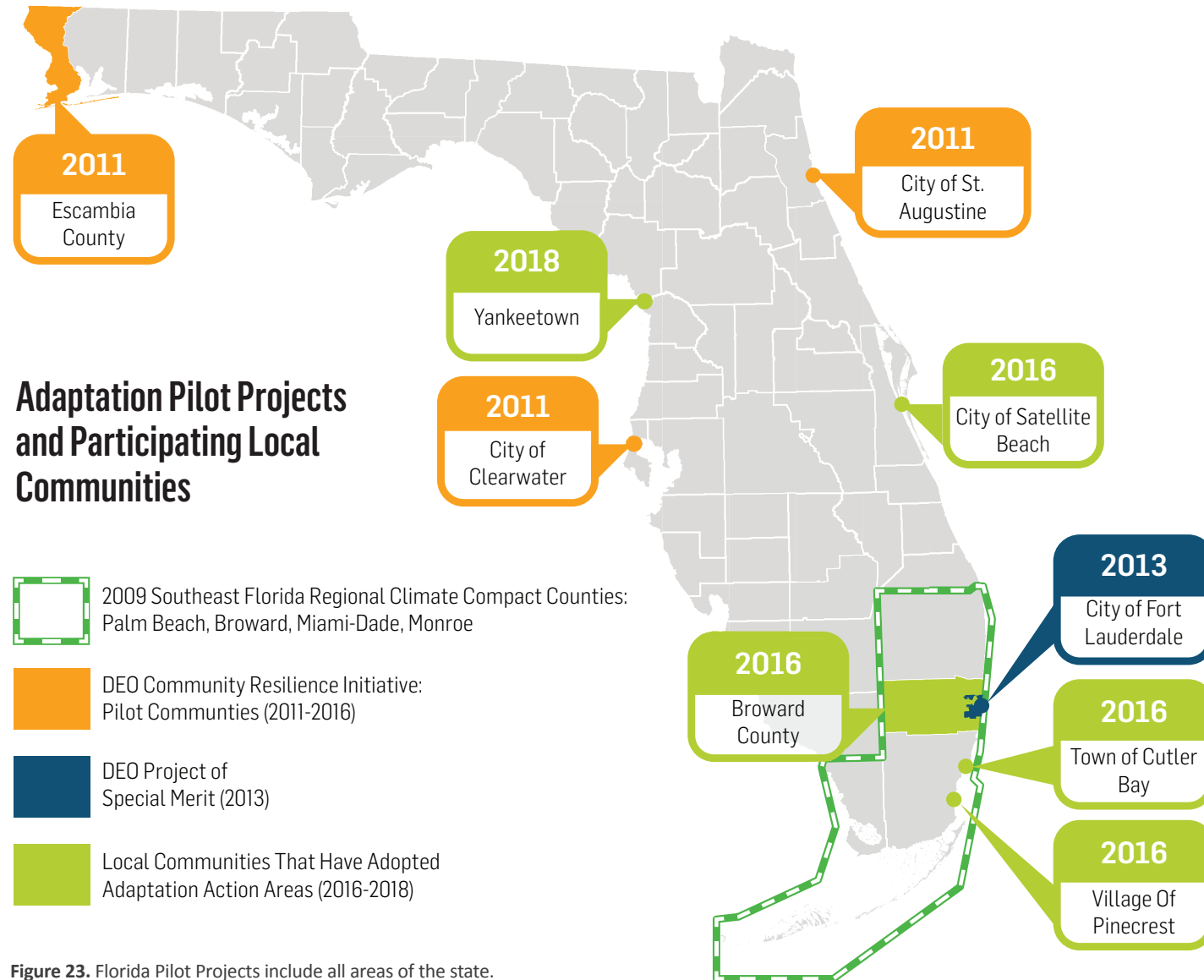


Figure 23. Florida Pilot Projects include all areas of the state.

3.6. Best Practices and Funding Opportunities

Best Practices

Comprehensive Plan Amendments and the establishment of AAAs have been completed by several Florida communities and can serve as examples for other local agencies. These amendments are available as PDFs at DEO's "Florida Papers" website and are searchable by local agency. Local governments with AAAs and/or Local Comprehensive Plan amendments include: Village of Pinecrest 15-1ESR (Adopted 2015), Town of Cutler Bay 16-1ER (Adopted 2016), City of Ft. Lauderdale 14-1ESR (Adopted 2014), Broward Co. 15-6ESR and 15-7ESR (Adopted 2015), City of Satellite Beach 16-1ESR (Adopted 2016), and Yankeetown 15-2ESR (Adopted 2016).

As part of the DEO's Community Resilience Initiative, Escambia County, the City of Clearwater, and the City of St. Augustine completed Adaptation Plans in 2011. Also, the Town of Jupiter, Florida completed a vulnerability case study using the University of Florida's GeoPlan Sketch Tool and NOAA's Coastal Flood Exposure Mapper and Sea Level Rise Viewer. The map on the previous page shows additional communities that have adopted AAAs. Other communities, such as the Cities of Punta Gorda and Sarasota, have also completed Vulnerability Assessments and/or Adaptation Plans using other funding sources.

Preliminary workshop participants in Escambia County emphasized that programs or projects oriented to adaptation goals would be received well by county commissioners and the public so long as the need for those measures and their benefits were clearly apparent. In practical terms, this means that proposed measures require analytical support that conveys their expected costs, benefits, and/or effectiveness relative to possible alternatives. Several tools are available to help generate that sort of analysis – FEMA has developed one for download (FEMA Benefit-Cost Analysis), the University of Southern Maine has developed another (Blue Marble Geographics Coastal Adaptation to Sea Level Rise Tool), and a number of published reports provide examples of those tools' application. This baseline can be cost compared to the cost of adaptation projects and more clearly draw a comparison and define urgency. *The Costs of Doing Nothing*,²¹ an aptly named report about the costs that flooding (with and without SLR) will define challenges experienced by Hampton Roads, Virginia. A similar report with the same name, *The Costs of Doing Nothing: Economic Impacts of Sea Level Rise in the Tampa Bay Region*,²² used economic impact analysis software to simulate changes in population, gross domestic product, personal income, employment, and tourism through 2060 in a few "business as usual" scenario simulations.

²¹ George Van Houtven et al., *Costs of Doing Nothing: Economic Consequences of Not Adapting to Sea Level Rise in the Hampton Roads Region*; Final Report (Nov. 2016)

²² *The Costs of Doing Nothing: Economic Impacts of Sea Level Rise in the Tampa Bay Region*. Tampa Bay Regional Planning Council, January 2017.

As discussed in their adaptation plan, the City of St. Augustine learned through damage sustained by Hurricane Matthew that its wastewater management system is acutely vulnerable to sea level rise. Some system components, such as the pumps whose electrical circuitry was destroyed by flooding during Matthew, can be hardened by replacement with components rated for saltwater inundation. Similarly, the city can ensure at a reasonable expense that key points in the system have access to mobile backup generators during storm conditions.

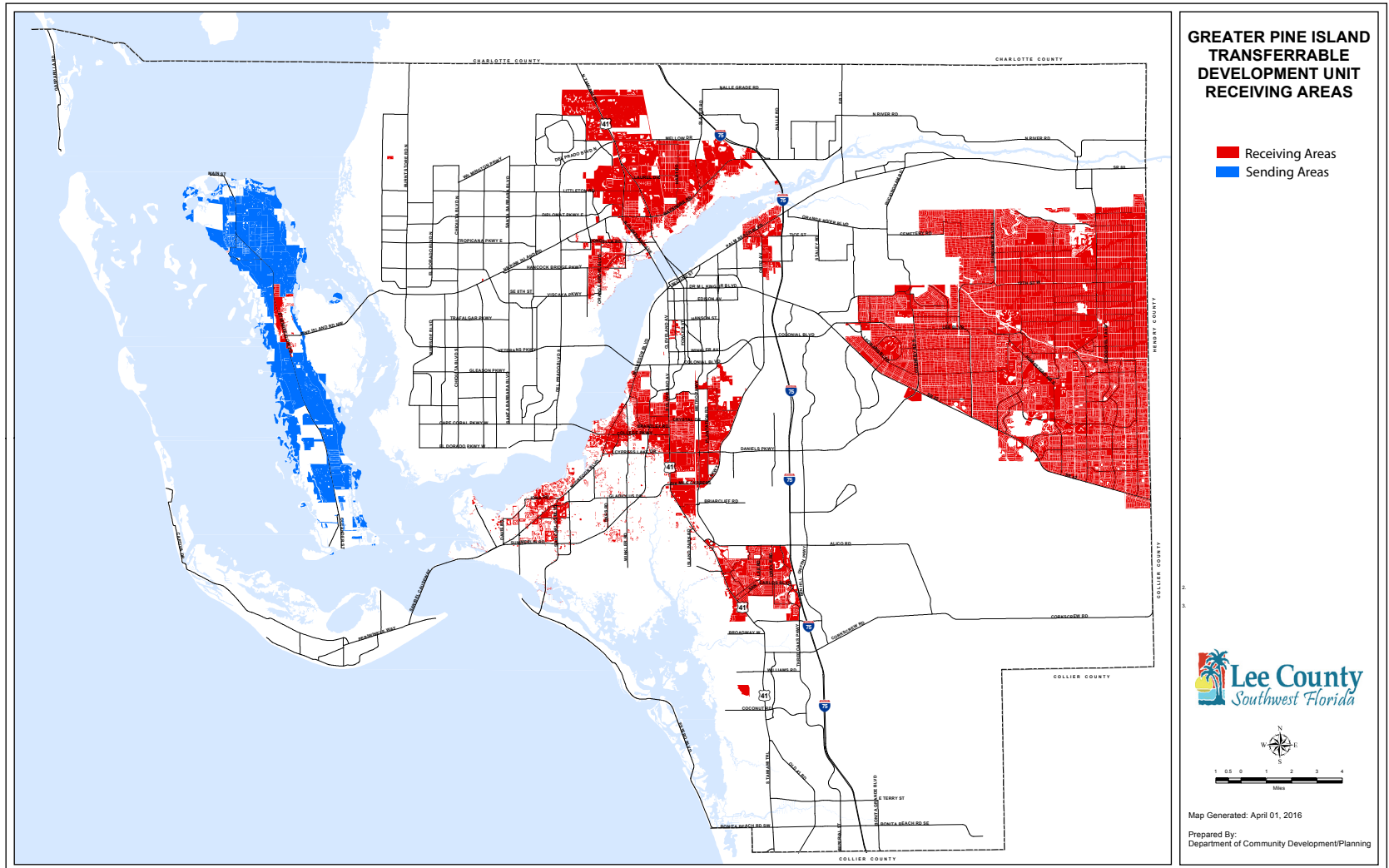
An example of incentivized avoidance is a Transfer of Development Rights (TDR) program. An example of this in Florida is Lee County's Pine Island TDR program, begun in 2016. Ownership of a parcel of land is considered to come with a bundle of separable and alienable rights, one of which is the right to develop that land. A TDR program allows development rights for a parcel to be purchased and then transferred to another parcel, which is then eligible to be developed above the previous allowed density. Typically, a TDR program will define a sending area and a receiving area. A sending area is a vulnerable area or an area set aside for preservation (e.g., natural areas, farmland, historic districts) and a receiving area is an area designated for more intense development. Over time, growth is then diverted from the sending area to the receiving area. TDR programs often have only a single district boundary defined as a receiving area but cannot direct where development is to occur within the district. Local government might use AAAs to designate the sending areas.

Other administrative and regulatory solutions can involve knowledge sharing and learning platforms, outreach projects, encouraging or requiring elevation certificates within real estate sales located in the AAAs, a public information campaign, adaptation financing, defining an extended planning horizon, encouraging low impact development (LID) standards, encouraging low intensity zoning, implementing riparian or littoral buffers, or establishing rolling conservation easements. Restrictions can be written to apply only to new or redevelopment projects and not requiring already built projects to change unless they are to be redeveloped.

Ordinances authorizing reduced maintenance of roads and bridges under particular environmental and budgetary circumstances can also be adopted. A step further would be to link adoption of that ordinance to establishment of an AAA that encompasses portions of the barrier islands and other coastal areas where roads are identified as vulnerable to nuisance flooding in a 2-foot SLR scenario. Clearwater, Florida has included this action in their "recommendations" for adaptation strategies. A local agency can also explore options for applying for FEMA Hazard Mitigation grant funds like the post-disaster Hazard Mitigation Grant Program or the Pre-Disaster Mitigation program to buy out properties that are especially vulnerable to repeated and severe flooding.

A stormwater system capacity gap already exists in Escambia County and an update of the one-time drainage impact fee to either a higher

Figure 24. The Lee County Transfer of Development Rights (TDR) Program is an example of incentivized avoidance. Development rights from parcels in the ‘sending areas’ are allowed to be transferred to parcels in ‘receiving’ areas, which then allows the parcel to be developed above the previous allowed density. Map from Lee County Department of Community Development and Planning.



fee or recurring fee would help pay for improvements. The county's drainage impact fee of \$0.05 per square foot generates little revenue for the county and creates little incentive for private property owners to avoid it by limiting the amount of impervious surface on their properties. Incentives being considered may be including an option to reduce a new fee for installation of low impact development projects or an increase to the local option tax specifically for the purpose of paying for green and grey stormwater infrastructure improvements.

Local agencies in communities not immediately impacted by sea level rise have the opportunity and responsibility to integrate adaptation strategies into existing repair/replacement schedules for bridges, roads, and other infrastructure. Similar to starting a college fund for a newborn child, this is an effective way to plan for eventual impacts and allow funding to be identified for specific identified needs over a much longer time period.

Funding Opportunities

Funding opportunities to complete adaptation planning or projects can come from a variety of sources. DEP has a Coastal Partnership Initiative with annual grant funding and the Clean Water State Revolving fund provides access to low interest loans. DEO funds technical assistance grants for planning purposes. The EPA and FEMA have several grant programs as well. See [Appendix 6.2](#) for more details about specific funding programs.

3.7. Public Outreach Approach and Opportunities for Community Participation

The Adaptation Strategies step is the most “solution-based” part of the Adaptation Planning process. An extensive public involvement component is appropriate for this point and should build off the findings of the Vulnerability Assessment. Unique local solutions are only possible when people with different expertise and interests come together and collaborate.

Structured discussion will help guide collaboration and keep the conversation on task and productive. It is possible to delve into great depth on particular issues and this type of detail is not always appropriate in settings with large numbers of attendees. Questionnaires sent to participants before the workshops that ask about their goals and expectations for the workshop can be especially helpful as is a second questionnaire sent after the workshop to ask participants about how they would like to make use of the Adaptation Plan in their respective departments.²³

As learned during the pilot community projects, local officials want to better understand their options and constraints. Knowing both the local context as well as what has been done in other parts of Florida will enable local officials to make informed decisions. Information pertaining to both is appropriate to include in public materials and discussions.

²³ Escambia County Adaptation Plan, Page A-2.

4. Implementation Strategies

Once a set of adaptation strategies has been developed and analyzed, it is time to transition to implementation activities to move the strategies from plan to action. This process includes identifying, preparing for, and applying for potential funding opportunities; creating a schedule of adaptation actions for the future; and monitoring and evaluating progress.

Implementation strategies are the specific steps a community takes to incorporate the adaptation strategies into existing planning, budgeting, and staffing mechanisms. The Assess Adaptive Capacities sub-component ([Chapter 3.1](#)) should outline the ability of the community to take action. Even before the Vulnerability Assessment is conducted, communities may want to consider possible implementation strategies based on available capacities, existing implementation schedules, or available funding sources. Communities must be able to support and implement adaptation activities to successfully reduce the negative impacts of potential sea level rise that were identified during a Vulnerability Assessment. The ability to implement can increase over time, so communities should not simply settle for what is available at the current time but expect that, as they undertake the first round of implementation, their knowledge and capacity will grow.

The Implementation Strategies component contains most of the adaptation plan's "logistics" – the actions and functions that need to take place for the product (adaptation strategies) to be delivered. By carefully aligning the schedule of activities to funding opportunities and assigning groups who can competently prepare each of the adaptation strategies for incorporation into their appropriate plan or physical loca-

tion, the planning team can bring the plan to life and ensure it is not written only to "sit on a shelf." Monitoring new data and updated sea level rise models also helps safeguard the adaptation plan's relevancy as the applicable science advances.

4.1. Survey of Funding Options

It is recommended that a systematic review of all known funding sources, as well as inquiry into new funding opportunities that may facilitate a successful implementation strategy, be completed.

The availability of funds is often a key determinant as to what activities could be undertaken. Funding can originate at non-profit, private, local, state, and federal levels. It may originate from a source such as penny sales tax, tax-increment financing, cooperative banking, or grants. Available grants often change, but the following list identifies agencies that may offer grants to fund adaptation strategies as well as past and current grant examples:

- National Oceanic and Atmospheric Administration (NOAA) – Office for Coastal Management Broad Agency Announcement for special projects
- US Environmental Protection Agency (EPA) – P3 awards: A national student design competition for sustainability
- US Department of Housing and Urban Development (HUD) – Community Development Block Grants

- Florida Department of Environmental Protection (DEP) – Florida Coastal Partnership Initiative
- Florida Department of Economic Opportunity (DEO) – Community Resiliency Technical Assistance Grants
- Local land conservation trusts (such as the Florida Keys Environmental Restoration Trust Fund)

The Federal Emergency Management Agency (FEMA) may also provide several kinds of assistance to communities who have prepared a local mitigation strategy that conforms to the standards set forth in the Code of Federal Regulations (44 CR §201.6). If the community has developed a hazard mitigation plan that is recognized by the State (under Section 322 of the Robert T. Stafford Disaster Relief and Emergency Act as amended April 2013), then some examples of applicable FEMA funding that can be applied to coastal Protection, Accommodation, and Retreat measures are as follows:

- Hazard Mitigation Grant Program (HMGP)
- Pre-Disaster Mitigation (PDM)
- Flood Mitigation Assistance (FMA)

FEMA makes the Hazard Mitigation Assistance guidance, which provides the detailed information on these mitigation grant programs, available annually. In some instances, funding can be obtained to assist with the Vulnerability Assessment component also. Hazard Mitigation Plans (known locally in Florida as the Local Mitigation Strategy or LMS), which can be funded under HMGP and PDM, can also include Avoidance measures.

Figure 25. FEMA's Hazard Mitigation Assistance Guidance applies to HMGP disasters declared on or after February 27, 2015 unless indicated otherwise. This guidance is also applicable to the PDM and FMA program.

Federal Emergency Management Agency. (2015). Hazard Mitigation Assistance Guidance. Washington, DC.



Hazard Mitigation Assistance Guidance

Hazard Mitigation Grant Program, Pre-Disaster Mitigation Program, and Flood Mitigation Assistance Program

February 27, 2015



Federal Emergency Management Agency
Department of Homeland Security
500 C Street, S.W.
Washington, DC 20472

After major disasters, the Department of Housing and Urban Development (HUD) can provide mitigation grants under its Community Development Block Grant-Disaster Recovery (CDBG-DR) program when Congress approves a disaster supplemental. The eligible activities vary from disaster to disaster and would be provided in the Federal Register notice along with the State Action Plan that must be developed.

In addition, the Natural Resources Conservation Service (NRCS), under the US Department of Agriculture, has two programs that may be available to communities: the Emergency Watershed Protection (EWP) Program and the Watershed Protection and Flood Prevention (WFPO) Program. The EWP Program is a federal emergency recovery program available after disasters and offers assistance to communities to relieve imminent threats to life and property caused by natural disasters that impair a watershed. The WFPO is a cooperative program between the federal government, states, and locals to prevent floodwater and sediment damage and erosion and work towards conservation of water and land in authorized watersheds.

The Florida Department of Economic Opportunity manages the Florida Disaster Recovery Program and assists communities “in developing economic development strategies, meeting the requirements of the Community Planning Act, addressing critical local planning issues, and promoting innovative planning solutions to challenges identified by local government applicants.” Community Planning Technical Assistance Grants are for one fiscal year and are awarded on a cost-reimbursement basis. Deliverables must be approved by the Bureau before

money is disbursed. The grants provide communities the opportunity to develop innovative planning and development strategies to promote a diverse economy, create vibrant rural and suburban areas, and meet the requirements of the Community Planning Act while protecting environmentally sensitive areas. In addition, the community is encouraged to brainstorm innovative local funding ideas and plan activities to build awareness and capacity for self-directed programs. If a community identifies a lack of funding, a key consideration in assessing management priorities may be to identify and develop additional funding resources.

4.1.1. Prioritize Strategies

Once a community has identified Protection, Accommodation, Retreat, and Avoidance strategies, it may prioritize actions within its Focus Areas. Funding should be prioritized for adaptation activities and actions, reducing risk

Different types of prioritization reflect where the urgency is, community acceptance, and what can get the biggest bang for the buck. It is better to establish the criteria upfront.

in the most cost-efficient way. It is important to maintain a balance between the urgency of the moment to address current risks while showing foresight to plan for future impacts. In several instances, it is a minimal cost to add an additional safety margin to a project which will also help maintain the project’s effectiveness as vulnerability and risk may increase over time. Keep in mind that many facilities and infrastructure are built to last 30 to 50 years, if not longer, and future risk

in the latter stages of development's useful life should be factored. Consideration of all possible options and the related costs and benefits of each will allow for a "no-regrets strategy" to be designed.

Priorities should be based on risks identified and potential losses as a result of those risks and reviewed in relation to funding, ability to implement, and consistency with other plans. FEMA and NOAA (2013) have developed a comprehensive but quick checklist of considerations known as "STAPLEE" that help evaluate each proposed action:²⁴

- *Social* – What are the socially acceptable adaptation strategies in the community?
- *Technical* – What are the technically feasible adaptation strategies within the community?
- *Administrative* – Which adaptation strategies are implementable by community leadership?
- *Political* – Which adaptation strategies are politically acceptable within the community?
- *Legal* – Which adaptation strategies are legally implementable by the community under state and municipal law?
- *Economic* – What are the cost-effective adaptation strategies available to the community?
- *Environmental* – Which adaptation strategies are most favorable to the environment as determined by community conservation plans and statewide guidance?

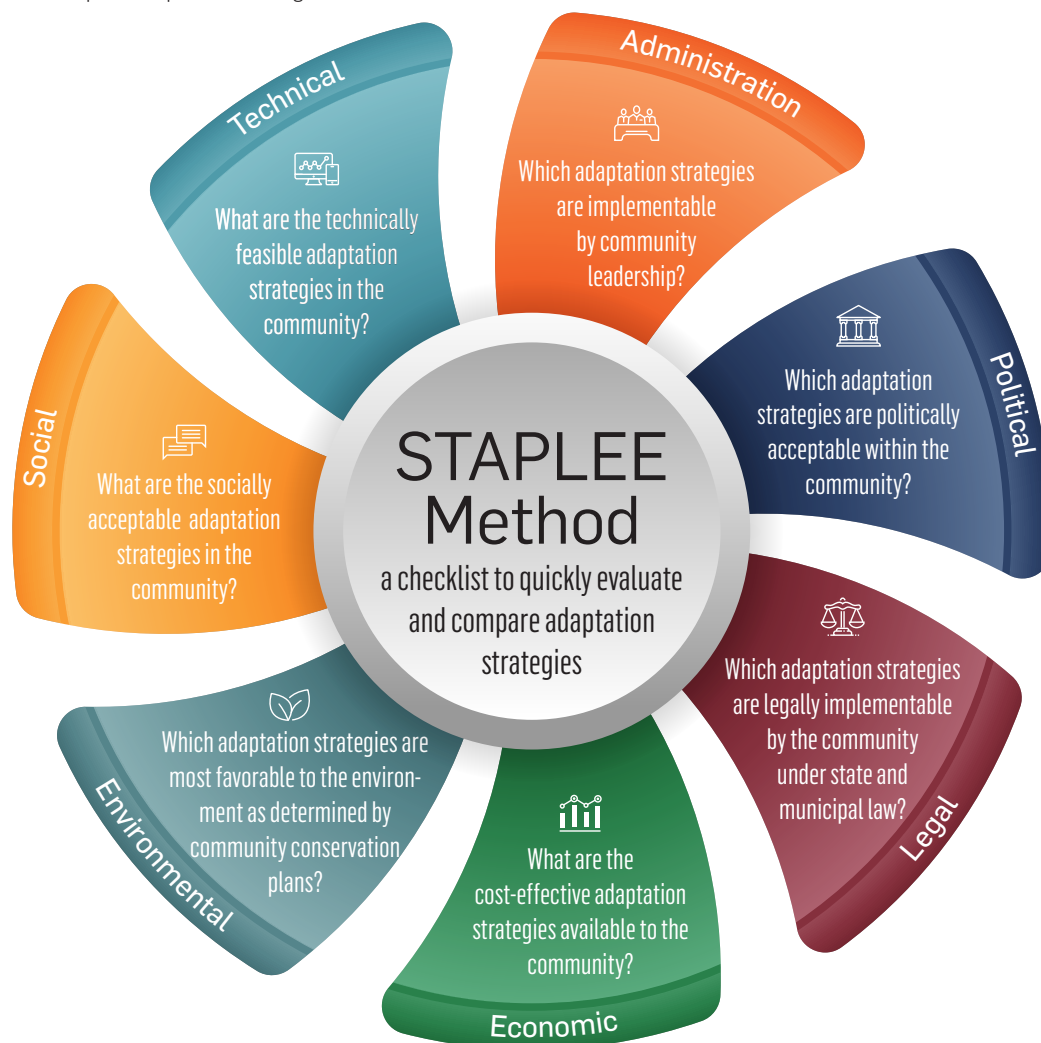
By using the STAPLEE categories, a community may prioritize adaptation strategies that meet local capacity and preferences. The STAPLEE method can evaluate costs in relation to benefits of implementing one particular action over another. Using STAPLEE serves as a 'reality check' that helps communities avoid putting too much effort into a type of action that has little chance of success due its particular circumstances, preferences, history, and culture.

An informal cost-benefit analysis can also be used to review proposed adaptation actions. Ratings of high, medium, or low can be assigned to the anticipated costs and the benefits associated with each action based on general criteria that are established by the community. Examples of ratings could include criteria such as:

- High cost – existing funding is not adequate.
- Medium cost – existing funding would require budget reapportionment or amendment.
- Low cost – funding available under existing budget.
- High benefit – action would have a significant impact on risk reduction.
- Medium benefit – action would have an impact on risk reduction.
- Low benefit – long-term benefits are difficult to quantify in short term.

²⁴ NOAA Coastal Services Center. (2013). What Will Adaptation Cost? An Economic Framework for Coastal Community Infrastructure. Silver Spring: National Oceanic and Atmospheric Administration.

Figure 26. STAPLEE Method: A checklist to quickly evaluate and compare adaptation strategies.



This methodology provides a framework for the overall costs and benefits of each action to be considered when setting priorities. As described in [Chapter 3](#), there are situations where the impacts from sea level rise are significant and already present or imminent that may warrant taking on the bigger challenges in the near term even if all the funding needed is not presently identified.

Prioritization enhances the impact of Focus Area-driven adaptation strategies by ensuring that the community adds additional aspects to the comprehension of coastal flooding in the greater context and functioning of the community.

4.2. *Create a Schedule of Activities, Actions, and Actors*

Creating a Schedule of Activities, Actions, and Actors takes the second half of implementation into account – providing impetus to the actions to be completed and the agency/department/staff responsible for each action. This sub-component can serve to program different types of adaptation activities according to their prioritized need (see [Chapters 3.2](#) and [4.1.1](#)) and, in pairing with funding opportunities, generate a concise and easy-to-follow plan.

To create a schedule that is flexible yet delegates responsibility, the planning team should identify the appropriate responsible party who has the ability to complete a task, activity, or strategy.²⁵ The planning team may then schedule their monitoring and evaluation (see [Chapter 4.3](#)) to follow up with the responsible local staff member. Scheduling transfers responsibility to the implementing entity to set and maintain timelines while ensuring that a coordinating group remains informed and responsive to the activity as it is carried out and later evaluated. However, due to the multi-disciplinary approach needed to undertake many adaptation measures, it is recommended that support personnel be assigned to projects to assist the primary with the additional skill sets, knowledge base, and contacts needed to successfully implement a project.

Scheduling activities and assigning staff may emphasize the utility of planning ahead as the various elements of the schedule come online. By naming the person or group responsible for each activity's implementation, more accurate timelines can be made which may economize the implementation process. As discussed in [Chapter 3.4](#), integrating adaptation into existing plans, if the strategy involves incorporating activities into a regulatory document, provides an opportunity to program capacity building measures. For this sub-component, the planning team is encouraged to consider consultants outside of local government staff. A diverse set of participants within the steering committee could connect individuals or entities from a wide berth in the private sector, non-profits, and universities.

²⁵ California Emergency Management Agency. (2012). California Adaptation Planning Guide. Mather.

Figure 27. Implementation Matrix – Broward County Climate Change Action Plan. This matrix provides information on all of the recommended actions in the Broward County Climate Change Action Plan. It includes the rank, description of action to be implemented, planning horizon, status of action, responsible entities, potential community partners, estimated resources required, and recommended performance measures.

Broward Metropolitan Planning Organization. (2010). Broward County Climate Change Action Plan: Addressing Our Changing Climate. Fort Lauderdale.

Appendix F

Broward County, FL Climate Change Action Plan Implementation Matrix

Action #	Rank	Action to be Implemented	Planning Horizon	Status of Action	Likely Responsible County Entity(ies)	Potential Community Partner(s)	Estimated Resources Required	Recommended Performance Measure(s)
Goal PC-2	Ensure that Broward County and local government comprehensive plans including the Broward Metropolitan Planning Organization's 2035 Long Range Transportation Plan, are updated to provide for a sustainable environment and to reflect the best available data and strategies for adapting to future climate change impacts.							
Action PC-2.1	HI	Support local, regional and state planning entities in mitigation and adaptation plans	Short (0-5 years)	Initiated	Board of County Commissioners All County Agencies	School Board of Broward County Various regional and state entities	Additional staff time	Number of regional plans developed
Action PC-2.2	HI	Update Broward County Comprehensive Plan for Climate Change and support local government efforts to update their comprehensive plans	Immediate (0-2 years)	In Progress	Environmental Protection & Growth Management Planning Council	League of Cities South Florida Regional Planning Council	Additional personnel	Number of elements incorporating climate change, mitigation and adaptation
Action PC-2.3	LO	Link transportation and land use	Mid (0-25 years)	On-going	Environmental Protection & Growth Management Planning Council	South Florida Regional Planning Council FI Dept of Community Affairs	Additional staff time and funds	Completion of plan with actionable recommendations
Action PC-2.4	LO	Develop adaptation skills applied to planning	Mid (0-25 years)	Pending	Sustainability/Climate Program (proposed)	Academic institutions	-	Implementation of Program

4.3. *Monitor and Evaluate*

In order to ensure that adaptation strategies continue to serve their intended purpose – to robustly respond to the community prioritized sea level rise vulnerabilities – it is recommended that an adaptation plan include a Monitoring and Evaluation component. Monitoring and Evaluation extends throughout the horizon of the plan’s implementation, which could extend for many years. The ability to communicate the guiding goals of the plan across iterations of implementing managers is essential. This is done through a Monitoring and Evaluation plan that uses consistent criteria, such as “indicators” that can be tracked throughout the implementation horizon, and rated by different implementing managers.

For this sub component, the planning team is encouraged to use indices or performance indicators to easily determine if an adaptation strategy is performing adequately. For example, point values could be assigned based on various levels or percentages of project completion to measure the progress towards completion, or project benchmarks or major milestones could be established to track accomplishments and project status.

Monitoring and Evaluation should be approached with an “Adaptive Management” mindset to constantly strive to improve the approach as lessons learned are obtained and new data is available. This sustained effort helps keep the planning process viable over many years and should help build momentum to adapt to the changing environment.

Monitoring of the adaptation strategies is a check-in to see that strategies are being carried out as anticipated and intended. This can include review of successful actions identified and implemented, review of barriers or obstacles to implementation for strategies that were identified but not completed, need for revisions to activities based on review, and reevaluation of proposed timelines based on new information on impacts and funding. Once the progress attained is evaluated, activities can be revised where needed to make certain the adaptation plan goals are being achieved. Revisions and updates of the strategies can also consider potential changes in hazard vulnerability, local capabilities and resources, and risk reduction priorities. Lessons learned during the implementation should be shared across the community and even with other communities to expand the knowledge base of what is working, what would work better with some modifications, and the pitfalls to avoid.

In addition to monitoring activities, it is important to revisit the data and methodologies that go into the Vulnerability Assessment. Of these, the sea level rise projection model may be one of the most important aspects of an adaptation plan to monitor. Over an example horizon of five years, global climate models and viewing tools may increase their accuracy and level of representation. The planning team can respond to this by incorporating model update results into new iterations of their adaptation plan. For example, new projection model updates could project a faster or slower rate of sea level rise, and therefore, the planning horizon and timelines for implementation of adaptation activities may be adjusted to reflect the updated or best available information.

Post-disaster evaluation efforts are a productive combination with adaptation monitoring and updates. Moreover, if a community experiences a disaster event, more attention will shift toward adaptation efforts, and higher incidences of buy-in for certain adaptation activities may arise. Particularly, larger-scale disaster events could greatly accelerate the implementation schedule. Therefore, the schedule of activities can be changed to reflect new timelines for more robust measures.

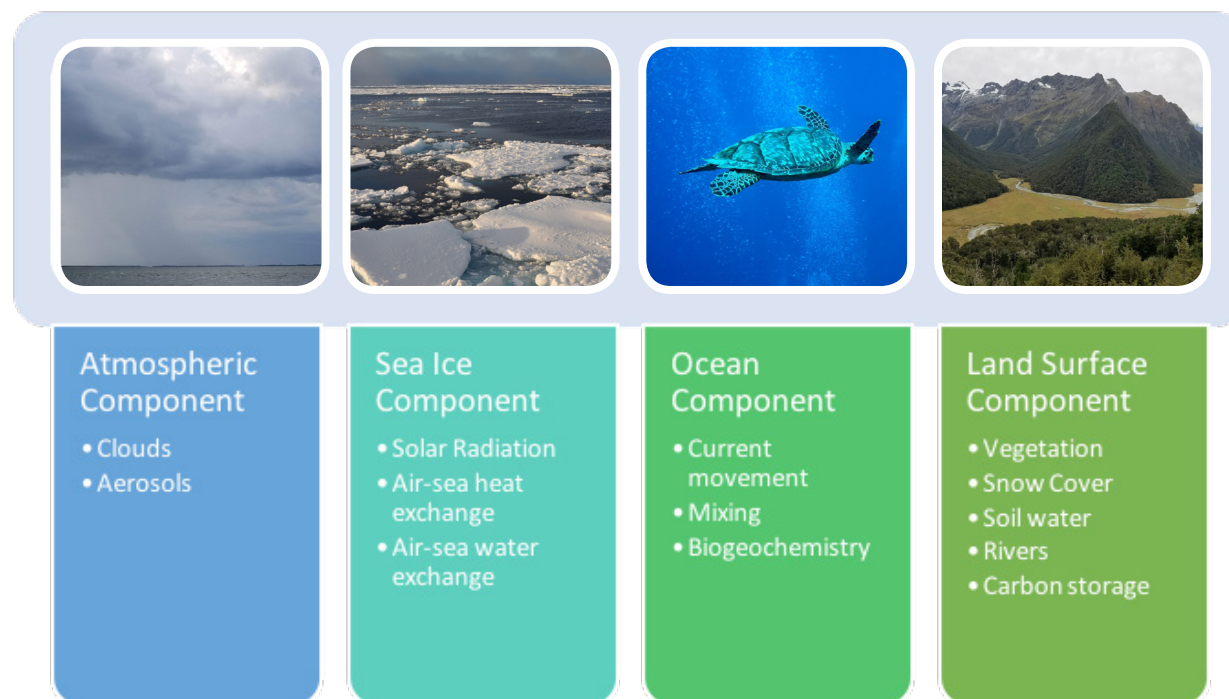


Figure 28. A Global Climate Model (GCM) is a complex mathematical representation of the major climate system components and their interactions. Earth's energy balance between the four components is the key to long-term climate prediction. Text from the Geophysical Fluid Dynamics Laboratory available at <https://www.gfdl.noaa.gov/climate-modeling/>

Sea ice graphic:
 USGS by Patrick Kelley, US Coast Guard.
<https://www.esrl.noaa.gov/psd/news/2014/122214.html>

Other graphics by Atkins staff:
 Atmosphere: Apollo Beach, Florida (Emily Henke)
 Ocean: Maui, Hawaii (Emily Henke)
 Land: New Zealand (Emily's mom Karen Harner)

4.4. *Best Practices and Funding Opportunities*

Implementation, Monitoring, and Evaluation

To streamline the Monitoring and Evaluation sub-component, consider combining other sub-components such as Assign Focus Areas ([Chapter 2.3](#)) and Prioritize Adaptation Needs ([Chapter 3.2](#)) into a final reference that names responsible parties, funding sources, timeframes for completion, and other pertinent information related to each adaptation strategy. Defining specific agencies, funding sources, and schedules for implementation can help assure adaptation strategies are implemented. This information can be captured in a table or spreadsheet that is updated over time to easily track progress made.

Integration of adaptation strategies into existing plans is another way communities can increase the likelihood of implementation. If adaptation strategies are integrated into municipal plans, ordinances, and land development codes, adaptive strategies will be incorporated into a community's land-use decision-making framework. Communities

Communities should include adaptation strategies in their Local Comprehensive Plans to reflect the best available data and strategies for adapting to future sea level rise. Similarly, developing and implementing adaptive planning and zoning policies, regulations, and programs to ensure appropriate land use, construction, and redevelopment activities address the potential impacts of sea level rise on the local economy and infrastructure should be proposed.

are encouraged to apply adaptation policies universally to all of their planning documents. Opportunities for integrating adaptation into existing plans is discussed in further detail in [Chapter 3.4](#).

Annual review of the adaptation strategies will provide an ongoing opportunity to evaluate implementation and make any necessary revisions. Including community members in addition to local government officials in the review process will allow for continued public outreach and participation.

Funding Opportunities

Potential funding opportunities for adaptation strategies are identified above in [Chapter 4.1](#).

4.5. Public Outreach Approach and Opportunities for Community Participation

Outreach can be one of the most important activities within a program because it can lead to municipal action in the future. Increased stakeholder engagement throughout the adaptation planning process can help to create buy-in amongst the public which can then in turn lead to greater political support for adaptation actions in the community. Holding public meetings, forums, or workshops that include business groups, residents, and other community stakeholders can provide an opportunity to educate participants and receive feedback based on their understanding of local vulnerabilities to sea level rise and potential responses. It can also be used as an opportunity to establish a connection between incremental improvements to citizen and property safety and welfare and a more desirable future community.

Participatory monitoring efforts can help the community observe unanticipated coastal flooding impacts and effects of adaptation strategies. Stakeholder feedback can be used to gauge community satisfaction with adaptation strategies and their implementation and provide a forum for addressing new concerns as they arise. These two participatory activities will continue after the initial planning effort is complete and may be integrated with other ongoing monitoring and evaluation mechanisms to ensure that continued attention is paid to them.

Communities should establish a long-term, simple feedback mechanism whereby individuals may express new concerns or developments about the selected adaptation projects. In addition, some adaptation projects (usually environmental) involve a degree of monitoring. Community members may be willing to volunteer their time to observe if the desired effects are occurring and even to provide maintenance and upkeep labor.

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5. Summary

Resilience has many definitions, but in the context of this guidebook, it means the ability of a community to prepare for and adapt to the effects of sea level rise, especially coastal flooding, erosion, and ecosystem changes. Done with care and thoughtfulness, adaptation planning can result in a community with a stronger infrastructure, economy, and ecosystems than was present prior to adaptation.

Adaptation planning will prompt coastal communities to consider the potential of future increase of coastal flood hazard risk and creatively develop responses. This guidebook walks readers through the steps of the adaptation planning process and serves as a resource for communities as they develop their own sea level rise adaptation plans. Adaptation Action Areas, a subset of this planning effort, represent the tangible product of the adaptation planning components of this guidebook that support adaptation planning.

The guidebook synthesizes years of research during the Community Resiliency Initiative that resulted in recommendations and best practices in sea level rise adaptation planning. The four components are the planning framework that contextualizes the local hazard, analyzes vulnerability, formulates adaptation strategies, and implementation considerations. It also presents 14 subcomponents within the four components that help to guide communities to create flexible, participatory plans that can serve as a blueprint in preparing for the potential effects of rising seas. Land uses, infrastructure, and populations may be reached by the rising tide; however, a multifaceted and flexible adaptation plan facilitates community resiliency.

More information and the products of the Community Resiliency Initiative that contributed to this guidebook can be obtained by contacting the Florida Coastal Office of the Florida Department of Environmental Protection.



Figure 29. Adaptation planning will prompt coastal communities to consider future potential coastal flooding hazards and creatively develop responses.

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6. Appendices

6.1. Specialty Topics

6.1.1. The Economic Value of Sea Level Rise Adaptation Planning

In 2010, Florida's 35 coastal counties contained 76% of Florida's population and contributed \$584 billion dollars in economic activity, making up 79% of the state's total economy.²⁶ Its ocean and coastal resources directly contribute around \$18 billion dollars annually. These resources also support over 228,000 jobs. When indirect effects are taken into account, the number of jobs supported by Florida's ocean resources exceeds 440,000. As the Sunshine State's number one industry, tourism was responsible for welcoming record 116.5 million visitors in 2017. According to VisitFlorida, visitors spent \$112 billion and supported 1.4 million Florida jobs. Tourism-related job numbers consistently outperform other ocean-based markets like water transportation, marine industry, recreation, and fishing in Florida's coastal counties. In 2011, the ocean tourism industry accounted for 72 percent of employees and 58 percent of wages.²⁷ Top counties for ocean and coastal industry employment (hotels and restaurants, by number of employees) rank from one to five as follows: Miami-Dade, Broward, Palm Beach, Hillsborough, and Pinellas.

Planning for and implementing actions to reduce risk to coastal hazards maintains and strengthens the local economy and makes communities more attractive to new investment and job growth

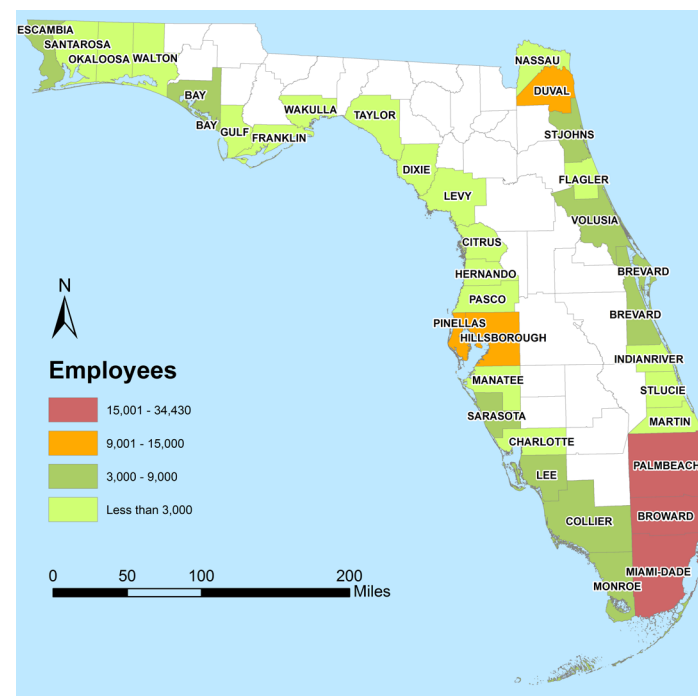


Figure 30. Florida's Coastal and Ocean Tourism Industry (2011) by number of employees by coastal county. Map adapted from Florida Ocean Alliance, Florida's Oceans and Coasts: An Economic and Cluster Analysis, page 30

²⁶ Florida Ocean Alliance, Florida's Oceans and Coasts: An Economic and Cluster Analysis, page 1.

²⁷ Florida Ocean Alliance, Florida's Oceans and Coasts: An Economic and Cluster Analysis, page 27.

There is significant value in exploring adaptation actions that mitigate potential future impacts of sea level rise and help to maintain a productive and thriving economy. With tens of thousands of homes vulnerable to even one foot of sea level rise, it is easy to see that the potential increase in risk could translate into large economic losses. Planning for saltwater intrusion, increased storm surge, shoreline erosion, and coastal flooding can help mitigate those losses. For example, a study of FEMA grants determined that every \$1 spent on hazard mitigation efforts saves society an average of \$4 in the long run. The same study concluded that mitigation activities associated with coastal hazards produced an even higher return on investment. Communities across Florida are already engaged in hazard mitigation planning. The actions taken by these communities to reduce their vulnerability to coastal flooding are very similar to those actions Florida communities may choose to implement for adaptation. Complementary planning efforts can multiply the investment.

Communities should view adaptation as an investment that may save them money in the long term. Actions taken to reduce risk may lead to a reduction in storm-related business interruption across a variety of important coastal industries such as the tourism, recreation, sea-ports and ocean transportation, marine, and fishing/living resources industries. By supporting a resilient business and community environment, workforces can return to work more quickly after coastal hazard events, customers will return more quickly with limited interruptions in service delivery, and suppliers will be able to continue to provide the level of service that businesses need. A 2007 study by Rose et al. found

that hazard mitigation projects that focus specifically on reducing business interruption have the largest return on investment.

More importantly, the cost of doing nothing should be factored into the decision to move forward with adaptation planning. Economic models, like REMI PI+, exist that can help communities quantify what they stand to lose by maintaining a “business as usual” approach instead of planning for change. Employment losses, gross domestic product, and other economic indicators can be modeled using storm and/or sea level rise scenarios to show how the losses from downtime and damage balance out with the gains from rebuilding.

6.1.2. The Community Rating System and Sea Level Rise Adaptation

In 2011, FEMA established a Climate Change Adaptation Policy to integrate climate change adaptation planning and actions into FEMA’s programs, policies, and operations.²⁸ FEMA’s National Flood Insurance Program’s (NFIP) Community Rating System (CRS) is a voluntary incentive program that recognizes and encourages a range of community floodplain management activities that exceed the minimum NFIP standards. Depending on the level of participation, flood insurance premium rates may be discounted from 5% up to 45%. The CRS uses a class rating system to determine flood insurance premium reductions. As a community engages in additional mitigation activities, eligibility for greater premium discounts increases.

²⁸ FEMA Climate Change Adaptation Policy Statement

CRS Class	Credits	Premium reduction	
		In SFHA	Outside SFHA
1	4,500 and above	45%	10%
2	4,000 to 4,499	40%	10%
3	3,500 to 3,999	35%	10%
4	3,000 to 3,499	30%	10%
5	2,500 to 2,999	25%	10%
6	2,000 to 2,499	20%	10%
7	1,500 to 1,999	15%	5%
8	1,000 to 1,499	10%	5%
9	500 to 900	5%	5%
10	0 to 499	0%	0%

Figure 31. A community's participation in FEMA's Community Rating System provides a flood insurance premium reduction.

The CRS encourages a comprehensive approach to floodplain management activities that increases public safety, reduces property damage and economic loss, and helps protect the environment.

Participating in the CRS provides an incentive to maintaining and improving a community's floodplain management program over time. Implementing CRS activities can help community projects qualify for certain other Federal assistance programs.

Some of the communities that have the highest CRS ratings are listed below. Each has developed a floodplain management program tailored

to its own unique character, hazards, and goals. Each carries out varied activities, many of which are credited by the CRS.

- **Roseville, California** was the first to reach the highest CRS rating (Class 1). Floods in 1995 spurred Roseville to strengthen its floodplain management program. As of 2018, the City earns points for almost all CRS-creditable activities. The average premium discount for policies in the SFHA is \$963.
- **Tulsa, Oklahoma's** comprehensive planning has been key in reducing flood damage from dozens of rivers and creeks within its jurisdiction. The City (Class 2) has cleared more than 900 buildings from its floodplains. The average SFHA premium discount is \$709.
- **King County, Washington** (Class 2) has preserved more than 100,000 acres of floodplain open space and receives additional CRS credit for maintaining it in a natural state. The average premium discount in the SFHA is \$722.

In Florida as of 2016, 230 cities and counties participated in the CRS.²⁹ The highest CRS rating in Florida is in the City of Ocala, which is Class 3 and earns a 35% percent discount on flood insurance premiums in the Special Flood Hazard Area (SFHA). Most Florida communities are in Classes 5 through 8 and have an average of 15% off flood insurance premiums as a result of their participation in the CRS. Florida communities in Class 5 include: the City of Anna Maria, Bay County, City of Cape Coral, Charlotte County, Citrus County, Collier County, City of Dunedin, Hernando County, Hillsborough County, Town of Juno Beach, Town of Jupiter, Lee County, Town of Longboat Key, Manatee County,

²⁹ Community Rating System (CRS) Communities and their Classes – October 2016. Available online at <https://www.fema.gov/media-library/assets/documents/15846>. Accessed June 14, 2018.

City of Marco Island, Miami-Dade County, Town of Miami Lakes, City of Naples, City of North Miami, Okaloosa County, Orange County, Palm Beach County, City of Palm Coast, Pensacola Beach – Santa Rosa Island Authority, Pinellas County, Town of Ponce Inlet, City of Port Orange, City of Punta Gorda, City of Sanibel, Santa Rosa County, Sarasota County, St Johns County, City of St Petersburg, Volusia County, and Walton County.

Lower cost flood insurance rates are only one of the rewards a community receives participating in the CRS. Other benefits include:

- CRS community participants have increased opportunities to learn about risk, evaluate their vulnerabilities, and act to protect themselves, their homes, and their businesses.
- Floodplain management activities under the CRS provides for improved public safety, damage reduction to property and public infrastructure, and avoidance of economic disruption and loss.
- Technical assistance in designing and implementing some activities is available to community officials at no charge.³⁰

For Florida, FEMA Region IV has developed a skilled workforce to support communities and first responders to work together to build, sustain, and improve capabilities to prevent, prepare for, protect against, respond to, recover from, and mitigate all hazards. FEMA's assistance to Florida includes Hazard Mitigation Planning, Hazard Mitigation Assistance, Floodplain Management and Insurance, and Community Education and Outreach.

³⁰ FEMA Community Rating System Fact Sheet, June 2017

Through Florida's Community Resilience Initiative, several applicable resources for local governments were developed, one of which is titled *Crediting Adaptation Strategies through the National Flood Insurance Program's Community Rating System Coordinator's Manual, A Resource for Florida's Local Governments*. This guide provides information on the connection between the CRS and implementing sea level rise adaptation strategies. With this guide, local governments can identify which strategies to address SLR will also lead to CRS credit.

6.1.3. Protecting and Preserving Historic and Cultural Resources³¹

People living in Florida have long depended on its coastline for food, shelter, and transportation. Early Native American inhabitants left behind historical evidence of their coastal habitations. Continued dependence and existence of people on the Florida coast through subsequent centuries have left a rich legacy of historic and valued cultural resources. These cultural resources have unique needs that will need to be addressed through adaptation strategies to ensure their continued capacity to teach and be used, appreciated, and enjoyed by future generations. In some Florida communities, the historic nature of many of their properties is the foundation for a substantial, tourism-driven economic base. Some very familiar historic districts in Florida include the South Beach Art Deco District in Miami Beach, Old St. Augustine in northeast Florida, Historic Key West, and the Ybor City in Tampa.

³¹ Adaptation Planning for Historic Properties: A product of the Community Resiliency Initiative.

A historic property review often begins with properties that are 50 or more years old which are further evaluated for their historic context and significance. Context is defined by “those patterns or trends in history by which a specific occurrence, property, or site is understood and its meaning within history or prehistory is made clear.”³² Significance means that it must represent a significant part of the history, architecture, engineering, or culture of an area and can be defined by (a) a significant event, (b) a significant person, or (c) physical features like the work of a master, last of its kind, or culturally significant.

Historic integrity is maintained when both the “why” and “when” is apparent in the structure. Seven facets define this: location, design, setting, materials, workmanship, feeling, and association.

- **Location** – the place where the historic property was constructed or the place where the historic event took place.
- **Design** – the composition of elements that constitute the form, plan, space, structure, and style of a property.
- **Setting** – the physical environment of a historic property that illustrates its character.
- **Materials** – the physical elements combined in a particular pattern or configuration to form the property during a period in the past.
- **Workmanship** – the physical evidence of the crafts of a particular culture or people during any given period of history.
- **Feeling** – the aesthetic or historic sense of a past period of time that a property invokes.

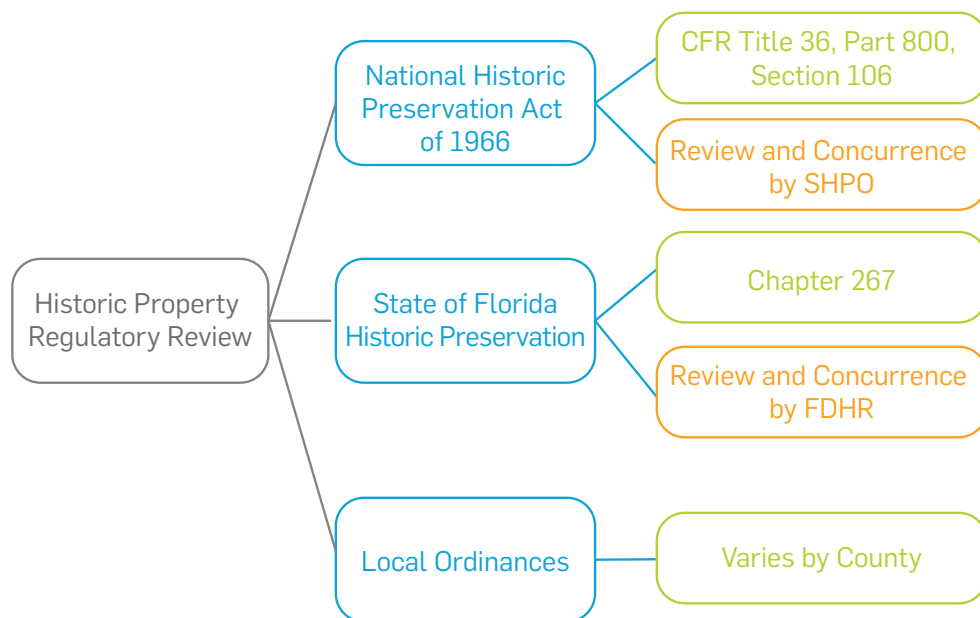
- **Association** – the direct link between a property and the event or person for which the property is significant.

The National Register of Historic Places (NRHP) lists six types of historic and culturally significant properties. They are as follows:

- **Historic Property** – This overarching term encompasses all types of historic resources. It is defined as “a district, site, building, structure, or object significant in American history, architecture, engineering, archaeology, or culture at the national, State, or local level.”
- **Building** – “A building, such as a house, barn, church, hotel, or similar construction, is created principally to shelter any form of human activity. ‘Building’ may also be used to refer to a historically and functionally related unit, such as a courthouse and jail or a house and barn.” Examples of buildings include administrative buildings, churches, courthouses, forts, houses, hotels, post offices, schools, stores, theatres, and train stations.
- **Structure** – “The term ‘structure’ is used to distinguish from buildings those functional constructions made usually for purposes other than creating human shelter.” Examples of structures include aircraft, automobiles, bridges, fences, gazebos, light-houses, silos, trolley cars, and windmills.
- **Object** – “The term ‘object’ is used to distinguish from buildings and structures those constructions that are primarily artistic in nature or are relatively small in scale and simply constructed. Although it may be, by nature or design, moveable, an object is associated with a specific setting or environment.” Examples of objects include boundary markers, fountains, monuments, and sculptures.

³² Adaptation Planning for Historic Properties: A product of the Community Resiliency Initiative, page 5.

Figure 32. Any alteration to qualifying historic properties are overseen by governmental units at either the Federal, State, or local level. Relevant statutes and laws are identified in this graphic.



- **Site** - “A site is a location of a significant event, a prehistoric or historic occupation of activity, or a building or structure, whether standing, ruined, or vanished, where the location itself possesses historic, cultural, or archeological value regardless of any existing structure.” Examples of sites include battlefields, campsites, cemeteries, ceremonial sites, habitation sites, natural features with cultural significance, rock carvings, ruins of a building or structure, shipwrecks, and village sites.
- **District** - “A district possesses a significant concentration, linkage, or continuity of sites, buildings, structures, or objects united historically or aesthetically by plan or physical development.”

Federal, State, and Local Historic Preservation Laws and Ordinances

Any action that is proposed for any of these six types of historic properties, including adaptation of these places to sea level rise, may require state or federal review. Federal laws concerning this are from the National Historic Preservation Act of 1966, details of which are contained in the Code of Federal Regulations (CFR) Title 36, Part 800, Section 106. Historic properties can include properties on the National Register or can be properties that meet the criteria for the National Register. If an undertaking affects a property that falls into either of these categories, the appropriate State Historic Preservation Officer (SHPO) or Tribal Historic Preservation Officer (THPO) must be consulted by the Federal agency throughout the rest of the process. Other consulting parties that are entitled to participate include the Advisory Council on Historic Preservation, local governments, and applicants for Federal assistance, permits, licenses, and other approvals.

The State of Florida has its own historic resource statute, Chapter 267, that outlines a similar review process for state actions to historic properties. If properties considered for adaptation to sea level rise are

State-owned or if the project is even partially State-funded or requires a State-permit, then Chapter 267 will be triggered, and the proposed actions will come under review by the Florida Division of Historic Resources (referred to as “the Division”). This will allow for consultation between the Division and the owner who may potentially alter the property.

Local preservation ordinances are also part of the legal framework that governs adaptation actions for historic properties. Local ordinances vary by community although a typical code of ordinances usually establishes an architectural, design, and/or variance review board, review process, and criteria to review plans to alter, relocate, or demolish locally designated resources. All Certified Local Governments (CLG) are required to have a preservation ordinance to obtain CLG status, but local governments not participating in the CLG program may also have local preservation ordinances. As per Federal regulations, communities that participate in the CLG program are automatically prioritized for funding allocations annually from the Division.

Archaeology Laws and Exemptions for Historic Properties

There are laws specific to the protection of archaeological sites at both the Federal and State levels. At the Federal level, the Archaeological Resources Protection Act of 1979 (ARPA) establishes uniform regulations that must be met before Federal authorities can issue a permit to excavate or remove any archaeological resource on Federal or Native American lands. Florida Chapter 267 includes a section that grants

the Division of Historic Resources title to sites and artifacts on State-owned and State-controlled land (see §§ 267.031 and 267.115, Fla. Stat., (2014)). The Statute also requires a permit to conduct archaeology, provides penalties for removing or disturbing sites to objects without a permit, and makes it illegal to offer or sell forged artifacts (see §§ 267.12 and 267.13, Fla. Stat., (2014)). Adaptation actions proposed for sites with archaeological resources will need to abide by these laws before any actions are taken that may remove, disturb, deface, destroy, or otherwise alter archeological sites and their resources. There are also State regulations impacting archaeological resources such as the Cemetery Act (Ch. 872, Fla. Stat 1990) and the Native American Graves Protection and Repatriation Act (Public Law 101-601; 25 U.S.C., 3001-3013) that will affect what adaptation options can be taken on sites with human remains.

The Florida Building Code may also affect what can be done to historic properties since it is tailored to Florida’s specific needs like wind and flood load forces. Chapter 11 of the Florida Building Code, Existing Buildings, is dedicated to design standards for historic buildings and allows for additional flexibility for historic properties. Other more stringent requirements that may apply include the high velocity hurricane zone, windborne debris regions, and floodplain management ordinances. The NFIP allows for exemptions or variances to local flood ordinance requirements for historic properties (e.g., a registered historic property could be floodproofed instead of having to be elevated).

Local Approach and Inventorying Historic Properties

Local communities can choose to focus on historic properties as a separate planning process or include them as one type of property in a more comprehensive adaptation planning process. In the initial planning steps, consider including historic preservation professionals in the steering committee or as part of a focus group. This group may include architects, engineers, policy makers, non-profits, and organization representatives. An important consideration is to identify how and when community discussions will include historic resources and consider specific needs of property owners of historic properties. Include specific historic preservation goals in the adaptation plan, for example, “Enhance the ability of vulnerable historic properties and cultural resources to withstand the anticipated impact of hazards while maintaining their historic integrity.”

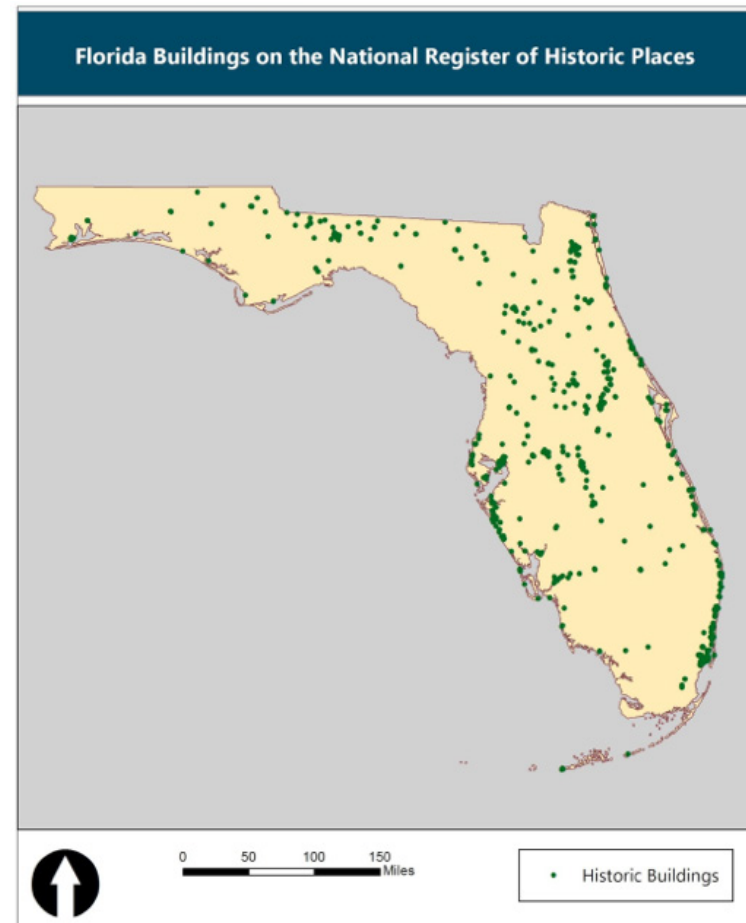


Figure 33. Florida buildings on the National Register of Historic Places. GIS data layer is publicly available on the National Parks Service Website Data Download page. Map as shown in the Adaptation Planning for Historic Properties, page 27.

A major step in this process is doing a baseline inventory of historic properties and archaeological sites within the local agency's boundaries and compiling it into a GIS layer if that resource is available to the local agency. This layer could be included in the Adaptation Plan to determine which historic resources are within the Adaptation Action Areas or other such designated vulnerable areas. Much of this information is already in this format and can be easily expanded if needed by GIS-capable professionals. Present sources of information include the National Register of Historic Places, the Florida Master Site File, and the property appraiser's website (to identify 50+ year old buildings). Detailed information about each historic property can be contained within this format in a well-designed attribute table and easily overlaid with vulnerable locations. Attribute information to consider includes:

- Geographic location
- Type of resource
- Name
- Tax identification number
- Street address
- Condition of resource
- Distinguishing features or characteristics (especially those features and characteristic that are related to the historic property's integrity)
- If the property is listed on the National Register or may be eligible for the National register
- Owner

- Individual(s) with maintenance responsibility and availability
- Date of construction
- Square footage
- Structural system
- Primary material(s) of property/resource
- Current function
- Property characteristics: building type, type of foundation, vegetation, topography, distance from hazard zone

Once a satisfactory inventory has been compiled, standard steps to adaptation planning can continue. This may be part of a more comprehensive Adaptation Plan in which all property types are included. A Vulnerability Analysis for historic properties are the same as other properties, consisting of an Exposure Analysis, a Sensitivity Analysis, and assigning Focus Areas. The next step, Adaptation Strategies, consists of assessing Adaptive Capacities, prioritizing Adaptation Needs, and identifying Adaptation Strategies. The STAPLEE evaluation method (described in greater detail in [Chapter 4](#), Implementation Strategies) is an example analysis type for prioritization that would work well for historic properties. Detailed information on the steps contained in this paragraph are contained in the guidebook titled *Adaptation Planning for Historic Properties: A Product of the Community Resilience Initiative*.

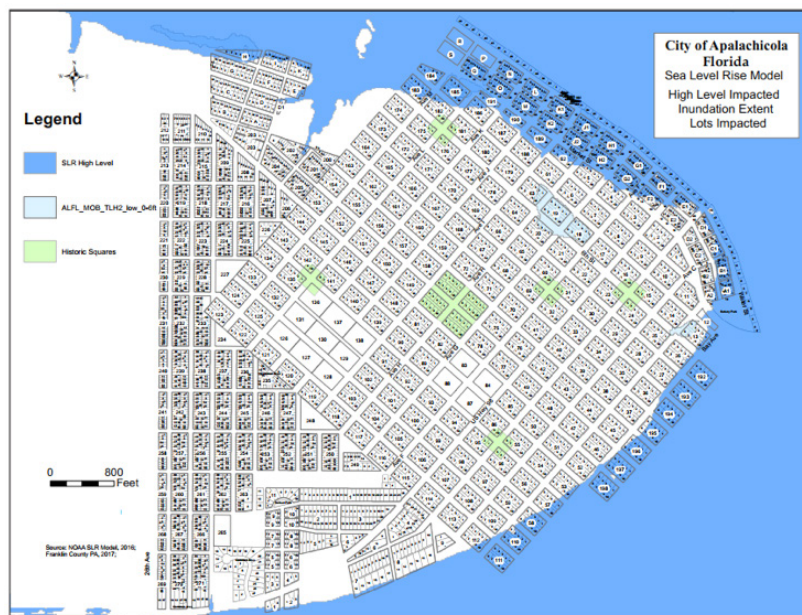


Figure 34. Vulnerability Assessment graphic showing the City of Apalachicola lots affected by High Level inundation overlaid with Historic Properties. From the Apalachicola Vulnerability Analysis, page 11.

Potential Historic Preservation Adaptation Strategies

Special considerations to historic properties include the adaptation strategy itself. The Secretary of Interior’s advisory (not regulatory) Standards for the Treatment of Historic Properties are divided into four sections: (a) Preservation, (b) Rehabilitation, (c) Restoration, and (d) Reconstruction. These standards are based in the understanding that there is a need to alter or add to historic properties to meet the requirements of continuing or new uses of the property while simultaneously retaining the property’s historic character. Details regarding these standards for each of these four types can be found on the National Parks Service Technical Preservation Services webpage. The goal of the Section 106 review process is to encourage (but not mandate) preservation.

The chosen adaptive strategy for historical resources should include input from the public. Does the community value the historic resource? Does the community have a preference on how to preserve the historic resource? Once a consensus is reached, cost may prove to be the biggest hurdle for any community when implementing a chosen adaptive strategy for a number of historic properties. Consider that tourism and economic growth is often linked to communities that have a significant amount of historic properties. Dan Scheidt, of the National Parks Service, says, “We can’t save everything; we have to set priorities. We live in a time when things are going to change.”

Real life examples of adaptation strategies for historic properties include:

- A new seawall to protect one of the seven historic districts and a historic seawall in St. Augustine.
- Protecting the Turtle Mound National Register Historic Site from erosion through implementation of living shoreline techniques in the Canaveral National Seashore.
- The Homeowner Elevation Grant Program which was part of rebuilding efforts for historic properties damaged by Hurricane Katrina in Mississippi and resulting elevation design guidelines book created by the Mississippi Development Authority providing a step-by-step process for both property owners and local officials.
- Darlington, Wisconsin's flood accommodation strategies for repetitive flooding in its historic downtown business district along the Pecatonica River.
- The Bachman Wilson House designed by Frank Lloyd Wright in Somerset County, New Jersey was relocated to Arkansas from its original location along the Millstone River.

Relocation is generally sought as a last resort; however, it may be the best choice in some cases. Daniel Odess, PhD, of the National Park Service, says, "On one hand, the context and setting of a historic property is critical to understanding it, but a more pragmatic view dictates that while you may lose some of that integrity if you relocate, it's going to lose a lot more if it's gone."



Figure 35. A historic home in Tampa being relocated as part of the Tampa Interstate Study. Photo by Atkins staff, 2016.

Funding sources for historic resources include the following:

- Division of Historic Resources: Special Category Grant. Assists in funding major restoration of a historic property for relocation or rehabilitation or funding to support a major archaeological investigation.
- Division of Historic Resources: Small Matching Grants. Assist in the identification, protection, and rehabilitation of historic and archaeological sites in Florida.
- National Trust Preservation Funds.

- National Trust for Historic Preservation: Johanna-Favrot Fund for Historic Preservation.
- National Trust for Historic Preservation: Cynthia Woods Mitchell Fund for Historic Interiors.
- Save America's Treasures Funding.
- Preserve America Grant Program.
- Federal Investment/Rehabilitation Tax Credit.
- National Park Service Historic Preservation Fund Grants-in-Aid.

6.1.4. Adaptation Action Areas to Protect Natural Resources³³

While adaptation planning often involves adaptation strategies applied to at-risk infrastructure, a focus on natural resources in the context of adaptation strategies is a unique blend of components that are simultaneously at risk and part of an effective solution. As the sea level rises, the boundaries of existing natural areas will likely change, encroaching on both existing critical habitats or nesting areas of endangered species as well as recreation areas. However, coastal resources such as mangroves, saltwater marshes, and estuaries can provide ecosystem services such as water filtration, ground water recharge, and wave attenuation, which helps protect developed areas from damage. When communities rehabilitate or add to these resources, developed areas can save homeowners millions of dollars in the event of a storm.

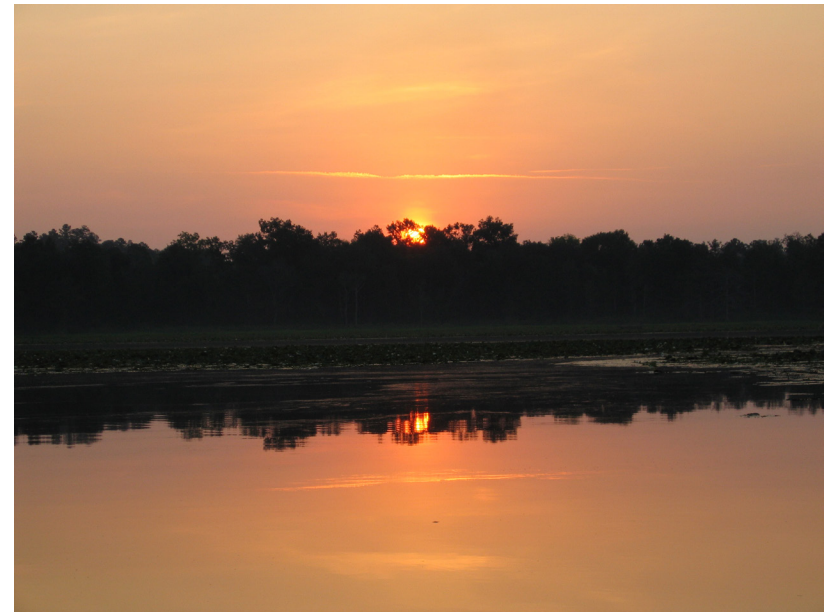


Figure 36. Coastal resources such as mangroves, saltwater marshes, and estuaries can provide ecosystem services such as water filtration, ground water recharge, and wave attenuation.

Many communities are already engaged in planning efforts that consider the natural processes that influence their coasts. This is primarily done through the Coastal Management Element of their Local Comprehensive Plans. There are also currently nine Florida Statutes that promote natural coastal areas. Eight are contained in F.S. §163.3177 one is contained in F.S. §163.3178:

³³ Conserving and Managing Natural Resources with Adaptation Action Areas: Planning Guidance for Florida's Local Governments. DEO/DEP Staff, CM501, Deliverable 3.10.

Status	Descriptions
F.S. §163.3177 6(a) 3.f	Ensure the preservation of natural resources.
F.S. §163.3177 6(a) 3.c	Preserve recreational uses in coastal communities.
F.S. §163.3177 6(a) 10.c	Ensure future land uses take into account future locations of beaches, shores, estuaries, rivers, bays, floodplains, wetlands, and coastal high hazard areas.
F.S. §163.3177 6(g) 1	Maintain, restore, and enhance the overall quality of the coastal zone environment including, but not limited to, its amenities and aesthetic values.
F.S. §163.3177 6(g) 2	Preserve the continued existence of viable populations of all species of wildlife and marine life.
F.S. §163.3177 6(g) 3	Protect the orderly and balanced utilization and preservation, consistent with sound conservation principles, of all living and nonliving coastal zone resources.
F.S. §163.3177 6(g) 4	Avoid the irreversible and irretrievable loss of coastal zone resources.
F.S. §163.3177 6(g) 5	Use ecological planning principles and assumptions in the determination of the suitability of permitted development.
F.S. §163.3178 2(f)	The redevelopment component of the Coastal Management Element must take new measures into account to minimize risk of flood damage to property.

Figure 37. There are nine Florida Statutes that promote natural coastal areas.

The natural resource elements in [Chapter 1](#), Context (component 1) encourages the inclusion of natural resource professionals in the adaptation planning or AAA steering committees. Example professionals include coastal conservation specialists, coastal ecologists, species experts, and wildlife managers that are generally employed at places like:

- The University of Florida IFAS Extension services
- Florida Sea Grant
- Florida Fish and Wildlife Conservation Commission
- Florida Department of Environmental Protection
- Audubon Florida
- The Nature Conservancy
- National Estuarine Research Reserves
- National and State Forests
- Everglades National Park and various State Parks

Even though they cannot provide input in a conventional manner, stakeholders may be thought of to include the natural communities themselves and the organisms that live there, especially endangered species. Goals can specifically highlight natural communities and overall relationships. For example, a goal can be to “Think of human activity as a subset of natural processes, not vice versa. The extinction of

one species may cause extinction of other species, causing a ripple effect through an ecosystem.” These kinds of impacts not only are detrimental to the organisms and the natural systems but may also impact human interests in these areas including tourism and fishing. Another goal could be to “Protect the integrity of drinking water sources for the planning area.”

The natural resources vulnerability analysis can be done alongside the man-made resources within the Vulnerability Assessment (component 2) to determine exposure, impacts, and focus areas. There are many places where natural system inventory data can be acquired in GIS format. GIS data sources include the Florida Natural Resources Inventory (FNAI), Florida Geodatabase Library (FGDL), Florida Estuarine Research Reserve (NERR) System, Florida Department of Environmental Protection (DEP), and Florida Fish and Wildlife Conservation Commission (FWC). Some resources and datasets are monitored and updated often enough that they can show changes to the resource over time. This will help identify whether a particular resource is healthy and resilient or being depleted or endangered.

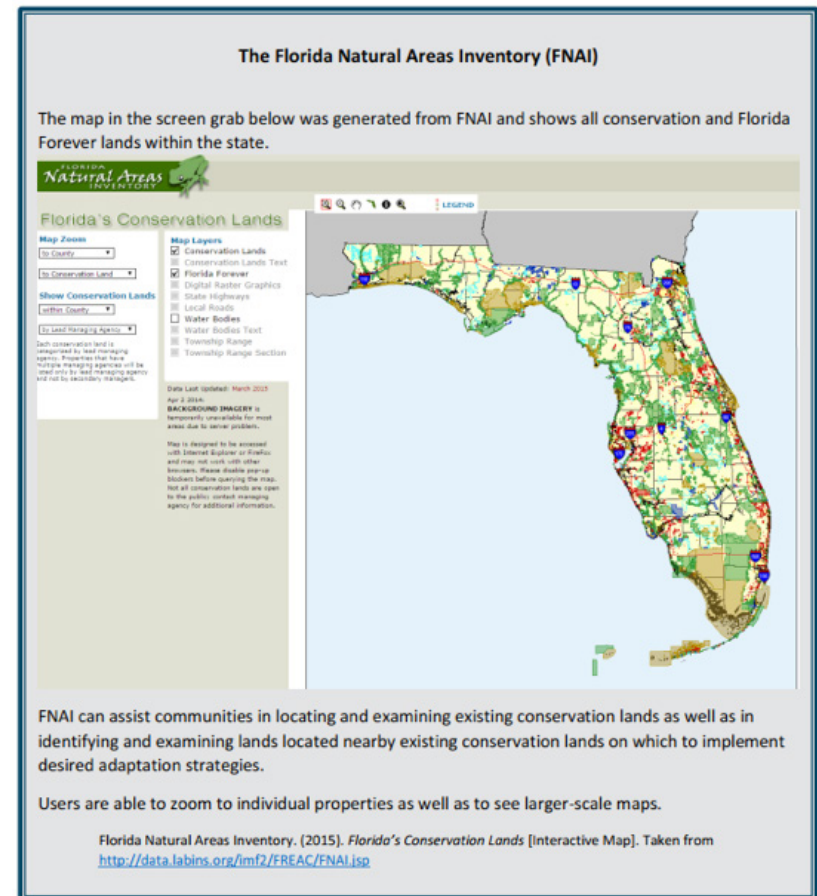


Figure 38. The Florida Natural Areas Inventory (FNAI). GIS data layer is publicly available on the Florida Natural Areas Inventory Website Data Download page. Map as shown in the Conserving and Managing Natural Resources with Adaptation Action Areas page 19.

Natural resource specific software that facilitates the Exposure Analysis includes the Sea Level Affecting Marshes Model (SLAMM), the Integrated Valuation of Ecosystem Services and tradeoffs (InVEST), the Coastal Resilience.org Mapping Tool, and NatureServe VISTA.

A Sensitivity Analysis measures the degree of impairment to an asset from coastal flooding. These impacts may require additional layers of asset information not already addressed in the Exposure Analysis. Impacts to common natural resources to consider include the following:

Coastal Resource	Potential Concerns for each resource
Beaches	Erosion, existing infrastructure, pollution, and runoff
Animal Habitats and Nurseries	Species habitat maps, vegetative species maps, soil maps, pollution, destruction of habitats for development, and water activity-related disruption of animal behavior
Coastal Aquifers	Saltwater intrusion, unsustainable usage of water supplies, and pollution
Wetlands, Marshes, Coastal Timberlands	Saltwater intrusion, development-related disruption of natural systems, and pollution
Reefs and Marine Habitats	Ocean acidification, pollution and runoff, human activity-related disruption of animal behaviors, and damage to seagrass beds

Adaptation Strategies (component 3 found in [Chapter 3](#)) begins with a review of the adaptive capacity of the local agency. For natural resources, this would include identifying the capabilities of the natural

resource professionals or defining (in a general sense) whether a natural area like a wetland can be expanded or rehabilitated. The prioritization of known natural resources can be included in a more comprehensive list and is likely to be based on community support or the economic urgency of impacts. Natural resource priorities may be already known and well documented. For example, if the protection of Scrub Jays is important to a community, then its local nesting areas will likely have been mapped at a prior point in the process.

Strategies can take the form of specific actions to protect resources or a policy change to guide future decisions. A specific action to protect resources may be as simple as land purchase and designation as a conservation area. A policy change could be to assign certain restrictions to the regulatory Coastal High Hazard Area (CHHA) and include a provision that it will likely need to be periodically updated as the location of natural systems change.

Intrinsic natural resources qualities can also serve as solutions to other community vulnerabilities. The benefits of mangroves, saltwater marshes, and estuaries include:

- Carbon sequestration
- Wave and storm surge attenuation
- Water filtration including pollutant and bacteria removal
- Habitat that encourages species diversity
- The maintenance of a natural floodplain that keeps floodwaters in less contact with developed areas

- Scenic viewsheds and recreational opportunities
- Increased property value for neighboring properties
- Increased community health and educational opportunities

A natural resource-specific Adaptation Action Area may be designed to address a specific concern that exists in the community, like a habitat district. A habitat district is a defined location that has specific characteristics to support populations of identified species, often species of special concern. When designing AAA overlays to accommodate or promote habitat, there are five considerations based on natural resource needs and shown in Figure 39 that tend to improve the effectiveness of the overlay district(s):

- Large districts are better than small ones.
- One district is better than several smaller ones.
- Districts that are closer together are better than spread apart.
- Connected districts are better than discrete districts.
- Circular districts are better than an oblong or unusually shaped district.

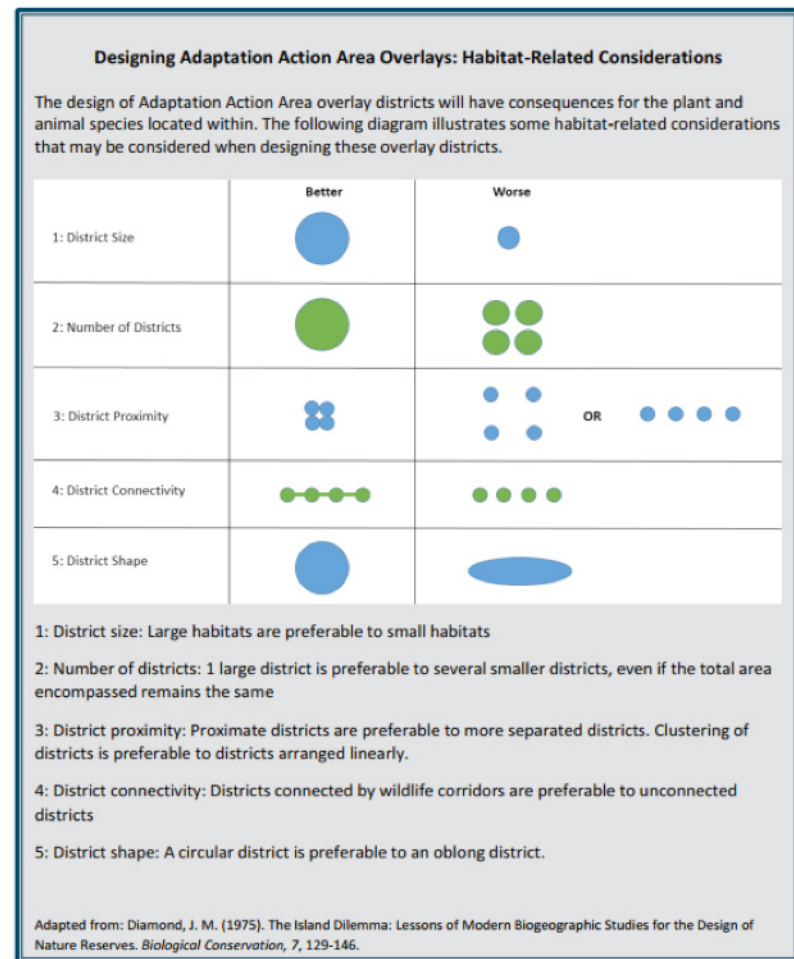


Figure 39. Graphic showing habitat-related considerations when designing adaptation action area overlays. Map as shown in the Conserving and Managing Natural Resources with Adaptation Action Areas page 35.

There are several funding sources available for natural resources and more details of these are contained in the reference document on pages 43 to 45. Funding for land purchase may be available from the Florida Forever Program, a popular DEP program dedicated to preservation of conservation and recreational lands in Florida. Numerous grant programs are available on the US Environmental Protection Agency website, including the Federal Funding for Utilities in Natural Disasters and Wetlands Program Development Grants. The Coastal and Estuarine Land Conservation Program administered through NOAA has a matching program where applicants are eligible to receive up to \$3 million per project. The US Fish and Wildlife Conservation commission has North American Wetlands Conservation Act Grants and Wildlife and Sport Fish Restoration Funds. The Florida Department of Emergency Management has funding for local governments through the Hazard Mitigation Grant Program that can be available for purchase of flood prone properties that can be restored to open space to enhance the natural function of the floodplain. DEP has funding for water resource projects including low interest loans, small community wastewater grants, stormwater facility retrofit grants, and Beach management funding assistance grants. Additional funding may be available through the Florida Water Management Districts.

6.2. Funding Opportunities

Funding for adaptation planning can originate at non-profit, private, local, state, and federal levels. The following tables identify potential funding programs and resources. Note that since URLs and points of contact often change, no weblinks or contact information has been added. Please call the funding agency or use a web search tool for more information.

Federal Funding Opportunities

Federal Funding Opportunity	Description and Details
DOC/Economic Development Administration Investment for Public Works and Economic Development Facilities	Economic Development Administration (EDA) provides assistance to support the construction or rehabilitation of essential public infrastructure and facilities necessary to generate or retain long-term private sector jobs and investments, attract private sector capital, and promote regional competitiveness. Grants may be used for projects such as expanding and upgrading infrastructure to attract new industry, supporting technology-led development, redeveloping brownfield sites, promoting eco-industrial development, and supporting heritage preservation development. Generally, EDA investment assistance may not exceed 50% of the project cost. Projects may receive an additional amount that shall not exceed 30%, based on the relative needs of the region in which the project will be located, as determined by EDA. Additional financial limitations may apply depending on the recipient.
EPA Aquatic Ecosystem Restoration (CAP Section 206)	Work under this authority may carry out aquatic ecosystem restoration projects that will improve the quality of the environment, are in the public interest, and are cost-effective. There is no requirement that an existing US Army Corps of Engineers project be involved.
EPA BEACH Grants	EPA makes grants available to eligible coastal and Great Lakes states, territories, and tribes to help them implement programs to monitor water quality at their beaches and to notify the public when water quality problems exist.
EPA Coastal Program	The U.S. Fish and Wildlife Service (FWS) Coastal Program partners with communities to provide technical and financial assistance to assess, protect, and restore or enhance priority coastal habitats for the benefit of fish and wildlife. The program is delivered through a network of 24 field offices in priority coastal habitats along the Atlantic, Pacific, Gulf of Mexico coasts and in the Great Lakes. Program biologists provide restoration expertise and financial assistance to federal and state agencies, local and tribal governments, businesses, private landowners, and conservation organizations such as local land trusts and watershed councils.

Federal Funding Opportunity	Description and Details
EPA Smart Growth Implementation Assistance Program	The SGIA program is an annual, competitive solicitation of state, local, regional, and tribal governments (and non-profits that have partnered with a governmental entity) that want to incorporate smart growth techniques into their future development. Once selected, communities receive direct technical assistance from a team of national experts in one of two areas: policy analysis (e.g., reviewing state and local codes, school siting guidelines, transportation policies, etc.) or public participatory processes (e.g., visioning, design workshops, alternative analysis, build-out analysis, etc.). The assistance is tailored to the community's unique situation and priorities. EPA provides the assistance through a contractor team – not a grant. Through a multiple-day site visit and a detailed final report, the multi-disciplinary teams provide information to help the community achieve its goal of encouraging growth that fosters economic progress and environmental protection. EPA initiated the SGIA program in 2005 with three goals in mind: 1. To support communities interested in implementing smart growth policies; 2. To create regional examples of smart growth that can catalyze similar projects in the area; and 3. To identify common barriers and opportunities for smart growth development and create new tools.
FEMA Community Disaster Loan Program	The Federal Emergency Management Agency (FEMA) provides direct loans to local governments to offset the loss of tax or other revenues as a result of a major disaster. The local government must demonstrate a need to maintain local governmental functions such as police and fire protection, or water and sewer services. Loans are not to exceed 25% of the local government's annual operating budget for the fiscal year in which the major disaster occurs, up to a maximum of \$5 million. To apply: The State's Governor requests a Presidential declaration of an emergency or disaster. An applicant should consult the office or official designated as the single point of contact in the state for more information on the process. Upon declaration, one may apply for assistance through the Governor's authorized representative.
FEMA Flood Mitigation Assistance Program	FEMA provides funds to local governments, tribes and some non-profits to reduce or eliminate claims made under the National Flood Insurance Program (NFIP). Specifically, the program aims to reduce the number of repetitive loss structures insured by NFIP. (Repetitive loss structures are those that have sustained two or more losses, each exceeding \$1000, within a ten-year period.) There are three types of grants that fall within the Flood Mitigation Assistance (FMA) program area: 1. Planning Grants to prepare flood mitigation plans; 2. Project Grants to implement measures to reduce flood losses, such as elevation, acquisition, or relocation of NFIP-insured structures; 3. Technical Assistance Grants for the state to help administer the FMA program and activities. To apply projects should be submitted as the need arises to the state which then selects applications based on predetermined priorities set forth in a disaster specific Mitigation Strategy to send to FEMA for final approval.
FEMA Hazard Mitigation Grant Program	FEMA provides funds to local governments, tribes and some non-profits to reduce the loss of life and property due to natural disasters and to enable mitigation measures to be implemented during the immediate recovery from a disaster. Grants given through the states to local governments following an official Presidential disaster declaration are used to implement long-term hazard mitigation measures that provide a long-term solution to a specific risk. For example, the grant could be used to elevate flood-prone homes or businesses, thus allowing floodwater to flow under the house rather than through it. FEMA will pay up to 75% of the project cost, while the remaining 25% must be funded through the state, local government applicants or individual property owners. In-kind services and materials can be used.

Federal Funding Opportunity	Description and Details
Pre-Disaster Mitigation Grant Program	The Pre-Disaster Mitigation (PDM) program provides annual funding to support states, territories, Indian tribal governments, communities, and universities for hazard mitigation planning and the implementation of mitigation projects prior to a disaster event. This program promotes implementation of activities designed to reduce injuries, loss of life, and damage and destruction to property from natural hazards. Administered by the state, the Pre-Disaster Mitigation (PDM) program is a competitive federal grant program that was created to assist communities with the implementation of cost effective mitigation activities prior to disasters. The intent of this program is to reduce overall risk to people and property, while also minimizing the cost of disaster recovery. The State of Florida provides workshops to explain the purposes of the program, eligible project types and application requirements. A 25-percent local match is required (to the federal contribution of 75 percent); this is a cost reimbursement program.
Repetitive Flood Claims Program	The Repetitive Flood Claims (RFC) grant program makes up to \$10 million available annually for FEMA to provide RFC funds to states and communities to assist them in reducing flood damages to insured properties that have had one or more claims with the NFIP. FEMA may contribute up to 100 percent of the total amount approved under the RFC grant award to implement approved activities, if the applicant has demonstrated that the proposed activities cannot be funded under the Flood Mitigation Assistance (FMA) program.
Transportation Enhancement Program by Federal Highway Administration	The Transportation Enhancement Program provides funding and technical assistance for eligible activities, as specified in the federal act (SAFTEA-LU), including bicycle/pedestrian facilities, renovation of historical transportation facilities and other transportation enhancement activities. All projects must be related to the transportation system; project examples include bicycle and pedestrian facilities, scenic or historic site acquisition, scenic or historic highway programs, landscaping and beautification projects, historic preservation, rehabilitation and operation of historic transportation facilities, preservation of abandoned railroad corridors, control and removal of outdoor advertising, planning and research, and mitigation of water pollution due to highway runoff. Local governments, metropolitan planning organizations (MPOs), state agencies, federal agencies and statewide or national interest groups are eligible to apply. Application requirements are coordinated through the Florida Department of Transportation's (FDOT) Environmental Management Office.
USACE - Aquatic Ecosystem Restoration	There is a total of \$50 million available nationwide per fiscal year under this authority. The federal funding limit per project is \$5 million. The source is continuing authority given by Congress to the USACE.
USACE – Hurricane and Storm Damage Reduction Projects	Authority for this action is provided under Section 103 of the River and Harbor Act of 1962, as amended. This authority may be used for protecting multiple public or private properties and facilities, and for the protection of single non-federal public properties against damages caused by storm-driven waves and currents. This authority allows federal participation in the cost of protecting the shores from hurricane and storm damage. The source is continuing authority given by Congress to the USACE. There is a total of \$30 million available nationwide per fiscal year under this authority. The federal funding limit per project is \$5 million.

Federal Funding Opportunity	Description and Details
USACE – Ecosystem Restoration in Connection With Dredging	Authority for this action is provided under Section 204 of the Water Resources Development Act of 1992. This program authorizes “projects for the protection, restoration and creation of aquatic and ecologically related habitats, including wetlands, in connection with dredging an authorized navigation project.” The source is continuing authority given by Congress to the USACE. There is a total of \$15 million available nationwide per fiscal year under this authority. There is no per project federal funding limit for this authority.
USACE - Clearing and Snagging for Flood Control	Authority for this action is provided under Section 208 of the Flood Control Act of 1954, as amended. Program authority provides for minimal measures to reduce nuisance flood damages caused by debris and minor shoaling of rivers. Work under this authority is limited to in stream clearing and snagging, or channel excavation and improvement with limited embankment construction by use of materials from the channel excavation. The source is continuing authority given by Congress to the USACE. There is a total of \$7.5 million available nationwide per fiscal year under this authority. The federal funding limit per project is \$500,000.
USACE - Flood Plain Management Services Program	The Corps may provide flood plain information and planning assistance to state, county and city governments, and Native American nations as well as to other federal agencies. Flood and floodplain information also is provided to private citizens, corporations and groups. Funding for FPMS is obtained through appropriations for non-reimbursable FPMS items and through cost recovery for reimbursable services. Non-reimbursable items are funded with congressional appropriation through the USACE. Within personnel and funding capabilities, technical services and planning guidance shall be provided for state, regional or local governments, other non-federal public agencies and for Indian tribes without charge. Requests from federal agencies and private persons for services limited to “quick responses” (walk-in or telephone requests each of which require only 10 minutes or less of work by one person) may also be honored without charge; otherwise, technical services and planning guidance shall be provided to federal agencies and private persons on a 100-percent cost-recovery basis.
USACE- Emergency Streambank and Shoreline Protection	Authority for this action is Section 14 of the Flood Control Act of 1946, as amended. This program is designed to implement projects to protect public or not-for-profit public facilities and/or services that are open to all on equal terms, have been properly maintained but threatened by natural processes on stream banks and shorelines, and are essential and important enough to merit federal participation in their protection. A non-federal interest must be a public agency able to enter into an agreement in accordance with the requirements of Section 221 of the Flood Control Act of 1970. Section 221 specifies that the non-federal sponsor be a legally constituted public body with full authority and capability to perform the terms of its agreement and to pay damages, if necessary. There is a total of \$15 million available nationwide per fiscal year under this authority. The federal funding limit per project is \$1.5 million. Total project costs, including any planning and design costs in excess of \$100,000, are cost shared. The maximum non-federal contribution is 50 percent.

Federal Funding Opportunity	Description and Details
USACE- Flood Damage Reduction	Authority for this action is provided under Section 205 of the Flood Control Act of 1948, as amended. This program provides authority to plan, design and construct certain small flood-control projects in accordance with current policies and procedures, and that have not already been specifically authorized by Congress. Both structural (levees, channels or pumps, for instance) and non-structural (flood proofing or relocation of structures, for example) solutions to reduce damages caused by over-bank flooding are considered. A non-federal interest must be a public agency able to enter into an agreement in accordance with the requirements of Section 221 of the Flood Control Act of 1970. Section 221 specifies that the non-federal sponsor be a legally constituted public body with full authority and capability to perform the terms of its agreement and to pay damages, if necessary, in the event of failure to perform. There is a total of \$55 million available nationwide per fiscal year under this authority. The federal funding limit per project is \$7 million. The minimum non-federal share is 35 percent. The maximum non-federal contribution is 50 percent.
USACE- Environmental Restoration	Authority for this action is provided under Section 1135 of the Water Resources Development Act of 1986. The program provides authority for the USACE to review and modify the structures and operations of water-resources projects constructed by the Corps for the purpose of improving the quality of the environment when it is determined that such modifications are feasible, consistent with the authorized project purposes, and will improve the quality of the environment in the public interest. If it is determined that a Corps water-resources project has contributed to the degradation of the quality of the environment, restoration measures may be implemented at the project site or at other locations that have been affected by the construction or operation of the project if such measures do not conflict with the authorized project purposes. There is a total of \$40 million available nationwide per fiscal year under this authority. The federal funding limit per project is \$5 million. The non-federal share of the costs of Section 1135 modifications shall be 25 percent, and the first \$100,000 is paid 100-percent federal and any additional costs are shared 50/50 with the sponsor.
USDA Community Facility Loan Program	U.S. Department of Agriculture (USDA) Rural Development provides loans and loan guarantees to rural communities and municipalities of 20,000 population or less to assist them in developing public facilities that provide essential services to their residents. Facilities providing health care, public safety, transportation or cultural services, public buildings and improvements are examples of eligible projects. No match is required; joint funding of projects with state, local and private funds is encouraged. Public bodies, such as municipalities, county governments and special districts; Indian tribes and community-based, not-for-profit corporations are encouraged to apply. Pre-applications may be filed with the rural development office serving your area; applications may be filed year-round.
USDA Community Facility Grant Program	USDA Community Facility Grants can be used to assist low-income, rural areas and municipalities in developing essential public facilities for public bodies, not-for-profit corporations and Indian tribes and rural areas and municipalities with a population of less than 20,000. Funding is on a graduated scale, with larger percentages geared toward small and low-income communities. A maximum of 75 percent of project costs may be funded with this grant, depending on population and median household income of the community. Remaining costs may be funded with a rural development loan or matching funds from other sources. Pre-applications may be filed with the rural development office serving your area; applications may be filed year-round.

Federal Funding Opportunity	Description and Details
USDA/RD Business and Industry Loan Program	USDA – Rural Development provides direct and guaranteed loans. Loan purposes include but are not limited to: Business and industrial acquisitions when the loan will keep the business from closing, prevent the loss of employment opportunities, or provide expanded job opportunities; Business conversion, enlargement, repair, modernization, or development; Purchase and development of land, basements, rights-of-way, buildings, or facilities; Purchase of equipment, leasehold improvements, machinery, supplies, or inventory. Applicants can be a cooperative organization, corporation, partnership, or other legal entities organized and operated on a profit or non-profit basis; an Indian tribe on a Federal or State reservation or other Federally recognized tribal group; a public body; or an individual. The total amount of Agency loans to one borrower must not exceed \$10 million. Initial applications are accepted on a rolling basis. The maximum percentage of guarantee is 80% for loans of \$5 million or less, 70% for loans between \$5 and \$10 million, and 60% for loans exceeding \$10 million.
Rural Development Water and Waste Disposal Loan and Grant Program	The U.S. Department of Agriculture’s Rural Development Department provides long-term low-interest loans and grants, as well as loan guarantees, to rural communities and small municipalities of 10,000 or less people. These loans and grants may be used to help fund new, upgraded, renovated and expanded water-supply storage and distribution systems and waste-collection treatment and disposal systems, including wastewater, solid waste and storm drainage. Applications may be filed with the Rural Development office serving your area; applications may be filed year-round. No match is required; however, joint funding of projects with private funds is encouraged.
National Science Foundation - Science, Engineering, and Education for Sustainability Program NSF-Wide Investment (SEES)	This addresses the challenge of building a sustainable future through promoting research and education. Research efforts are to include global community sustainability, sustainable energy, modeling, vulnerability, resilience, sensitivity to regional change, and public engagement.
National Science Foundation - Division of Ocean Sciences	Funding opportunity on the subject of Physical Oceanography. In years past, this program has funded several climate change-focused research projects, including climate impacts on proglacial lake outbursts, the role of ice in large lake response to climate change, effects of lunar nodal tide on climate variability, and ocean data assimilation to research climate change. Applicants can include scientists, engineers, and educators representing universities and colleges, state and local governments, non-profit organizations, for-profit organizations, and individuals. NSF does not typically provide awards to federal agencies.
National Association of Counties Strengthening Coastal Communities Challenge	This association invites coastal counties from the Gulf of Mexico region with populations of less than 250,000 and the communities within and surrounding them to form multidisciplinary teams to apply for technical assistance. The technical assistance program will help communities identify ways to strengthen existing and implement new local plans and policies to increase resilience to extreme weather and climate-related hazards across the region.
National Oceanic and Atmospheric Administration Office for Coastal Management Coastal Resilience Grant	This competitive grant program funds projects that are helping coastal communities and ecosystems prepare for and recover from extreme weather events, climate hazards, and changing ocean conditions. All project proposals undergo a rigorous merit review and selection process by a panel of subject matter experts from across the United States that include representatives of government, academia, and private industry. Funding is typically available on an annual cycle.

Federal Funding Opportunity	Description and Details
Gulf of Mexico Alliance Gulf Star Funding	Gulf Star is a public-private partnership administered by the Gulf of Mexico Alliance, a 501c3 public charity with flexibility to collaborate with others in the Gulf region. Gulf Star partners are agencies, businesses, private organizations, and citizens that provide funding for projects that are tied directly to Gulf economies such as sustainable seafood, loss of critical habitats, coastal resilience, water resources, living marine resources, and monitoring. The goal of the Gulf Star program is to facilitate partnerships between the Gulf of Mexico Alliance and outside funders who wish to use their investments strategically to achieve measurable results around these priority issues that are common to all five states of the Gulf of Mexico region.

State Funding Opportunities

State Funding Opportunity	Description
Florida Department of Environmental Protection - Coastal Partnership Initiative	The Coastal Partnership Initiative was developed to promote the protection and effective management of Florida's coastal resources in four specific priority areas: Resilient Communities, Coastal Resource Stewardship, Access to Coastal Resources, & Working Waterfronts. Florida's 35 coastal counties and all municipalities within their boundaries that are required to include a coastal element in their comprehensive plan are eligible to apply. Florida's public colleges, universities, regional planning councils, national estuary programs and non-profit groups may also apply, provided that an eligible local government agrees to participate as a partner. Applications are accepted once a year in response to a "Notice of Availability of Funds" published in the Florida Administrative Weekly. The funding year typically begins July 1 and ends June 30; however, this timeframe may be shifted if the grant cycle is delayed or postponed. Projects are to be completed within one year, no matter when the funding cycle begins.
DEP Clean Water State Revolving Fund Loan Program	The Clean Water State Revolving Fund (CWSRF) program provides low interest loans for planning, designing, and constructing water pollution control facilities. The Department solicits information each year for wastewater and stormwater projects. The information is used to establish project priorities for the following annual cycle. Funds are made available for Preconstruction Loans and Construction Loans. The Loan Terms include a 20-year amortization and low-interest rates. Preconstruction loans are available to all communities and provide up front disbursements for administrative services, project planning and project design. Cities, counties, authorities, and special districts responsible for sewerage services, stormwater management, and estuary protection are eligible for loans. The local government agency must generally own, operate, and maintain the facilities to be financed by a loan.
DEP Drinking Water State Revolving Fund Program	The Drinking Water State Revolving Fund Program provides financial assistance for improvements to drinking water facilities. Projects receiving the top priority are those that address public health risk problems. Compliance projects, those necessary to bring a system into compliance with the Safe Drinking Water Act, also receive a favorable priority score. Other projects are also eligible to secure remaining funds. Approximately \$65 million annually. Submit "Request for Inclusion on a Priority List" form, which may be obtained from the grant program office. A facilities plan required; project must be environmentally sound. Plans and specifications are required; all necessary permits must be obtained.

State Funding Opportunity	Description
DEP Florida Beach Erosion Control Program	The Florida Beach Erosion Control Program was established for the purpose of working in concert with local, state and federal governmental sponsors to achieve the protection, preservation and restoration of the coastal sandy beach resources of the state. Eligible activities of this grant-in-aid program include beach restoration and nourishment activities, project design and engineering studies, environmental studies and monitoring, inlet management planning, inlet sand transfer, dune restoration and protection activities, dune walkover construction and other beach erosion prevention-related activities. All projects must be cost effective and compliant with the Florida Strategic Beach Management Plan. Up to 50 percent of the project costs for beach restoration projects and up to 75 percent for inlet management projects; other state grant-in-aid funds may not be used as a local match. The program requires submittal of funding request, including a long-range budget plan with supporting information for ranking as required by Rule 62B-36, Florida Administrative Code. Annual updates of budget plans are due September 1 of each year.
DEP Florida Greenways & Trails Program - Financial Assistance	The purpose of the Florida Greenways & Trails Acquisition Program is to acquire lands to facilitate the establishment of a statewide system of greenways and trails. A greenway is defined as (1) a linear open space established along either a natural corridor, such as a riverfront, stream, valley or ridge-line, or over land along a railroad right of way converted to recreational use, a canal, a scenic road or other route; (2) any natural or landscaped course for pedestrian or bicycle passage; (3) an open space connector linking parks, nature reserves, cultural features or historic sites with each other and populated areas; or (4) a local strip or linear park designated as a parkway or greenbelt. Trails are linear corridors and any adjacent support parcels on land or water providing public access for recreation or authorized alternative modes of transportation. Florida Greenways & Trails Program proposal applications must be submitted by the deadline published in the Florida Administrative Weekly. Federal, state and local governments; not-for-profit organizations and individual are encouraged to apply. The program receives 1.5 percent of the allocations funded by the state under the Florida Forever Act. Limited funds will be applied to projects on a current workplan. Prior to submittal of an application, applicants must apply for and receive a "Certificate of Eligibility." Applicants must meet the minimum requirements: the project must meet the definition of a greenway or trail; the planned project corridor must be located on the recreational prioritization maps; and there must be a seller willing to negotiate and a willing manager.
Florida Department of Environmental Protection Recreational Trails Program	The Recreational Trails Program (RTP) provides funds for projects that provide, renovate or maintain recreation trails. Project proposals may address motorized trails, non-motorized trails or mixed-use projects (motorized, non-motorized or both). RTP grant applications must be submitted during an announced RTP application submission period; applicants may submit only one application during the submission period. Applications must involve only one project site. Florida Department of Environmental Protection staff will conduct grant application workshops to provide guidance and answer questions regarding the program. A 50/50, 60/40 or 80/20 match is required. Municipal, county, state or federal government agencies approved by the state. Florida non-profit corporations are eligible to apply and receive funding to conduct projects on public lands.

State Funding Opportunity	Description
Florida Inland Navigation District (FIND) - Cooperative Assistance Program	Under the Florida Inland Navigation District's Cooperative Assistance Program, financial assistance is provided to federal, state and regional governments with waterway management responsibility in the district's 12 counties for the development and implementation of waterway-related improvement projects. Applications are due April 1. Funding is available as of October 1 of each year. All projects require a 50-percent match except some public navigation dredging, which may qualify for a lesser match. Federal, state and regional governments that have waterway access and improvement management responsibility within the district's boundaries (the East Coast of Florida from Nassau County to Miami-Dade County) are encouraged to apply.
FIND - Waterways Assistance Program	Under the Florida Inland Navigation District's Waterways Assistance Program, financial assistance is provided to municipalities and county governments within the district's 12 counties for the development and implementation of waterway-related improvement projects. Approximately \$10 million per year. Funding is available as of October 1 of each year. Applications are due April 1. All projects require a 50-percent match except some public navigation dredging, which may qualify for a lesser match. General purpose local governments (municipalities and county governments) located within the district's boundaries (the East Coast of Florida, from Nassau County to Miami-Dade County) are encouraged to apply.
Florida Fish and Wildlife Conservation Commission (FWC) - Florida Boating Improvement Program (FBIP)	FBIP provides funding through competitive grants for boating access projects and other boating-related activities on coastal and inland waters of Florida. Projects eligible for funding through FBIP include recreational channel marking and other uniform waterway marking; publicly owned boat ramps, piers, docks, lifts, boats, hoists, marine railways, and other public launching facilities; derelict vessel removal; boater education; economic development initiatives that promote boating; and other local boating-related activities. Dependent upon annual appropriation by the Legislature. No cash match is required. Some non-cash (in-kind) match required. Eligible program participants include county governments, municipalities and other governmental entities of the State of Florida.
FWC State Wildlife Grants	Often this grant has a climate change, sea level rise, or resilience initiative that allows for grant funding to support a efforts towards the initiative.
DEM Residential Construction Mitigation Program	Section 215.559, Florida Statutes, created the Hurricane Loss Mitigation Program, which funds the Residential Construction Mitigation Program (RCMP). Annually, the Legislature appropriates \$10 million from the Florida Hurricane Catastrophe Fund for different mitigation programs which is funded by insurance surcharges. Notice of Funding Availability (NOFA) is advertised in the Florida Administrative Weekly and all requests for proposals are issued via the www.myflorida.com Web portal. Application deadlines can also be found at www.floridadisaster.org/mitigation/rcmp/index.htm .
Southwest Florida Water Management District - Cooperative Funding Initiative	The Cooperative Funding Initiative (CFI) is a cost-share program that covers up to 50 percent of the cost of projects that help create sustainable water resources, enhance conservation efforts, restore natural systems and provide flood protection. All CFI funding decisions are made by volunteer Basin Board members who are well informed on the specific resources and challenges within their individual basins. Working with local governments and community partners allows the district to leverage its investment. Approximately \$25 million is available yearly. 50/50 cash cost share between the Basin Boards and the cooperator. (In-kind services not eligible as a match.)

State Funding Opportunity	Description
State of Florida Pollution Control Bond Program	This State of Florida Pollution Control Bond Program provides loans to local governments for construction of water, wastewater, solid waste, stormwater and air pollution control facilities. Proceeds from bonds sold by the state provide for up to \$300 million per year. Eligible entities must submit complete loan applications with plans and specs. Florida municipalities, county governments and special districts are encouraged to apply.
State Revolving Fund Loan Program for Wastewater Treatment	The State Revolving Fund (SRF) Loan Program for Wastewater Treatment provides low-interest loans to fund water pollution control activities and facilities. Eligible projects include publicly owned wastewater and stormwater treatment, collection, transmission, disposal and reclamation re-use facilities, as well as infiltration/inflow correction. In addition, the SRF can now fund agricultural stormwater runoff pollution control activities, brownfields associated with contamination of ground or surface waters, and estuary pollution control activities. Funded by annual federal and state match appropriation, plus repayments from previous loans, investment earnings and bond proceeds. Municipalities, county governments, special districts, authorities or agencies thereof with jurisdiction over collection, transmission, treatment or disposal of wastewater, industrial wastes or other wastes are eligible as well as districts or authorities with responsibility to provide airport, industrial or research park, or port facilities to the public. Non-governmental parties are eligible for loans to control stormwater pollution related to agricultural operations.

Non-Profit Funding Opportunities

Non-Profit Funding Opportunity	Description
The Trust for Public Land - Conservation Finance Program	A national, non-profit organization, TPL offers a variety of services to cities, including conservation real estate transactions and conservation finance. TPL's Conservation Finance Program helps local governments gauge public support for open space and craft ballot and legislative initiatives that can generate new sources of funding for conservation. Over the last eight years, TPL's Conservation Finance Program has worked on 303 successful state and local measures to create more than \$22 billion in new funding for land, conservation including 15 measures in Florida. Over the last 12 years, TPL's Conservation Finance Program has supported 294 local ballot measures that have created \$19.3 billion in land conservation funding. In Florida, TPL's Conservation Finance Program has assisted 18 local governments in creating more than \$1.3 billion in new funds for land conservation. There is no application deadline; contact TPL with requests, as needed. Local governments and citizen groups are encouraged to apply.
Southeast RCAP Financial Service	Southeast RCAP Financial Service, is a regional non-profit lender committed to helping rural communities with water, wastewater, and housing and economic development activities in DE, MD, VA, NC, SC, GA, and FL. Its loan fund offers interim funding up to \$500,000, with interest rates as low as 3%. The terms are flexible and can be tailored to meet the needs of rural communities. It also provides money to entities that are currently waiting to draw down on rural development money. In addition, Southeast RCAP Financial Service provides financial assistance to individual household members to reconstruct and refurbish their wells. This program allows a 1% loan up to \$11,000 for a term that is flexible from 10 to 20 years for the 7-state region. The maximum loan for individual household well loans is approximately \$11,000; loan amounts for water, wastewater, housing development activities and economic development loans is \$150,000. Loans cover 75 to 100 percent of total project costs, up to \$150,000. There is a 1-percent application fee and filing cost. Borrower must pay applicable attorney fees, which are usually around \$800. There are no deadlines. Applications are accepted year-round. Commitment letters are issued within 60 to 90 days of receipt of application. Local governments, public service authorities, user associations and not-for-profits are encouraged to apply.

Non-Profit Funding Opportunity	Description
The Wildlife Conservation Society's Climate Adaptation Fund	Funding for on-the-ground projects that focus on implementing conservation actions for a climate adaptation at a landscape scale. U.S.-based non-profit organizations with approved IRS 501(c)(3) status are encouraged to apply. Public agencies, tribal governments, and universities may partner with eligible non-profits to submit proposals. There is a 1:1 match ranging from \$50K to \$250K with a maximum of 50% match funding from in-kind sources.
The Doris Duke Charitable Foundation (DDCF)	DDCF's Environmental Program strives to meet four main strategies through grant awards: 1) enabling strategic wildlife habitat conservation in an era of climate change; 2) reducing impacts on the landscape from increased energy development and energy demand; 3) encouraging land stewardship and sustainability; 4) helping to build a clean-energy economy.
The Rockefeller Family Foundation (RFF)	RFF focuses on public education of the risks of global warming, conservation of natural resources, protection of health as affected by the environment, meaning implementation of environmental laws, and public participation in national environmental policy debates. Since 2006, RFF has focused its Environment program almost exclusively on climate change. The program emphasizes public education on the risks of global warming and implementation of sound solutions. RFF is interested in the development of initiatives designed to enact aggressive policies at the state and national levels to reduce carbon emissions; disrupt the coal life cycle from mining and burning to ash disposal and exporting; bring diverse and compelling new voices into the climate debate; and examine how special interests are distorting science and delaying constructive steps to deal with this impending global crisis. United States non-profit organizations engaged in activities of national significance are encouraged to apply.
The Kresge Foundation	This Foundation's Environmental program invests in projects that revolve around the following strategies: 1) building the field of climate change adaptation; 2) fostering development of place-based adaptation strategies; 3) informing and promoting climate-wise policies and practices. The foundation primarily accepts grants by invitation; however, preliminary applications can be submitted that includes background information about the proposal. 501(c)(3) organizations, government entities are encouraged to apply
Surdna Foundation	This foundation invests in projects that support their program areas of Sustainable Environments, Strong Local Economies, Thriving Cultures, Community Revitalization, and Effective Citizenry. An example of a previous grant award is \$200K to the American Planning Association to aid U.S. planners with initiatives to integrate energy sustainability and climate change in to contemporary planning practices. U.S. based non-profit organizations are encouraged to apply. There are no application deadlines. Grants are assessed three times a year (Feb, May, and Sept), and must be submitted three to four months prior to staff review.
Alfred P. Sloan Foundation	This foundation offers grant assistance in 6 major program areas. Two such areas are the "Public Understanding of Science," and the "Basic Research" areas. Through these programs, the foundation offers grants for high-quality, original STEM (science, technology, engineering, and math) research that benefits the scientific community, as well as increases the public understanding of relevant and complex scientific issues. The Public Understanding of Science program promotes using books, television, radio, film, theatre, and other media in order to engage the public in science and technology. No application deadlines. The foundation makes grants year-round.

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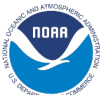
6.4. Example Adaptation Plan

Florida Community Resiliency Initiative Pilot Project

Adaptation Plan for St. Augustine, Florida

May 2017

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EXECUTIVE SUMMARY

Florida communities like St. Augustine are already experiencing the adverse impacts of rising seas, more intense storms, and heavier downpours. The Florida Department of Economic Opportunity's Coastal Resiliency Initiative aims to provide St. Augustine and two other pilot communities with:

- Thorough and robust technical information about the threats they face as sea levels rise and rainfall and storm patterns intensify;
- A clear understanding of the legal context in which they must operate when adapting to those threats;
- Information about the policy and legal tools available to local governments interested in pursuing an adaptation agenda;
- Suggestions about particular options available to each community to pursue adaptation efforts while also continuing to work toward other goals.

This report is intended to complement Dewberry's Vulnerability Assessment and to provide St. Augustine with a law and policy framework for pursuing coastal resiliency. The Vulnerability Assessment draws on data from federal agencies and on inputs from St. Augustine officials and community members in order to characterize the nature, implications, and certainty of the most important ways in which St. Augustine is vulnerable to the impacts of sea level rise (SLR) and changing weather patterns. The present document identifies relevant legal and policy-making tools available to Florida localities that might serve to effectuate appropriate responses to those vulnerabilities. It also identifies legal, political, economic, and other limits on St. Augustine's potential resiliency initiatives.

Information contained in the Adaptation Plan

Reference material. On October 17, 2016 the Sabin Center for Climate Change Law, Dewberry and state and local partners convened a Preliminary Workshop to introduce and discuss development of a Strategic Resiliency Plan. Some of the information covered in this document may be familiar to participants in that workshop, but has been included to provide a resource that officials and others can draw on as a reference point. For instance, the Preliminary Workshop introduced the Protection-Accommodation-Retreat adaptation rubric and a number of land use policy tools (including setbacks, transferrable development rights and conservation easements) suitable for coastal localities that want to adapt themselves to rising seas. However, many residents of St. Augustine and at least some political representatives are likely unfamiliar with this material. Accordingly, we have referenced herein a robust universe of material, including material relevant to prioritizing particular resiliency measures. So that users of this report can get easy access to the documents referenced in its footnotes, including those that might sit behind paywalls, those documents have been stored using permanent internet hyperlinks.

St. Augustine, Fla.

Adaptation Plan | ES-1

Summaries of key vulnerabilities. Dewberry's Vulnerability Assessment provides an accessible, authoritative snapshot of the challenges facing St. Augustine now and in the foreseeable future. This document's short summaries of key vulnerabilities draw on that Assessment and on comments made during the Preliminary Workshop. Readers can refer the adaptation measures discussed in section 4 of this document directly to Dewberry's Assessment, but section 2's summaries make internal cross references available as well.

Critical circumstances unique to St. Augustine. Discussion at the Preliminary Workshop brought to light aspects of St. Augustine's situation that are critically important to prospective adaptation efforts. The most salient of these features, which section 3 discusses at greater length, are as follows:

- St. Augustine's historic districts are vulnerable, immovable, and irreplaceable;
- Foreseeable SLR conditions are at odds with state-determined design parameters for local roads and bridges;
- Despite dire SLR predictions, routine nuisance flooding, and the recent experience of storm surge with Hurricane Matthew, the revised Flood Insurance Rate Maps (FIRMs) proposed by the Federal Emergency Management Agency (FEMA) would not change the City's designate floodplain or base flood elevations (BFEs);
- Many residents seem not to know what's coming.

Potential responses to key vulnerabilities. Much of this document describes important parts of the context in which adaptation efforts would occur. Section 4 discusses adaptation measures that could serve adaptation efforts in St. Augustine.

Legal reference material. This document does not contain legal advice for St. Augustine. Its descriptions of legal issues (located in Appendix A) such as sovereign immunity and takings law do not tell a lawyer for the City everything they would need to know in order to anticipate the legal implications of a particular policy agenda. Descriptions of legal issues instead provide a summary—for lawyers and non-lawyers—of how the law might push, tether, or prohibit particular parties in relation to various rights and obligations implicated in actions intended to better adapt to changing environmental circumstances.

Suggestions for Adaptation in St. Augustine

The following list summarizes proposals set forth in this report and notes the section(s) that discuss a particular proposal more fully. The first two proposals are overarching and meant to inform the way not just one but multiple adaptation measures are developed and implemented. The remaining proposals focus on policy tools or vehicles that can be applied to various vulnerabilities and on particular problems or decisions facing the City.

The two overarching proposals are as follows:

- *Educate the public, and business- and property-owners in particular, about what SLR impacts and policy responses to expect in the foreseeable future*

This suggestion appears in multiple places throughout this document because no single adaptation agenda item is more important for St. Augustine than conveying to stakeholders how rising seas and changing weather are expected to affect the City. In many instances, this education will occur by requiring private parties to give or take notice of known risks, for instance by requiring disclosure in real estate transactions of the frequency and height of all types of flooding that affect the property, or by a survey of the capacity and state of repair of existing coastal armoring. In other instances, it might accompany revisions to the Future Land Use comprehensive plan element or announced changes to infrastructure location or capacity. Sections 3 and 4, and Appendix A, discuss various approaches to informing stakeholders about risks and responses.

- *Develop baselines so that budgets reflect expected future costs*

Preliminary Workshop participants made clear that the City's current approach to budgeting does not capture in an easily discernible fashion the costs imposed by nuisance flooding or other SLR-driven impacts. Discerning what it costs the City to deal with such impacts could greatly improve St. Augustine's ability to anticipate future costs, which in turn will help inform when to consider planning, land use, or design changes because "business as usual" is likely to become prohibitively expensive. Sections 4.1 (Priority-Setting), 4.3.2 (Stormwater and wastewater management), 4.3.3 (Roads and bridges), and A.2.2 (Takings) discuss different ways to apply this suggestion.

Section 4.2 discusses the following three types of policy vehicles:

- *Pre-disaster planning for post-disaster policy changes (section 4.2.1)*

Disasters highlight topography, systems, and structures that are vulnerable. Thus, in addition to causing damage, disasters also convey information. Ordinances and comprehensive plan elements can make use of that information by making the occurrence of a disaster a trigger for changes to land use restrictions or levels of service for vulnerable infrastructure segments. Such changes might include: increased setback requirements; only granting permits for coastal redevelopment if the property owner eliminates hard armoring or covenants to abandon the property in part or *en toto* after next storm; or requiring that the restoration of an infrastructure segment must be preceded by a review of the cost effectiveness of maintaining it using its current design parameters. St. Augustine could also make use of disaster planning for two additional purposes:

- to educate—and gather information from—the public about gaps in preparedness relative to expected future flooding and storm impacts;

- and to make adaptation measures and initiatives compatible with the criteria used by the Federal Emergency Management Agency (FEMA) when allocating grant funding for disaster mitigation programs.

- *Making level of service or capital spending contingent (section 4.1.2)*

St. Augustine is experiencing several instances where routine nuisance flooding might lead to the City to curtail maintenance or even abandon roads and bridges. St. Augustine should consider adopting policies that limit spending in instances where retreat or redesign would be more cost-effective than reconstruction or hard armoring. The same can be said for planned capital investments.

- *Designate Adaptation Action Areas or AAAs (section 4.2.4 and Appendix A)*

An AAA is a highly flexible form of zoning overlay that the Florida legislature devised expressly for the purpose of facilitating local adaptation planning in the face of the impacts of SLR. Within the boundary of an AAA, St. Augustine could employ one or more policies that are distinct from what governs other parts of the City. And, because Florida law leaves it to localities to devise criteria for designating AAAs, St. Augustine would have the option not only to choose where to draw the AAA's boundary but whether to do so in a way *that is expressly subject to change as environmental circumstances change*. Such an approach can send a powerful signal about future conditions and regulatory responses to those conditions.

Section 4.3 proposes the following more specific adaptation measures:

- *Act now to address the revision to the City's Flood Insurance Rate Maps (FIRMs) (section 4.3.1)*

FEMA's updated FIRMs for St. Augustine are slated to become effective in June. The City should consider two responses to that change. First, it should inquire whether FEMA would consider delaying and reevaluating the preliminary map segments covering St. Augustine, perhaps by including Hurricane Matthew in the storm set from which FEMA derives some of its flood elevations. Second, if FEMA indicates that it is too late to reevaluate its preliminary map, the City should consider imposing some form of supplementary designation, such as an AAA, in locations where the FEMA floodplain will shrink upon the preliminary maps becoming effective and possibly also in other locations where flooding is expected to occur in the foreseeable future but which are beyond the FEMA-designated floodplain.

- *Install more Low Impact Development / Green Infrastructure on public property and encourage its installation on private property (section 4.3.2)*

St. Augustine's stormwater management system is caught in a pincer: SLR on one side and increasingly frequent and intense rainfall on the other. Adding to the City's

complement of Low Impact Development / Green Infrastructure would help take pressure off of that system. The City can do this directly by replacing impervious surfaces on public property, and indirectly by providing information and support to private property owners. Reducing stormwater utility fees for property owners who reduce the impervious cover on their property is one way to provide such support.

- *Make targeted upgrades to the stormwater management system (section 4.3.2)*

St. Augustine should move ahead with plans to make its stormwater management system more robust to higher sea levels. However, it should take a systematic approach as it decides how much to spend and where. That is, the City should not invest in expensive forms of SLR accommodation whose value is likely to be undermined quickly if a high-SLR scenario materializes.

- *Clarify the City's options for wastewater management now to better inform the hard choices ahead*

The wastewater treatment plan (WWTP) in St. Augustine is already vulnerable to flooding, and that vulnerability is expected to increase. Because of the WWTP's indispensable role in the City, and because of the expense of *any* adaptation measures that would seek to make it less vulnerable to flooding, it is important that St. Augustine grapple with its options for the WWTP sooner rather than later. The charrette proposal described in section 4.3.2 would engage the public in the process of clarifying and evaluating the City's options, and would thereby also lay the groundwork for whatever difficult decisions follow.

- *Direct queries and suggestions to the Florida Department of Transportation about adapting roads and bridges maintained by the state (section 4.3.3)*

Several of St. Augustine's arterial roads and major bridges are under the control of the Florida Department of Transportation (FDOT). Several of those road and bridge segments are also vulnerable to flooding. As the City develops its adaptation agenda, it should keep FDOT informed about plans for local adaptation measures affecting or affected by road and bridge design and maintenance decisions, particularly if local plans would be reinforced—or undermined—by FDOT's present approach.

- *Ensure that decisions about vulnerable road and bridge segments are cost-effective (section 4.3.3)*

Recognizing that the costs imposed on road and bridge upkeep by flooding of all sorts will continue to mount, St. Augustine should make cost-effectiveness a basic criterion for future road and bridge designs, levels of service determinations, and maintenance schedules. At the outset, this might involve employing a budgeting baseline like the one discussed above, but it should eventually involve more formal measures, such as revision

to the comprehensive plan transportation element (section 4.2.3) or an express statement via ordinance that some road and bridge segments' level of service will be contingent on their relative costs remaining close to the City-wide average.

- *Modify the Historic Preservation comprehensive plan element to better allow for the decisions ahead (section 4.3.4)*

The City's Historic Preservation element does not contemplate that changing environmental circumstances will be a source of pressure on the integrity of historic buildings and districts. The element should be revised through an organized decision-making process that will ensure that the allocation of resources toward preservation is consistent with public priorities and good technical practice.

Note on Exclusions

This document does not contain instructions for St. Augustine about how to respond to its changing environmental circumstances. It does not contain an exhaustive list of adaptation options, or a map of the legal issues the City might encounter if it opts for one approach instead of another. Instead, it contains information about the challenges that St. Augustine already faces and can expect to face as sea level rises, information about approaches other localities have taken to similar challenges, and proposals and measures—all of which would need to be fleshed out and refined before they could be considered for implementation by one or more of the City's departments.

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Introduction: Sea Level Rise in Florida and the Coastal Resiliency Initiative

Florida communities are experiencing adverse effects of sea level rise (SLR), stronger coastal storms, and more intense precipitation events,¹ and these effects are expected to become increasingly severe in the coming years and decades.² Seeing what is happening now and recognizing what lies ahead, a number of Florida communities have begun working to adapt to present and projected impacts.³ Although Florida communities have taken somewhat diverse approaches to adaptation, their efforts have generally aligned with the approach suggested in the National Oceanic and Atmospheric Administration's U.S. Climate Toolkit: 1) identify climate-related changes and risks, 2) assess vulnerabilities, 3) investigate possible responses, 4) prioritize responses to achieve near- and longer-term adaptation goals, and 5) execute and evaluate outcomes.⁴

The Florida Department of Economic Opportunity (DEO) is leading the pilot phase of the Community Resiliency Initiative in partnership with the Florida Department of Environmental Protection and with support from the Division of Emergency Management and the National Oceanic and Atmospheric Administration. The Initiative provides technical assistance to coastal communities in Florida that want to integrate effective adaptation and improved resiliency into their plans for development in the midst of SLR. By inviting localities to take the lead, the Initiative ensures that the efforts it supports are consistent with local circumstances and priorities regarding public safety, the economy, natural resources, and others.

St. Augustine is one of three localities participating in the Community Resiliency Initiative pilot, which entails tasks that correspond to the second and third steps of the Climate Toolkit approach to adaptation listed above. Concretely, the Initiative will provide St. Augustine with a Coastal Vulnerability Assessment and this Adaptation Plan. During Phase 1 of the Initiative, Dewberry, Inc. developed the Coastal Vulnerability Assessment in collaboration with local

¹ L.M. Carter et al., *Ch. 17: Southeast and the Caribbean*, in *Climate Change Impacts in the United States: The Third National Climate Assessment* 396, 400–05 (J.M. Melillo et al., eds., 2014), <https://perma.cc/8AG2-7ASJ>; Florida Oceans and Coastal Council, *Climate Change and Sea-Level Rise in Florida: An Update of "The Effects of Climate Change on Florida's Ocean and Coastal Resources."* [2009 Report] (2010), <https://perma.cc/44Q3-EUMJ> (discussing effects of SLR on coastal ecosystems and infrastructure).

² U.S. Global Change Research Program, Chapter 1: Overview and Report Findings, in *Climate Change Impacts in the United States: The Third National Climate Assessment* 8 (Jerry M. Melillo, Terese (T.C.) Richmond, and Gary W. Yohe eds., 2014), <https://perma.cc/6S2L-66DV>.

³ See, e.g., Kathryn Frank et al., *Planning for Sea Level Rise in the Matanzas Basin: Opportunities for Adaptation* (Aug. 2015), <https://perma.cc/X593-XYNX>; James W. Beever III et al., *Southwest Florida Regional Planning Council, Lee County Climate Change Resiliency Strategy* (Oct. 6, 2010), <https://perma.cc/B5XT-EBGZ>.

⁴ U.S. Climate Resilience Toolkit, *Overview: Steps to Resilience*, <https://perma.cc/PAA4-3BMP> (last updated Nov. 16, 2016); see also Katherine Jacobs, Tom Wilbanks, et al., *National Academies of Sciences, Adapting to the Impacts of Climate Change* 135 fig. 4.1 (2010) (suggesting similar process), <https://perma.cc/D3DX-G3RR>. The Centers for Disease Control and Prevention (CDC) has developed a similar framework for improving community resilience. See Centers for Disease Control and Prevention, *CDC's Building Resilience Against Climate Effects (BRACE) Framework*, <https://perma.cc/E6PG-538W>, (last updated Oct. 22, 2015).

stakeholders. The Assessment integrates multiple layers of mapping information—topography, facilities and infrastructure locations, weather and flooding patterns, and SLR projections for the coming decades—and reflects stakeholders' input regarding the location and nature of local vulnerabilities.⁵ Faculty and staff at Columbia Law School's Sabin Center for Climate Change Law and Professor Keith Rizzardi of the St. Thomas School of Law developed this Adaptation Plan using Dewberry's Coastal Vulnerability Assessment and based on the input gathered from stakeholders in a Preliminary Workshop on October 24, 2016. Whereas Dewberry's consultation with stakeholders clarified the location and nature of particular vulnerabilities, the Preliminary Workshop put those vulnerabilities into a policy and legal context and began to identify potential responses.

This Introduction has noted the programmatic context for St. Augustine's adaptation efforts. The rest of this Adaptation Plan proceeds in four sections. Section 1 summarizes the generic adaptation framework and goals that are basic to this Plan. Section 2 reviews the vulnerabilities that Dewberry identified and that Preliminary Workshop participants discussed in more detail. Section 3 discusses local and regional circumstances relevant to both vulnerabilities and potential responses, with a particular focus on coastal development and the impacts of nuisance flooding on the management of stormwater, roads, and bridges. Section 4 discusses priority-setting and potential responses to local vulnerabilities. In addition to these sections, Appendix A describes the relevant legal context, covering not only materials that were presented to stakeholders at the Preliminary Workshop but also additional information about requirements and limits for local action in support of adaptation.

1. Conceptual Framework for Adaptation

This section introduces general answers to several key questions: What does adaptation to SLR involve? What does it aim to achieve? What policy tools are available to pursue those aims? What measures should take priority over others?

1.1. What does adaptation to SLR involve?

Answers to the first question sometimes use different terminology, but consistently describe the same basic measures for coastal communities confronting SLR:

- **protecting** current land uses and activities in vulnerable areas;
- **accommodating** SLR by modifying current uses and activities to reduce vulnerabilities;
- **retreating** from places vulnerable to SLR; or

⁵ Dewberry's Coastal Vulnerability Assessment based its projections of SLR on those issued by NOAA in 2012 and the Army Corps of Engineers in 2015. St. Augustine Vulnerability Assessment at 9; see also Adam Parris et al., NOAA, *Global Sea Level Rise Scenarios for the United States National Climate Assessment*: NOAA Tech Memo OAR CPO-1 (Dec. 2012), U.S. Army Corps of Engineers, *Climate Change Adaptation: Sea-Level Change Curve Calculator* (2015.46).

- **avoiding** development in locations where structures or people would be vulnerable.⁶

Protecting part of a coastline means interposing barriers between rising seas and landward infrastructure, assets, and people with the goal of preventing SLR from disrupting or otherwise forcing changes to existing landward patterns of economic and other activity. This category of adaptation measures uses “hard armoring,” such as sea walls or revetments (see Figure 1 below), and “soft armoring,” such as beach renourishment or living shorelines. Although hard armoring measures can give the impression of preserving a given shoreline segment permanently and cheaply, such measures tend to displace wave action rather than abating it, causing the waves’ force to carve away—“scour”—the soils or sands adjacent to or seaward of the armored area, while also preventing natural erosion processes from replacing what is scoured away.⁷ This tends to create expensive problems over time.

Figure 1. Revetment in Santa Cruz, California (note the absence of a sand beach).⁸



⁶ South Florida Regional Planning Council, *Adaptation Action Areas: A Planning Guidebook for Florida's Local Governments Regional Climate Action Framework: Implementation Guide 50–62* (2015), <https://perma.cc/2H39-7WUC>; John R. Nolon, *Protecting the Environment Through Land Use Law: Standing Ground 221* (2014).

⁷ South Florida Regional Planning Council, *Adaptation Action Areas: Policy Options for Adaptive Planning for Rising Sea Levels 17–18* (Nov. 2013), <https://perma.cc/U2NZ-1ZMG> (“Many studies report that hard armoring does more damage in because flooding and erosion on neighboring properties can be exacerbated and natural resources such as beaches and wetlands can be damaged or stunted from migrating naturally”); Molly Loughney Melius et al., *2015 California Coastal Armoring Report: Managing Coastal Armoring and Climate Change Adaptation in the 21st Century 8–11*, (2015) <https://perma.cc/9AQA-4EXH> (describing adverse effects of hard armoring).

⁸ Gary B. Griggs, *The Effects of Armoring Shorelines—The California Experience*, in *Puget Sound Shorelines and the Impacts of Armoring—Proceedings of a State of the Science Workshop*, May 2009 (Hugh Shipman et al., eds. 2010), <https://perma.cc/FN54-7425>.

Soft armoring, sometimes also called “natural infrastructure,” is generally favored by scientists, planners, and civil engineers relative to hard armoring, but is usually feasible only where development (i.e., asphalt, concrete foundations, structures, and infrastructure) can be displaced or has not encroached too close to the water’s edge.⁹

Accommodation means changing how land in the path of SLR is used so that the assets and people engaged in or reliant on those uses are made less vulnerable. Examples of physical accommodation include elevating buildings, moving mechanicals to upper floors or rooftops, up-rating machinery and infrastructure to endure inundation by saltwater, and retrofitting stormwater management systems with one-way valves that allow stormwater to drain into the ocean but prevent seawater from flowing to low-lying City streets (see Figures 2 and 3, below).

Figure 2. Building floodproofing options for different FEMA-designated zones.¹⁰

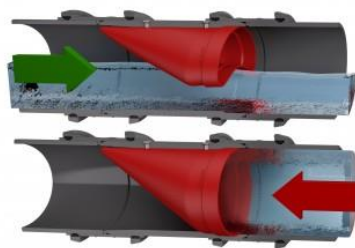
FLOOD PROTECTION STRATEGY	A ZONE		V ZONE
	DRY FLOODPROOFING WATERTIGHT STRUCTURE e.g. FLOOD SHIELDS	WET FLOODPROOFING WATER TO RUN-IN / RUN-OUT e.g. FLOOD VENTS	ELEVATED STRUCTURE VIRTUALLY OPEN STRUCTURE e.g. OPEN LATTICE
GROUND FLOOR CONFIGURATION	FLOOD SHIELDS PREVENT WATER FROM ENTERING	1 INCH OF NET OPEN AREA PER 1 SQ. FT. OF ENCLOSED AREA	OPEN STRUCTURE
	NON-RESIDENTIAL SPACE	1" MAX	VERTICAL FOUNDATION MEMBER
PERMITTED USE BELOW DFE	LOWEST OCCUPIED FLOOR ALLOWED TO BE EXCAVATED BELOW GRADE NOT PERMITTED FOR ENTIRELY RESIDENTIAL BUILDINGS	LOWEST OCCUPIED FLOOR TO BE AT OR ABOVE DESIGN FLOOD ELEVATION	BOTTOM OF LOWEST STRUCTURAL MEMBER TO BE AT OR ABOVE DESIGN FLOOD ELEVATION
	✓ PARKING ✓ ACCESS ✓ STORAGE ✓ NON-RESIDENTIAL ✗ RESIDENTIAL	✓ PARKING ✓ ACCESS ✓ STORAGE ✗ NON-RESIDENTIAL ✗ RESIDENTIAL	✓ PARKING ✓ ACCESS ✓ STORAGE ✗ NON-RESIDENTIAL ✗ RESIDENTIAL

“BFE” indicates base flood elevation; “DFE” indicates design flood elevation, which is BFE plus freeboard requirements designated for particular areas and building types.

⁹ Robert Verchick & Joel Scheraga, *Protecting the Coast, in The Law of Adaptation to Climate Change: United States and International Aspects 18–19* (Michael B. Gerard and Katrina Kuh, eds., 2012).

¹⁰ See, e.g., City of New York Department of City Planning, *Coastal Climate Resilience: Designing for Flood Risk 16–17* (June 2013), <https://perma.cc/7VWS-BLFL>.

Figure 3. Diagram of tidal backflow prevention insert.



Flexible insert gives way to water flowing from one direction but blocks water flowing from the other.

Accommodation also encompasses changes not just to physical structures but to systems and information—such as revised emergency planning protocols or mandatory notices in real estate transactions for vulnerable properties—and patterns of use—such as shifting commuter car traffic away from a coastal route to a more landward one.

Partial or full retreat involves abandoning land made vulnerable by rising seas and is appropriate in situations where SLR makes continued use and maintenance of existing structures—even in modified form—prohibitively costly. Retreat is conceptually simple, but establishing criteria and implementing decisions to retreat is nearly always complex and politically difficult.¹¹ In particular, efforts to undertake retreat often raise contentious questions about ownership, value, and liability in relation to assets that are to be moved, demolished, or left behind. Even more fundamentally, retreat tends to strain community cohesion and residents' shared sense of place.

Retreat necessarily involves avoiding new development in the area being abandoned to rising seas. Whether such avoidance follows retreat or precedes any effort to develop a vulnerable area in the first place, it entails a prohibition on development. Thus while the result of this strategy is avoiding new vulnerabilities, it can usefully be thought of as a prohibition on imprudent development.¹²

¹¹ See C. Kousky, *Managing shoreline retreat: a US perspective*, 124 *Climatic Change* 9, 9 (2014), <https://perma.cc/5MY2-NVP3> ("Retreat could be left to the market . . . however, the market is unlikely to lead to optimal levels or types of retreat in all locations.").

¹² *Id.* ("realistically, the actual choice may be allowing development to occur and persist past the optimal time or at a greater intensity versus preventing it altogether.").

In rare instances, a community might adopt measures that fit squarely and exclusively into just one of the foregoing four adaptation categories. The Quinault Tribe of Washington State, for instance, is not repairing the sea wall that is losing the battle to protect its village of Taholah from the encroaching Pacific Ocean.¹³ Instead, the tribe is simply retreating. That is, they are moving the whole village, which is home to about 700 people, to higher ground.¹⁴ But their case is exceptional; more often, coastal communities looking to adapt will make use of all four of the foregoing types of measures in combination.

1.2. What does adaptation aim to achieve?

Using some combination of the approaches described above, coastal communities vulnerable to SLR generally pursue one or more—or all—of the following five goals:

- make infrastructure and the built environment robust to expected changes;
- make systems—physical or organizational—that are vulnerable to SLR more flexible by altering and/or moving their components;
- enhance the ability of natural systems to reduce vulnerabilities;
- identify maladaptations and begin undoing them; and
- inform the public about the short- and long-term risks that SLR will create.¹⁵

Some of these goals obviously complement each other: for instance, making built systems more flexible can involve enhancing neighboring natural systems' capacity for resilience. However, some of these goals can potentially conflict: for instance, making infrastructure robust to change can mean reinforcing rather than undoing maladaptations. Just as conflicting adaptation measures make each other less cost-effective, ensuring that adaptation efforts are mutually supportive is a means of avoiding unnecessary expense.¹⁶

1.3. What policy tools are available to pursue these aims?

In the Preliminary Workshop conducted on October 24, 2016, we reviewed various policy tools available to localities seeking to adapt to SLR:

- Transferable Development Rights;
- Incentives;
- Setbacks and Buffers;
- Rebuilding Restrictions;
- Stormwater Utility;
- Special Assessments; (continued on p.7)

¹³ NOAA, U.S. Climate Resilience Toolkit, *Case Studies: Quinault Indian Nation Plans for Village Relocation*, <https://perma.cc/3PC4-79B3> (last updated Dec. 2, 2016).

¹⁴ *Id.*

¹⁵ Richard J.T. Klein & Richard S.J. Tol, *Adaptation to Climate Change: Options and Technologies*, An Overview Paper, United Nations Framework Convention on Climate Change Secretariat, FCCC/TP/1997/3, at 6 (Oct. 1997), <https://perma.cc/N52P-7EM6>.

¹⁶ See National Academies of Sciences, *supra* note 4, at 135 fig. 4.1 (noting importance of identifying opportunities for synergies and co-benefits across sectors).

- Building Codes and Design;
- Floodplain Regulations;
- Zoning and Overlay Zones;
- Hard- and Soft-Armoring Permits;
- Conditional Development;
- Impact Fees;
- Conservation Easements;
- Real Estate Disclosures;
- Coastal Land Acquisition Programs; and,
- Land Trusts.

The South Florida Regional Planning Council’s *Adaptation Action Areas Planning Guidebook*, and *Policy Options for Adaptive Planning For Rising Sea Levels*, both of which are available online,¹⁷ describe each of these tools. For example, whereas a conventional setback simply demarcates the line beyond which private property owners may not develop their property, a tiered setback restricts particular types development based on risk: bigger and less resilient structures must be set back farther than smaller and more resilient ones.¹⁸ A tiered approach to setback can be combined with use of annual erosion lines to demarcate where each tier begins.¹⁹ Georgetown Climate Center’s 2011 Adaptation Toolkit also provides a helpful set of summaries and more thorough descriptions of how each of these tools can be applied to the task of adapting to SLR.²⁰

In addition to describing these tools and noting examples of their use in particular localities (e.g., transferrable development rights in Monroe County, an overlay zone in Yankeetown, a stormwater utility in Bay County), the *AAA Planning Guidebook* also provides two tables that align each tool with a particular “management category” (for instance, “setbacks and buffers” align with shoreline conservation and also with stormwater management).²¹ As these tables show, a given tool can be useful for more than one category of infrastructure management or adaptation.

A further type of policy tool relates not to land use restrictions but to the level of service provided to residents and businesses by segments of infrastructure networks, such as roads and the wastewater management system. If erosion or flooding impacts incidental to SLR are making maintenance of a segment of infrastructure prohibitively expensive, a locality can decide to downgrade the level of service it will provide to those who might rely on that segment. A locality can also signal years or even decades in advance that it anticipates making such a downgrade. It can do so using an ordinance and/or an amendment to its planning documents (discussed in Appendix A: Legal Context). In the aftermath of a case disputing the adequacy of maintenance

¹⁷ Adaptation Action Areas Guidebook, *supra* note 6, at 50–62, <https://perma.cc/2H39-7WUC>; Policy Options for Adapting Planning, *supra* note 7, at 12–26, <https://perma.cc/U2NZ-TZMG>.

¹⁸ *Id.* at 54.

¹⁹ *Id.*

²⁰ Jessica Grannis, Georgetown Climate Center, Adaptation Tool Kit: Sea-Level Rise and Coastal Land Use How Governments Can Use Land-Use Practices to Adapt to Sea-Level Rise 2–4, 19–62 (Oct. 2011), <https://perma.cc/L4KJ-PM6E>.

²¹ Adaptation Action Areas Guidebook, *supra* note 6, at 62, 132.

of a road segment north of St. Augustine in St. Johns County, a group of Florida attorneys expert in adaptation and land use drafted a model ordinance that localities seeking to downgrade the level of service for a particular road segment—but also to avoid litigation—could adopt.²² That model ordinance creates a special category for the purpose: “any road categorized as ‘environmentally compromised’ under this ordinance shall be the subject of a requested design/maintenance exception.”²³ It provides thorough definitions of key terms, such as “environmentally challenging location” and “environmentally compromised local road segment,” which support decisions to reduce a given road segment’s level of service based on the cost of its upkeep relative to that of other local road segments. By making the *relative* cost of upkeep (rather than simple dollar-amounts) the threshold for level of service reduction, the approach taken by the model ordinance creates flexibility for a local government confronted with both budget constraints and multiple acute adaptation issues.

1.4. What measures should take priority over others?

Translating adaptation goals and tools into a plan for action means making a series of decisions, first about what the community wants, then about how much the community is willing to spend, and finally about how and when to allocate that spending among competing priorities. In practical terms, the last of these means deciding both what measures would be most cost-effective and the order in which they should be undertaken. The South Florida Regional Planning Council, recognizing that social, political, and economic factors—as well as technical ones—are highly relevant to the process of setting adaptation priorities, recommends use of the STAPLEE framework for decision-making.²⁴ STAPLEE is intended to help organize a process that takes all of the following considerations into account:

- Social - The action should be socially acceptable.
- Technical - The action should be technically feasible, help to reduce losses in the long term, and have minimal cumulative and secondary impacts.
- Administrative - The action should be implementable by the state or local government.
- Political - The action should be politically acceptable.
- Legal - The state or local government must have the legal authority to implement/enforce the action.
- Economic - The action should be cost-effective and be likely to pass a benefit-cost analysis.

²² Thomas Ruppert et al., Environmentally Compromised Road Segments—A Model Ordinance, <https://perma.cc/3RLM-DY7K> (last visited Jan. 6, 2017).

²³ *Id.* at para. 1.

²⁴ Adaptation Action Areas Guidebook, *supra* note 6, at 63; see also NOAA, Adapting to Climate Change: A Planning Guide for State Coastal Managers 52–53 (2010), <https://perma.cc/E4M2-M6Y7>; FEMA, Developing the Mitigation Plan: Identifying Actions and Implementing Strategies (2003), <https://perma.cc/56PU-K5CS> (listing STAPLEE factors in detail).

- Environmental - The action should meet statutory considerations and public desire for sustainable and environmentally healthy communities.²⁵

The Georgetown Climate Center's Adaptation Tool Kit provides a summary illustration (see Figure 4 below) of how a version of the STAPLEE framework can be used to evaluate applications of the tools listed above:

Figure 4. SLR Policy Tools and Criteria for Decision-making.²⁶

Potential Responses	Evaluation Criteria			Governance Criteria	
	Economic	Environmental	Social	Administrative	Legal
PLANNING TOOLS					
1. Comprehensive Plans*	*	*	*	*	*
REGULATORY TOOLS					
2. Zoning and Overlay Zones*	*	*	*	*	*
3. Floodplain Regulations*	*	*	*	*	*
4. Building Codes and Resilient Design	~	~	~	~	+
5. Setbacks/Buffers	~	+	~	~	~
6. Conditional Development and Exactions	~	+	+	~	~
7. Rebuilding Restrictions	~	+	~	~	~
8. Subdivisions and Cluster Development	+	+	~	~	+
9. Hard-Armoring Permits	!	!	~	~	~
10. Soft-Armoring Permits	~	~	~	~	~
11. Rolling Coastal Management / Rolling Easement Statutes	~	+	~	~	!
SPENDING TOOLS					
12. Capital Improvement Programs	~	+	~	~	~
13. Acquisitions and Buyout Programs	!	+	~	~	+
14. Conservation Easements	+	+	+	~	~
15. Rolling Conservation Easements	~	~	+	!	!
TAX AND MARKET-BASED TOOLS					
16. Tax and Other Development Incentives	~	+	+	~	~
17. Transferable Development Credits	+	+	+	!	+
18. Real Estate Disclosures	~	~	~	~	~

Advantageous (+)	The tool maximizes benefits and is feasible.
Neutral (-)	The tool may present some disadvantages or some feasibility problems.
Disadvantageous (!)	The tool may be difficult to implement because of costs or infeasibility.

²⁵ NOAA, Adapting to Climate Change, *supra* note 24, at 52–53 (citing FEMA, Developing the Mitigation Plan: Identifying Actions and Implementing Strategies (2003), <https://perma.cc/56PU-K5CS>).

²⁶ Georgetown Adaptation Tool Kit, *supra* note 20, at 10–11.

Figure 4 simplifies the type of characterization that the STAPLEE process might arrive at for the tools listed in the left column, and serves to illustrate the utility of anticipating how a given adaptation tool is likely to fare when proposed to different groups of stakeholders. For instance, some tools—such as rolling easements—might be socially acceptable but limited in application and subject to legal uncertainty.²⁷ By bringing into focus the benefits, sources of support, and potential sources of opposition to application of a given tool, STAPLEE can help guide decision makers as they convene stakeholders and present arguments about why using particular tools to pursue particular goals can strike an optimal balance for the community.

In addition to encouraging a planning process that deals with all contentious issues as early as possible, adaptation planning literature counsels that communities should seek “no regrets,” “low regrets,” and “flexible” solutions when deciding about allocations and timing.²⁸ Each of these terms emphasizes the importance of not locking a community’s scarce resources into investments whose value could be undermined by foreseeable potential changes to the climate and shoreline.²⁹ They also reflect the crucial fact that adaptation is an ongoing process rather than a finite one.³⁰

2. Vulnerabilities

This section summarizes key findings from Dewberry’s Vulnerability Assessment regarding the nature and severity of flooding in different SLR scenarios. Vulnerabilities to that flooding include roads and bridges, buildings, historic districts, and wastewater treatment system components and facilities.

Dewberry’s Vulnerability Assessment examined the scope and effects of three categories of flooding in particular: attributable to Mean Higher High Water (MHHW; defined as NAVD88 water elevation of approximately 2 feet); nuisance (NAVD88 = 3.75 feet); and 1% or 100-year (NAVD88 = 6–10 feet). MHHW occurs daily. The following figure integrates several features of Dewberry’s flooding projections. The top portion indicates expected changes in the proportion of St. Augustine’s acreage that will be susceptible to flooding during each event type at different levels of SLR. (Note that the vertical scale of the top portion ranges from 20% to 80% of the city’s total acreage, which Dewberry calculated using GIS data.) The bottom portion indicates

²⁷ See Thomas Ruppert, Use of Future Interests in Land as a Sea-Level Rise Adaptation Strategy in Florida (Aug. 2012), <https://perma.cc/6SJM-58B5>.

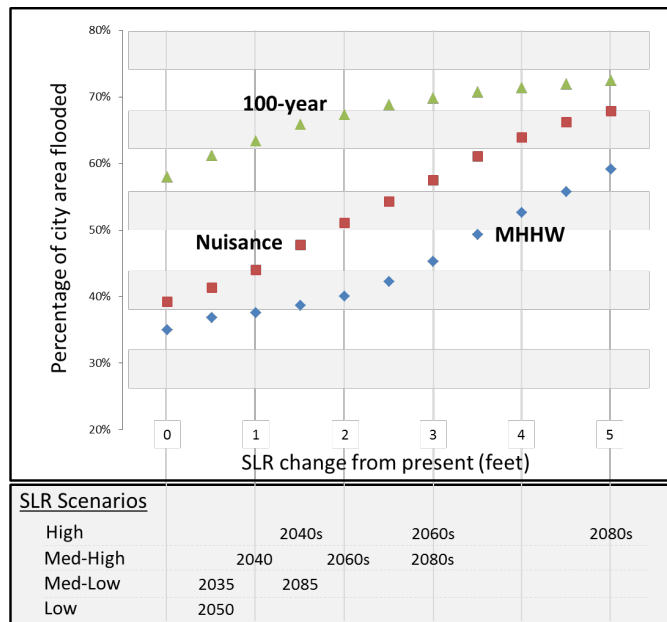
²⁸ William H. Butler et al., *Low-Regrets Incrementalism: Land Use Planning Adaptation to Accelerating Sea Level Rise in Florida’s Coastal Communities*, J. Planning Edu. & Res. 1, 9–10 (2016); see also Donald Watson, *Literature Review: Principles and Practices of Coastal Adaptation in the Era of Climate Change*, in Coastal Change, Ocean Conservation and Resilient Communities 23, 25–26 (2016) (emphasizing need to plan for uncertainty, in part by enabling multiple programmatic options).

²⁹ NOAA, Adapting to Climate Change: A Planning Guide for State Coastal Managers 53 (2010), <https://perma.cc/E4M2-M6Y7>.

³⁰ National Park Service, Coastal Adaptation Strategies Handbook 2 (2016), <https://perma.cc/PAN7-EA6V>.

the timeframes for SLR heights in each of four scenarios (high, intermediate-high, intermediate low, and low).

Figure 5. Acres of St. Augustine covered by flood events in different timeframes and scenarios.³¹



Thus, whereas 3 feet of SLR is projected to occur by the 2060s in the high scenario, only 2 feet is projected for the 2060s in the intermediate-high scenario, and only 1 foot or so in the intermediate-low scenario. Figure 5 also shows how these scenarios correspond to different percentages of flood coverage: by the 2060s in the high scenario, nuisance flooding is expected

³¹ See St. Augustine Vulnerability Assessment at 10, 12–13.

to occur on about 58% of city acres; in the intermediate-high scenario, 51%; and in the intermediate-low scenario, about 46%.

Using a tool created by the Federal Transit Administration, Dewberry also compiled data relating the change in flood event frequency to SLR. Those data, shown in the table below, indicate how SLR conditions affect the annual chance of flood events in turn. A 100% annual chance, marked in light blue, indicates that the event can be expected to occur at least once every year, on average.

Table 1. Changes in annual chance of flood event across SLR increments.³²

Recurrence Interval as of Today		Estimated Annual Chance									
Frequency	Annual Chance										
"10-year"	10%	25%	50%	100%	100%	100%	100%	100%	100%	100%	100%
"50-year"	2%	6%	20%	50%	100%	100%	100%	100%	100%	100%	100%
"100-year"	1%	1%	2%	6%	20%	50%	100%	100%	100%	100%	100%
"500-year"	0.5%	0%	0%	1%	1%	1%	2%	6%	20%	50%	100%
		0.5	1	1.5	2	2.5	3	3.5	4	4.5	5
		SLR Increment (feet above existing condition)									

For reference, the high SLR scenario anticipates an addition of 1 foot by 2030, 2 feet by the 2040s, and 3 feet by the 2060s; the intermediate-high scenario anticipates those changes by 2040, the 2060s, and the 2080s, respectively; the intermediate-low scenario anticipates those changes by 2060, and after 2100 respectively.³³

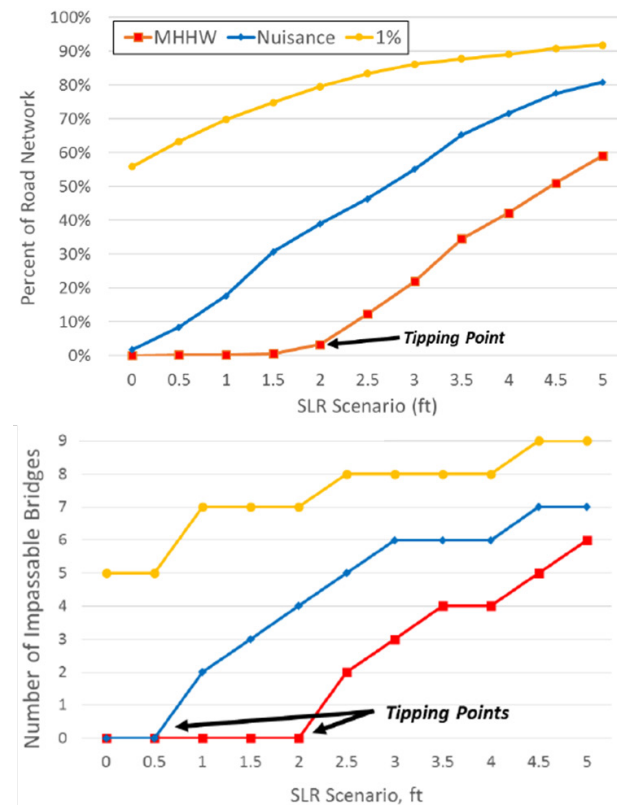
In addition to these indications of how SLR can be expected to affect the coverage and frequency of flood events, Dewberry also provided indications of impacts on particular infrastructure components and structures in the city. These highlight not only rates and degrees of change over time, but also tipping points at which impacts would jump in severity.

³² *Id.* at 19.

³³ *Id.* at 10.

Figure 6. Percent of road network flooded (top), bridge flooding vulnerability (bottom).³⁴

³⁴ St. Augustine Vulnerability Assessment at 21 fig. 9 & 30 fig. 14.



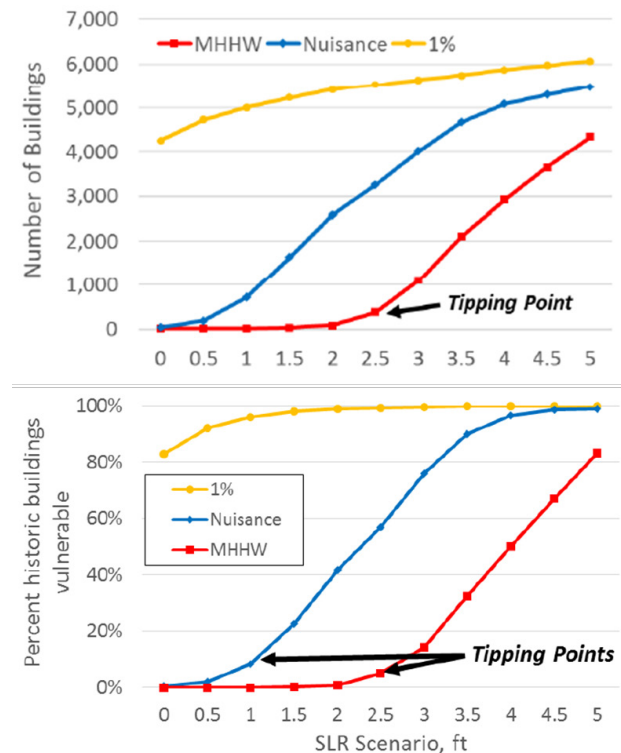
As the first of these graphs shows, nuisance flooding is expected to steadily expand its scope across the city's road network; while there is no tipping point in that curve, its rate of increase is steep as well as steady. The effect of nuisance flooding on bridge passability (second graph) follows a similar pattern, but because bridges (unlike roads) lack for easy substitutes in flood

conditions it is perhaps more accurate to think of each increment of vertical increase as a tipping point for the city's complement of bridges. The three bridges that will become impassable during a nuisance flooding event with 1.5 feet of SLR include the Bridge of Lions, the West King Street bridge, and the Florida East Coast Railway bridge linking to the causeway in the San Sebastian River. The MHHW curves in both graphs, which indicate daily maximums, show tipping points at 2 feet of SLR (high scenario: 2040s; intermediate-high: 2060s; intermediate-low and low: beyond 2100).

Figure 7 shows that many of St. Augustine's buildings are vulnerable to flooding, and highlights that buildings in historic districts, which are generally located closer to the water and at lower elevations, are especially vulnerable. Notably, the historic district data reflects averages that mask the severity of circumstances facing some areas, such as the Castillo and its vicinity, and the relative invulnerability of others, such as the North City historic district.³⁵ This latter point deserves particular attention because, as discussed in subsequent sections, the vulnerability of historic buildings is harder to mitigate.

³⁵ See *id.* at 31.

Figure 7. Flooding impacts on buildings (top) and historic buildings (bottom).³⁶



Although nuisance flooding was a prominent topic in the October 24th Preliminary Workshop, and although rising MHHW levels are inevitably a salient consideration, it is important to note

³⁶ *Id.* at 30–31.

the high starting points and higher ending points for the 1% storm event curves in these graphs. The city's recent experience of Hurricane Matthew provides a tangible demonstration of what these curves signify—indeed, Preliminary Workshop participants noted that flooding attendant to Matthew occurred in precisely the locations predicted by Dewberry's projection for a 1% chance event. The immediacy of risks posed by 1% chance events informs the emphasis that section 4 of this document places on the potential for post-disaster planning for St. Augustine's adaptation efforts.

In addition to historic buildings, these three types of flood events will also inundate archeological sites and cemeteries.³⁷

Components and facilities that make up St. Augustine's wastewater management system are also highly vulnerable to flooding. Here again, the recent experience of Hurricane Matthew highlighted some of these vulnerabilities. For instance, as Preliminary Workshop participants reported, flooding shorted out and effectively destroyed the electrical components of several wastewater relay pumps, which must now be replaced. It also caused a bypass event of the city's treatment plant, which Dewberry's Vulnerability Assessment notes is currently protected from nuisance and MHHW flooding by berms and wetlands (though this changes with 1.5 feet or more of SLR), but is already vulnerable to the sort of flooding that accompanied Matthew.³⁸ With just 1 foot of SLR, most of the structures that together make up that facility will be subject to flooding in a storm of Matthew's scale.³⁹

3. Local Context and Priorities

The development of plans for adaptation measures, and implementation of those plans, will necessarily occur in a context where technical and fiscal feasibility inform but do not determine decisions. Political, economic, social, and other considerations will likely play at least as great a role, if not greater. The STAPLEE framework summarized above was devised to help communities take all of these factors into account. This subsection notes features and circumstances that are specific to St. Augustine and that give shape to the political, economic, and social features of any STAPLEE analysis of the city's adaptation options.

St. Augustine's historic districts are vulnerable, immovable, and irreplaceable. In the background of these STAPLEE features is a basic, existential conundrum: can St. Augustine adapt while continuing to embody those features that are fundamental to its current character? That character centers on its historic district's buildings and their surrounding streets, squares, and waterfront, which make the place a beloved tourist destination. Unfortunately, those buildings stand in the path of increasingly frequent and severe flooding, and their material composition make them highly susceptible to flood damage. Furthermore, efforts to make the

³⁷ *Id.* at 36–40.

³⁸ *Id.* at 34–35.

³⁹ *Id.* at 35.

city's historic buildings less vulnerable by elevating or relocating them would unravel significant aspects of the city's historic fabric and would be technically difficult to accomplish besides, as those buildings are largely unsuitable for either elevation or complete removal to a different location. This dire situation admits of only constrained options for adaptation: accommodation measures in the near term and at least partial retreat in the longer. Consequently, St. Augustine's circumstances are not likely to inspire enthusiastic action on the part of residents and council members in response to calls for prudent steps toward effective adaptation.

Foreseeable SLR conditions are at odds with state-determined design parameters for local roads and bridges. Several main thoroughfares and bridges, including those noted as being vulnerable to flood events, are maintained by the Florida Department of Transportation (FDOT). This means, among other things, that FDOT specifies their design parameters. Though preserving the currently-required Level of Service for these road segments and bridges is FDOT's responsibility, increasing SLR will require redesign in the foreseeable future. A further problem for adaptation efforts arising from this division of authority between FDOT and St. Augustine relates to decisions about how best to ensure that barrier island residents can be evacuated in the event of a hurricane. Whereas FDOT concluded that building an additional bridge would be best, St. Augustine planners would have preferred to consider restricting the islands' further development.

FEMA's proposed revised FIRMs would reduce the scope of the City's floodplain and with it local base flood elevations (BFEs). In response to statutory directives about how to develop flood maps, FEMA will be making two distinct, and—in St. Augustine's case—divergent types of changes to existing maps. The first is to improve the precision of topographic and historical data used for mapping. Plans to revise local FIRMs in keeping with this change have, in St. Augustine's case, resulted in a smaller flood zone.⁴⁰ The second is to integrate SLR into mapping data based on the recommendations of the Technical Mapping Advisory Council. As a California pilot study shows, these recommendations could yield maps that indicate not only BFEs for shoreline segments, but "Future BFE" and projected shoreline changes based on different SLR scenarios.⁴¹ New York City will be the first U.S. locality to formally adopt maps of this sort.⁴² There is no statutory or regulatory deadline for a nationwide application of this approach, which means that it could be several—or many—years before it leads to widespread changes to FIRMs.

⁴⁰ See Jake Martin, *Proposed FEMA maps remove over 10,000 structures from St. Johns County flood zones*, The St. Augustine Record, July 14, 2016, <https://perma.cc/9AF6-PDAH> (reporting that 10,299 structures in St. John's County will no longer be included in the designated flood zone "mostly due to high dune systems" and that 1,686 will now fall within the updated zone).

⁴¹ FEMA Region IX Sea Level Rise Pilot Study Future Conditions Analysis and Mapping: San Francisco County, California 54 tbl. 19 & 55 tbl. 20 (Jan. 2016), <https://perma.cc/Z4MG-EXC4>.

⁴² FEMA, Press Release: Mayor De Blasio and FEMA Announce Plan to Revise NYC's Flood Maps (Oct. 17, 2016), <https://perma.cc/S3VY-VN2K> ("Revised flood maps will provide New York City residents with more precise current flood risk data, in addition to providing a new map product reflecting future conditions that account for climate change.").

Many residents do not know what's coming. Rising property values in St. Augustine reflect the divergence between optimistic expectations about the future of local real estate and business and the grim projections presented in Dewberry's Vulnerability Assessment. Statements by Preliminary Workshop participants suggest that this reflects a combination of (i) lack of detailed information, (ii) skepticism about the relevance of information that is available, and (iii) a possibly unexamined expectation that significant SLR impacts will not materialize in the near future.

4. Priority-Setting, Policy Vehicles, and Potential Responses

Previous sections have described basic goals for adaptation and categories of adaptation measures, vulnerabilities particular to St. Augustine, and features of the city's community and economy that will likely enable, inform, and constrain ambitions for local adaptation. This section discusses priority-setting, likely vehicles for implementing adaptation measures, and potential responses to the vulnerabilities identified in section 2, keeping in mind the context discussed in section 3.

4.1. Priority-setting

Successful adaptation planning builds on the best available relevant information, aims to maximize adaptation-related benefits without committing irreversibly to incurring large costs ("no- or low-regrets"), gets stakeholders involved, and keeps them informed. This can, in theory, move progressively from "no regrets" to "low regrets" to "flexible" to increasingly difficult and costly solutions. It may also employ evaluation and assessment tools like those referenced above. But, practically speaking, what does this mean?

First, adaptation planning involves evaluating not only how much it would cost to install or undertake a particular measure, but also what options that measure would foreclose and how it compares to alternative means of providing some or all of the same benefits. Properly accounted for, the costs of a sea wall include not only the materials and labor involved in its installation, but also the costs of its future upkeep, the costs it imposes on adjacent properties, and the opportunity cost or lost chance to make some other use of the shoreline and of the money spent on the sea wall. In short, any evaluation of an adaptation measure is incomplete unless it considers that measure's relative cost-effectiveness for its purpose and whether the measure will raise or lower the cost of likely future options for development or adaptation.

In addition, adaptation planning involves identifying both potential responses to vulnerabilities and stakeholders that will be affected by those responses. The STAPLEE factors described in section 1.4 should guide this step: Even if a given measure is unlikely to deprive anyone of economic value, will it nonetheless cut against a social tradition or preference? Even if a measure is likely to only affect a small handful of people or businesses, is it likely to generate extensive legal battles? Furthermore, even if a measure has the potential to be popular, such popularity is not guaranteed: planners might focus on identifying and evaluating an adaptation

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measure in terms of its aggregate costs, effects, legal viability, and administrative feasibility, but lose sight of the need to craft outreach and prepare responses to questions from stakeholders in order to assure its political popularity.

Balancing all relevant considerations is much easier said than done, not least because the foregoing description assumes a linear progression of steps, rather than a nonlinear, sometimes redundant set of processes taking place at the same time. The inevitable complexity and messiness of identifying, analyzing, promoting, and implementing multiple adaptation measures while carrying on with other business favors an approach that brings adaptation efforts under a common analytical and political roof. Adaptation Action Areas (AAAs) lend themselves to this sort of administrative consolidation by providing a clearly delineated physical context and administrative and legal scope for whatever changes adaptation will entail.

4.2. Policy vehicles

Although dealing effectively with SLR in St. Augustine requires swift action, the city's social, political, economic, administrative, and legal circumstances limit what can be done and how. Three vehicles in particular could be well-suited to the task of navigating these circumstances while yet supporting implementation of measures discussed in the next subsection.

4.2.1. Pre- and post-disaster planning and recovery

Enduring a natural disaster may be bad, but failing to learn from one is worse. Natural disasters play a vital role in adaptation efforts: they signal the nature and potential dangers of future events, and they create a moment of decision for communities about whether and how to reconstitute what existed before disaster struck. By forcing a decision to invest in more or less vulnerable forms of recovery, disasters also scrape away the undue optimism that can cloud individuals' and communities' approach to valued but highly vulnerable places and structures. For these reasons, and because including a disaster-trigger in a land use restriction can shield that restriction from takings claims,⁴³ disasters and post-disaster recovery feature prominently in adaptation literature. Recommendations for how to employ disaster scenarios (chiefly, coastal storms with accompanying flooding) in adaptation planning tend to include:

- Restrict rebuilding of structures damaged by flooding that would be vulnerable to SLR or to future flooding, whether by simply prohibiting redevelopment, imposing design requirements, or imposing setbacks on affected properties;⁴⁴

⁴³ See *Esposito v. S.C. Coastal Council*, 939 F.2d 165, 170 (4th Cir. 1991) (rejecting argument that statutory restrictions on post-disaster coastal redevelopment amounted to an unlawful taking), *cert. denied* 505 U.S. 1219 (1992).

⁴⁴ See Anne Siders, Columbia Center for Climate Change Law, *Managed Coastal Retreat: A Legal Handbook on Shifting Development Away from Vulnerable Areas* 85–86 (Oct. 2013), <https://perma.cc/ZSA2-ALQB>.

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- Condition rebuilding on a prohibition against shoreline armoring, thereby ensuring that the land, even if developed, will act as a buffer in the next storm;⁴⁵
- Encourage dedication of conservation easements or pursue public acquisition of property repeatedly struck by floods or affected by SLR-driven flooding.⁴⁶

Consistent with some or all of these recommendations, an ordinance or planning element focused on disaster recovery—and possibly based on an updated post-disaster recovery plan—could accomplish several interwoven goals in support of adaptation efforts. The most general and basic of those goals is to provide the public with information—and to gather information *from* the public—about local risks and options for mitigating those risks. Another goal is devising and implementing pre-disaster mitigation and adaptation efforts. A third goal, but perhaps the most important for this document’s purposes, is aiming to minimize damage from future disasters by preventing the post-disaster restoration of vulnerabilities.

All of this argues for exploring whether to make a disaster of particular scale and scope the triggering events for significant alterations to land use and infrastructure levels of service. Of course, adding community-altering triggers into a comprehensive plan is only politically feasible if key stakeholders agree to such a step—a fact that highlights the relationship between an ambitious plan for adaptive disaster recovery and the process involved in building broad support for potentially dramatic, post-disaster adaptation measures.⁴⁷

A further point about adaptation via pre- and post-disaster planning and recovery has to do with federal funding. The Conservation and Coastal Management Element of St. Augustine’s Comprehensive Plan⁴⁸ (discussed further in Appendix A) states that the city’s PDRP must distinguish between “redevelopment” and “repair.”⁴⁹ This distinction is an important factor to consider when exploring options for federal disaster recovery funding for adaptation efforts. While it is possible to read federal disaster recovery law as only supporting restoration of what existed before, that reading incorrectly excludes the option of using federal funds to adopt new designs that are better able to survive the next disaster—or, where appropriate, to undertake buyouts.⁵⁰

4.2.2. Making levels of service or capital expenditures contingent

⁴⁵ *Id.*

⁴⁶ See Georgetown Adaptation Tool Kit, *supra* note 20, at 31–33.

⁴⁷ Carri Hulet et al., *Why Public Engagement Is Necessary to Enhance Local Readiness for Climate Adaptation, in* Managing Climate Risks in Coastal Communities 60–64 (Lawrence Susskind et al., eds. 2015) (discussing forms of public engagement and its indispensability to effective planning measures).

⁴⁸ St. Augustine’s current (as of May 2017) comprehensive plan is available here: <https://perma.cc/3XC5-KGA7>.

⁴⁹ *Id.* at 79 (Conservation and Coastal Management Element Policy 10.1).

⁵⁰ Justin Gundlach & Channing Jones, *Integrating Climate Change Resilience Into HUD’s Disaster Recovery Program*, 46 *Env’tl. L. Rep.* 10282 (Apr. 2016), <https://perma.cc/CQ4U-XJV7>.

The model ordinance mentioned in section 1.3 above can serve localities facing prohibitively expensive infrastructure maintenance schedules by preventing legal challenge of the sort that led to the *Jordan v. St. Johns County* case, discussed in Appendix A. As noted in section 1.3, the model ordinance is drafted for roads, but could arguably be applied to components of stormwater or wastewater systems that are succumbing to increasing rates of sea-borne damage. The basic concept embodied in that model legislation is that service levels should be contingent on the cost-effectiveness of maintenance. Once the cost of maintaining a given component exceeds a threshold set by average maintenance costs for other similar components, the locality can staunch the flow of public funds to that repeatedly damaged component.

This concept need not be limited to the case of foregone maintenance that inspired Ruppert et al. to draft their model. It can also be applied to planning as well. For instance, recognizing the growing threat facing particular neighborhoods on Anastasia Island, St. Augustine need not prevent redevelopment or investment through express restrictions, but it can make clear—ideally years or even decades in advance—that services relied upon by residents will be provided only so long as the cost of their provision remains proportionate to average costs elsewhere in the city. This sort of signaling can help resolve social, political, economic, and legal problems that might stymie development restrictions aimed at a similar goal.

Similarly, the city could require capital expenditures to meet a cost-effectiveness threshold to proceed. Phrased as a Policy in St. Augustine’s Capital Improvement Element—which currently sets limits on spending in Coastal High Hazard Areas⁵¹—this might read as follows:

Capital spending shall only be provided for the repair or upkeep of infrastructure components repeatedly damaged, degraded, or routinely impaired as a result of SLR’s impacts, such as nuisance flooding, after considering alternative design standards and determining that design changes would not yield net savings over the useful life of the component or components.

The University of Florida Conservation Clinic offers two similar but harder-hitting approaches:

Policy 1.3.2: No capital improvements within the vulnerable area shall be financed or constructed without having first been reviewed to determine the extent to which the proposed improvement is sea-level rise-ready, taking into account the sea-level rise adaptation zone in which it is located, and whether it will contribute to additional development within the vulnerable area.

⁵¹ St. Augustine Comprehensive Plan, *supra* note 48, at 92 (“CI Objective 2: The City will limit capital expenditures for public facilities in Coastal High Hazard Areas as indicated on the Coastal High Hazard Area Map adopted as part of the Future Land Use Map series.”).

Policy 4.1.1: Within [the most vulnerable areas], the City/County shall eliminate new investment in public infrastructure likely to be subject to the impacts of sea level rise within the planning horizon.

4.2.3. Adaptation Action Areas to implement 4.2.1 & .2

AAAs are an ideal means of designating the physical area(s) where measures like those just described would apply. AAAs make it possible to change important policies without rewriting zoning decisions and other plan language. They also serve an important educational, social, and political function because their basic logic is transparent to stakeholders: because SLR, which is expected to increase in predictable increments, causes flooding in a given area, that area is exceptional and will receive different policy treatment. This is not to say that AAAs simply make political challenges go away. However, they can help to inoculate adaptation measures against objections that the resulting costs and services would be allocated unfairly, and they can provide a stable foundation for any number or combination of adaptation policies.

In addition, because AAAs can be designated using objective *and dynamic* criteria, such as the frequency of flooding to a particular height, they can remove controversy from questions about the boundaries within which particular policies should apply and when to change those boundaries. Should the city decide on designating AAAs in this way, it should schedule a periodic update of AAA boundaries using a standard methodology.

4.3. Potential responses to vulnerabilities

The following potential responses to vulnerabilities identified by Dewberry could be implemented independent of one another or in any number of combinations. In several instances, combinations would likely increase individual responses' effectiveness while reducing their cost.

4.3.1. Flood maps and freeboard

FEMA's recently issued preliminary updates to the FIRMs that cover St. Augustine are not yet final; they are scheduled to be published in final form in June 2017.⁵² The National Flood Insurance Program's website does not indicate a deadline for appeals of the preliminary digital FIRMs published on May 16, 2016.⁵³ However, even if such a deadline has already passed, St. Augustine should consider requesting a delay of final adoption and reconsideration of preliminary FIRMs that appear—based in particular on Dewberry's Vulnerability Assessment and the recent experience of Hurricane Matthew—to understate the flood risks attending a 1% flood event. FIRMs are derived from a statistically random selection of past storm and flood data and FEMA is generally receptive to requests that FIRMs reflect data addition to those initially selected for a preliminary FIRM. St. Augustine should consider asking FEMA to recalculate its

⁵² FloodSmart.gov, Flood Map Update Schedule Tool, *All Communities with map updates scheduled for St. Johns County, FL*, <https://perma.cc/B8DF-6L2M> (last updated Sept. 2016).

⁵³ *Id.*

estimated flood elevations after adding data from Hurricane Matthew to the relevant storm set. FEMA, which is generally not averse to expanding flood zones relative to those mapped in a preliminary FIRM, could not deny the reasonableness of this suggestion, given that the storm hit after issuance of preliminary FIRMs.

If the preliminary FIRMs are to be adopted in June unchanged, St. Augustine should examine how the resulting changes would be translated by local ordinances and planning documents into changes to land use and development restrictions.⁵⁴ If a particular aspect of the FIRM revision appears likely to invite maladaptive development by residents or business owners, the city could consider options for maintaining at least some of the restrictions by other means. For instance, designating one or more AAAs using Dewberry's mapping of flood risks would provide a valid, transparent, and logically and legally defensible basis for restricting development in what are no longer Special Flood Hazard Areas but nonetheless remain areas susceptible to various types of flood events. Timing would be critical to such a step: signaling as early as possible that restrictions may not in fact be lifted in June 2017, notwithstanding the FIRM revision, could help avoid upset and uncertainty among stakeholders.

Preliminary Workshop participants indicated that an impending update to the state building code will impose a freeboard requirement of 1 foot in addition to the BFE requirements imposed by FEMA via the National Flood Insurance Program. The city should consider adopting an even more stringent alternative: imposing requirements of varying stringency for new or renovated structures based on the vulnerability of their location to 1% annual chance floods, as identified by Dewberry. Thus, for instance, structures located in the current zone of 1% annual chance floods could be required to add 3 feet of freeboard, those in the area projected to fall within that zone after 1 foot of SLR could be required to add 2 feet of freeboard, and those in the area projected to fall within that zone after 1.5 feet of SLR could be required to add 1 foot. While such a requirement would make it more expensive to build or improve structures in these vulnerable locations, it would also serve to inform everyone considering such development of the expected future risks—and thus the likely costs—of investing in immovable and flood-susceptible assets there. It would also counter much of the effect of FEMA's proposed revisions.

In addition to these direct responses to the prospect of revised FIRMs, the city might also consider indirect responses that inform property owners about SLR-related risks. Consider these four examples:

1. The city could require that property purchasers and/or developers be given full information about the expected future levels of SLR, as projected in Dewberry's Vulnerability

⁵⁴ See, e.g., Ordinance number 10-07, § 2, 4-12-10, *codified at* § 8-428 of the St. Augustine code (defining Coastal High Hazard Areas in terms of FEMA-designated flood zones and imposing requirements on construction or substantial improvements to structures there); St. Augustine Comprehensive Plan, Capital Improvements Element ("Objective 2. The City of St. Augustine will limit capital expenditures that subsidize development in coastal high hazard areas, but will place no limitation on expenditures in those areas that enhance or restore natural resources.").

Assessment, and the impacts of SLR on levels of service for infrastructure serving the property, as determined by the appropriate city departments.

2. The city might also require that any development or redevelopment be preceded by an environmental impact analysis (i) the time horizon for which aligns with the expected life of the new structures or facilities, and (ii) that adopts the SLR projections in Dewberry's Vulnerability Assessment.

3. Rather than imposing requirements on private property owners or developers, the city could conduct a review of the sufficiency of existing shoreline stabilization measures vis-à-vis the SLR projections in Dewberry's Vulnerability Assessment. The University of Florida Conservation Clinic has drafted model language that would provide for such a review:

Policy 2.1.2: Based on projected rates of sea level rise within the sea-level rise planning horizon the City shall inventory all existing shoreline stabilization structures and determine their capacity to maintain functionality throughout the SLR planning horizon.⁵⁵

4. If this sort of review seems politically feasible and likely to both provide the city and individual property owners and developers with useful information, the city might consider a similar but more extensive review of planned and existing infrastructure and development or redevelopment proximate to shorelines. Here again, the U of F Conservation Clinic's model language could be useful:

Policy 1.3.1: The City/County shall inventory all existing and planned infrastructure and land development [projects] within the vulnerable area for its capacity to accommodate projected sea-level rise over the life expectancy of the infrastructure and development [projects].⁵⁶

4.3.2. Stormwater and wastewater management

St. Augustine's systems for managing stormwater and wastewater are vulnerable to all three forms of flooding discussed above (MHHW, nuisance, and 1% events). In some instances those vulnerabilities can be addressed with measures that are clearly cost-effective and unlikely to commit the city to large investments whose value could quickly be undermined by flood events. In other instances, however, the scale and immovability of system upgrades will require the city to make difficult decisions about the basic viability of the existing systems—with material consequences for the people and businesses they serve.

⁵⁵ Krystle Macangdang & Melisa Newmons, *Sea Level Rise Ready: Model Comprehensive Plan Goals, Objectives and Policies, to Address Sea Level Rise in Florida* (May 2010), <https://perma.cc/JF7U-N4FY>.

⁵⁶ *Id.*

Stormwater

Preliminary Workshop participants described two problems visited on the stormwater management system by SLR. The first problem is that the system facilitates nuisance flooding by connecting outfalls to city streets via subterranean conveyances. The second problem is the repeated killing of residents' lawns by saltwater or brackish inundation. Participants also indicated that the city is already planning to install backflow prevention devices at different points in the system.

One response to both of these problems could be to install various forms of low impact development (LID) or green infrastructure (GI) on public property and to encourage its installation on private property.⁵⁷ A recent SLR adaptation effort focused on the Matanzas Basin recommended this step and assembled a list of types of LID/GI suitable for St. Augustine's region:⁵⁸

- **Bioretention cells and rain gardens (top of figure 8, below):** These are landscaped areas, often shaped into shallow depressions, that are positioned to capture and detain stormwater so that it can then slowly infiltrate into the soil beneath the cell/garden. In addition to detaining stormwater, these units capture the sediment and pollutants that would otherwise flow to adjacent bodies of water.
- **Permeable pavements:** In contrast to asphalt, concrete, or stone, these do not impede water and so allow it to infiltrate rather than running to a storm drain or a retention area. They resemble standard pavements and have similar functionality.
- **Cisterns and detention basins:** By retaining or even just detaining stormwater, these devices reduce runoff. They can also substitute for non-potable freshwater from other sources. Flagler University has installed a basin beneath one of its courtyards.
- **Bioswales (bottom left of figure 8, below):** These enclosures detain and filter stormwater flowing from sidewalks and streets. In some instances they can wholly replace storm drains.
- **Green roofs (bottom right of figure 8, below):** Reinforced roofs that are covered with growth medium and plants accomplish several things that standard roofs do not, including: retaining, detaining, and filtering stormwater; improving the longevity of the roof; and improving the energy efficiency of the structure.

⁵⁷ EPA, *Green Infrastructure: What is green infrastructure?*, <https://perma.cc/Z6TN-DH23> (last updated Sept. 23, 2016).

⁵⁸ Matt Wolfe & Michael Volk, *Planning for Sea Level Rise in the Matanzas Basin*, Appendix G: Smart Growth and Low Impact Development (LID) 7–9 (June, 2015), <https://perma.cc/K4CZ-DYRR>.

Figure 8. Illustrations of installed LID/GI.⁵⁹



In addition to these forms of LID/GI, which are suitable for public rights of way and properties owned by governments, universities, or large businesses, small changes to landscaping small private parcels can contribute to the same positive results.⁶⁰

With this in mind, St. Augustine should consider making more direct investments in LID/GI on public property and also encouraging private property owners to do the same. It bears noting that LID/GI installation *outside* of areas subject to nuisance flooding can help mitigate levels of nuisance flooding by reducing the amount of stormwater flowing across surfaces and through the system in lower-lying areas. CDM Smith, which advised St. Augustine on various changes to its stormwater management system and utility fee in 2012 and 2013, recommended encouraging LID/GI installation.⁶¹ However, St. Augustine does not make stormwater utility fee

⁵⁹ Photographs from EPA's *What is green infrastructure?* webpage: <https://perma.cc/Z6TN-DH23>.

⁶⁰ See St. Johns Riverkeeper, *River-Friendly Landscaping: Landscaping Your Yard*, <https://perma.cc/NKB8-WG3H> (last visited Jan. 26, 2017).

⁶¹ CDM Smith, *Stormwater Master Plan Update Phase 1 Final Report*, at 6-5 to 6-6 (Feb. 2013), <https://perma.cc/753G-T4J5>.

credits available to the owners of single- or multi-family properties for impervious surface reductions or the installation of detention basins.⁶² Nor does the city's website provide easily-accessible information about LID/GI options and benefits.

Another, complementary response would involve making targeted upgrades to the pipes and valves through which stormwater flows. Preliminary Workshop participants indicated that the city is already planning to install stormwater backflow valves on some stormwater system segments, and also that some components of the system are especially old. Targeting upgrades should take several factors into account, including: the current performance of the system in a given area versus level of service required for that area; the remaining useful life of the existing components or their replacements; and opportunities to couple installation of stormwater backflow valves with replacement of old or worn components. In keeping with the suggestion in the section 4.2.2 about making levels of service contingent, the city could also make the installation of stormwater backflow valves an occasion to announce the implementation of new long-term plans to accommodate SLR over the coming decades by reducing maintenance schedules.

Wastewater

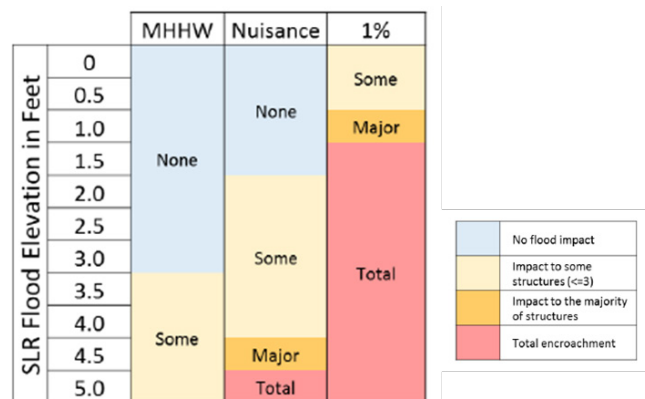
As Hurricane Matthew made clear, St. Augustine's wastewater management system is acutely vulnerable to SLR.⁶³ Some system components, such as the pumps whose electrical circuitry was destroyed by flooding during Matthew, can be hardened by replacement with components rated for saltwater inundation. Similarly, the city can ensure at reasonable expense that key points in the system have access to mobile backup generators during storm conditions. The same cannot be said, however, for the city's WWTP. That facility is already vulnerable to flooding (see figure 9 below), is expected to become increasingly vulnerable, and is adjacent to marshland that currently serves as a buffer against storm surge.⁶⁴

⁶² St. Augustine Code § 29-5(4) ("Credits shall not be allowed for single-family or multifamily properties.").

⁶³ Lynnsey Gardner, *7-foot storm surge devastates St. Augustine neighborhood*, News4JAX, Oct. 12, 2016, <https://perma.cc/6DAG-U89G> (Arnow's home was flooded by 4 to 5 feet of water and also raw sewage.).

⁶⁴ St. Augustine Vulnerability Assessment at 34.

Figure 9. WWTP vulnerability to different flood types at different SLR levels.⁶⁵



Thus, while armoring and/or raising the WWTP would protect it for some number of years (depending on the SLR scenario that materializes, and on the height and strength of the armoring) such steps would be extremely expensive and armoring would damage or destroy the marsh by displacing wave energy onto it. Because this impact on the marsh would make the surrounding area *less* resilient to storms and flooding, armoring the facility would not only require a significant investment but would also, at best, be a partly maladaptive measure for the city as a whole. Furthermore, unless offsetting wetlands were created elsewhere, such a step would also be contrary to local planning provisions, which call for “[t]he City [to] pursue no net loss of wetlands.”⁶⁶

As was discussed at the Preliminary Workshop, Florida law now *instructs* localities to add a redevelopment component to their coastal management planning element, and for that component to (among other things) encourage and facilitate the “removal of coastal real property” from flood zones. The statutory language is somewhat elliptical, but it provides clear sanction for plans that encourage managed retreat for some structures and facilities from areas vulnerable to flood. Currently, St. Augustine’s coastal conservation and management element provides that “post-disaster redevelopment will reduce or eliminate the risk of human life and

⁶⁵ *Id.* at 35.

⁶⁶ St. Augustine Comprehensive Plan at 73–74 (CCM Objective 4.1).

property damage by natural hazards.”⁶⁷ Like Florida law, this language does not provide definitive instructions about how to respond to the wastewater management system’s vulnerability, but it does provide the city with authority to “reduce . . . property damage” by either redesigning the WWTP or relocating it. Also relevant is Objective 2 of the city’s capital investment element, which provides that the city “will limit capital expenditures that subsidize development in coastal high hazard areas, but will place no limitation on expenditures in those areas that enhance or restore natural resources.” In sum, existing law limits the city’s ability to armor the WWTP, arguably limits the city’s ability to raise it in part or as a whole (depending on whether such investment is characterized as a subsidy for development), but does not limit the city’s ability to relocate it.

St. Augustine’s WWTP is unique among the city’s infrastructure and facilities because decisions about its location, service capacity, and protection against flooding will substantially determine the range of planning options available to city residents and businesses as a whole. Decisions about the WWTP are also uniquely challenging: there is no obviously superior answer to the question of how to respond optimally to the WWTP’s vulnerability to SLR.

Because all options for responding to the vulnerabilities confronting St. Augustine’s wastewater management system (and its WWTP in particular) will be costly, difficult to implement, and highly consequential, this document proposes convening a planning charrette among regional experts and local stakeholders before taking any significant action. The charrette’s primary objective would be to generate a thorough and detailed understanding of what different courses of action would mean in terms of costs, levels of service provision, vulnerability to SLR, and impacts (e.g., economic and environmental) resulting from armoring, redesign, or relocation of the WWTP. The charrette would necessarily consider the various costs involved in preparing for and/or recovering from one or more coastal storms that land a direct hit on the WWTP. In addition to developing a complete picture of the wastewater management situation facing St. Augustine, the exercise would also help to establish a common understanding among key decision makers and those most directly affected by their decisions about the relevant circumstances and available options.

This suggestion reflects an important assumption, namely that any significant decision about wastewater management will inevitably become politically contentious and will likely garner intense public reaction.

4.3.3. Roads and bridges

Responses to vulnerabilities in the city’s network of roads and bridges necessarily fall into one of two categories: those arterial road segments and major bridges that are designed and maintained by the state department of transportation (FDOT), and those smaller road segments

⁶⁷ *Id.* at 79 (CCM Objective 10).

and bridges designed and maintained by the city. Influencing design decisions and maintenance schedules for the first category is not impossible, but it necessarily involves requests or suggestions being communicated to and approved by FDOT before being implemented. During the Preliminary Workshop, participants discussed how best to approach FDOT and what changes to suggest to existing design standards (beyond compliance with Transportation Element Objective 1.4's prescriptions for coordination among the city, FDOT, and St. Johns County). That discussion concluded that FDOT is likely to be receptive to overtures from the city, but that the city should seek indications from FDOT officials about planning timeframes, concerns or types of information they would be open to receiving from the city, and the level of detail the city should include in any submission to FDOT.

As for non-state road segments, Preliminary Workshop participants indicated that several are becoming increasingly expensive to maintain as a result of heightened rates of erosion and increasingly frequent nuisance flooding. The city's responses to this vulnerability can build on several general provisions of existing plan elements, including:

- Transportation Element Objective 1.3: The Transportation Element system shall be consistent with and support the Future Land Use Plan as depicted on the Future Land Use Map series and all subsequent amendments.
- Future Land Use Element Objective 1: The Future Land Use Map and subsequent amendments to it shall be adopted and implemented in a manner consistent with topography, soil conditions, and the availability of facilities and services to support such development.
- Capital Investment Element Objective 2: The City of St. Augustine will limit capital expenditures that subsidize development in coastal high hazard areas, but will place no limitation on expenditures in those areas that enhance or restore natural resources.

In addition to making use of these existing provisions, the city should consider adopting a new Transportation Element Objective 1.6—"The City shall address impacts of flooding, including nuisance flooding, cost-effectively"—and Policy 1.6.1—"Planning decisions shall take into account projections of future rates and patterns of flooding as well as the implications of such flooding for maintenance and other costs." The key purpose of these additions would be to establish a realistic baseline for the purpose of budgeting and planning. Doing so would ensure that, as the city considers capital investments and design and maintenance program changes in response to flooding impacts, it will not be constrained by the historical baseline of budgets and other planning documents pertaining to roads and bridges. Design and programmatic changes appear inevitable: as shown in Figure 6 in section 2 above, a large and growing proportion of the city's road segments will be flooded routinely, meaning that the "costs" side of any realistic future cost-benefit analysis should take the impacts of that flooding into account.

In addition to ensuring that flooding vulnerability features in city budgets and plans, the city should also consider establishing an AAA that would encompass street segments affected by nuisance flooding—indeed, the presence of nuisance flooding could be a criterion for designating the AAA's boundary. As explained in section 4.2.3 above, an AAA could serve as a useful vehicle for pursuing several substantive adaptation goals because it would allow the city, with no other plan or policy changes, to treat road segments differently solely because they fall within or outside of the AAA. Substantive policies that could be applied to road segments within such an AAA might include reduced levels of service, periodic or general limitations on motorized vehicle traffic, and design changes such as taller curbs, deeper gutters, or road segments that are *designed* to flood and thereby to direct water away from more sensitive areas or structures.

While the model ordinance developed by Ruppert et al. in response to the *Jordan v. St. Johns County* decision could be adopted without use of an AAA, it is easy to see how the two tools might complement one another: the ordinance (whether adopted as an ordinance or incorporated into the city's Capital Improvements Element) providing a legal basis for reduced levels of service and maintenance spending, and the AAA providing a legal basis for restricting road traffic. In addition, the AAA would effectively announce the scope of expected SLR impacts in the foreseeable future, providing the public with notice not only of road service and maintenance changes but also of potential changes to land use options and infrastructure availability in the medium- and longer term.

4.3.4. Historic resources

The unique value of the city's famous historic resources derives from the integrity of their location, circumstance, character, and construction—to borrow from the National Park Service: "Because cultural resources hold significance from both place and the past, they are unique and nonrenewable."⁶⁸ Changing even one of these things can greatly diminish if not totally negate that value. Yet rising seas leave the city no choice but to adapt, and adaptation will mean making physical changes that necessarily affect—and possibly compromise—attributes relevant to the criteria used by the National Historical Society and Florida's Division of Historic Resources to distinguish historic buildings from others:

if they possess integrity of location, design, setting, materials, workmanship, feeling, and association . . . embody the distinctive characteristics of type, period, or method of construction. * * *

Ordinarily . . . structures that have been moved from their original locations; reconstructed historic buildings; . . . shall not be considered eligible for the National Register. However,

⁶⁸ Courtney Schupp et al., Chapter 5: Cultural Resources, in *Coastal Adaptation Strategies Handbook* 51, 51 (National Park Service, Oct. 2016)), <https://perma.cc/4KNG-Y8AK>.

such properties will qualify if they are integral parts of districts that do meet the criteria or if they fall within the following categories: * * *

- b) a building or structure removed from its original location but which is significant primarily for architectural value, or which is the surviving structure most importantly associated with a historic person or event; or
- e) a reconstructed building, when it is accurately executed in a suitable environment and presented in a dignified manner as part of a restoration master plan, and no other building or structure with the same association has survived; or a property primarily commemorative in intent, if design, age, tradition, or symbolic value has invested it with its own exceptional significance.⁶⁹

Because these criteria allow for some flexibility, St. Augustine can strike a balance by implementing measures that respond effectively to vulnerabilities without robbing the City's historic resources of features that qualify them for the historic register and make them appealing to residents and visitors. Importantly, however, St. Augustine must strike that balance with limited financial and administrative resources. It cannot protect all of its historic district or local buildings from flooding, nor can it accommodate flooding by elevating all historic buildings (which would not survive elevation well and would no longer be of their original character besides), nor can it simply move them and their surroundings in their entirety to another location. Yet, the city can do *some* of each of these.

In order to provide basic legal and policy support for limited and cost-effective adaptation measures in relation to its historic resources, the city should consider revising the basic Goal and Objective 3 of its Historic Preservation Element. The amended Goal might read as follows: "Maintain and enhance the historic integrity and ambiance within the City of St. Augustine **amid changing environmental circumstances** while encouraging economic growth and the identification, preservation, continued use and adaptive reuse of existing historic structures."⁷⁰ The amended Objective might read: "Continue to identify, preserve and encourage the adaptive reuse of historic structures in all areas of the City, **recognizing that preservation must in some cases entail adaptation to changing environmental circumstances.**" These revisions would open the door to flooding-related adaptation measures, but not to every modification a property owner might request.

This sort of basic change will facilitate other procedural and substantive measures. Procedural measures are especially important here because of the role they can play in helping the city's policymakers and residents to arrive at a common understanding of the situation and to

⁶⁹ National Park Service, National Register Bulletin: How to Apply the National Register Criteria for Evaluation, <https://perma.cc/XW3C-94RT> (last updated 2002); Florida Division of Historic Resources, Criteria for Listing: Criteria Used for Evaluating National Register Eligibility, <https://perma.cc/Q5EW-2LZS> (last visited Jan. 31, 2017).

⁷⁰ St. Augustine Comprehensive Plan at 100.

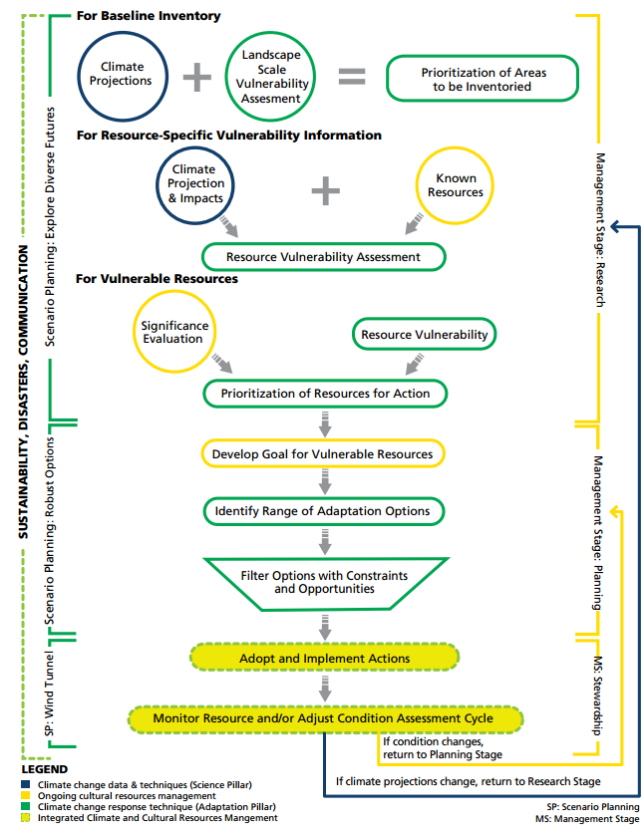
develop clear goals based on that understanding. In particular, because the fiscal and administrative capacity of the City—even engrossed by grants or investments by residents—is insufficient to the task of adapting *all* of St. Augustine's historic districts and properties to rising seas, someone must decide what to preserve and what to cease preserving. For instance, at Dry Tortugas National Park, the National Park Service assessed the various threats to the integrity of Fort Jefferson before deciding on a handful of key measures—chiefly the removal of structural iron elements that, when rusted, displaced masonry, and the reinforcement of masonry at risk for collapse.⁷¹

Decisions about which historic resources to preserve and how carefully to do so *could* be made on an ad hoc basis as individual owners respond to changing circumstances, or they could be made through an organized process that frames the problem as a matter for the public as well as directly-affected stakeholders. The former approach might require no changes to existing planning documents or procedures, but could lead to disorganized measures that compete or even conflict with one another. The latter approach would be more procedurally intensive, but would also be more likely to result in the cost-effective preservation of historic resources valued more highly by stakeholders and the broader public. In addition to being more cost-effective for directing resources *to* particular areas and structures, the latter approach would also be well-suited to specifying which structures would *not* be restored to historical standards after being damaged by flooding.⁷²

The National Park Service developed the following flow chart to depict a generic analytic and decision-making process for historic resources. The chart is useful for several purposes but in particular for suggesting this order of analysis and decision: prioritize vulnerable resources, specify goals for priority resources, identify relevant constraints and opportunities, and *then* adopt a particular program of action. Crucially, this process begins by prioritizing—a task that, in St. Augustine, will likely involve gathering input from much if not most of the community.

⁷¹ Dan Kimball et al., Coastal Adaptation Strategies Case Study 5: Strategic Planning and Responsible Investments for Threatened Historic Structures, Dry Tortugas National Park, Florida (2016), <https://perma.cc/4UYZ-DYDQ>.

⁷² See Jonathan B. Jarvis, National Park Service, Policy Memorandum 14-02 ¶ 2.F (Feb. 10, 2014), <https://perma.cc/S7EW-YW86> ("Managers should consider choices such as documenting some resources and allowing them to fall into ruin rather than rebuilding after major storms. Such decisions for loss cannot be made lightly nor without appropriate consultation and compliance.").

Figure 10. Cultural resources management and adaptation flowchart.⁷³⁷³ National Park Service, Cultural Resources Climate Change Strategy 27 (2016), <https://perma.cc/TZ5W-SZXL>.

The same National Park Service report that contains this flowchart also describes how it was employed at Cape Lookout National Seashore to arrive at key adaptation decisions.⁷⁴ Those decisions considered the following range of options:

- Simply not intervening;
- Offsetting environmental stresses by making changes away from vulnerable structures (e.g., living shorelines);
- Investing in improved resilience of structures themselves;
- “Managing change” (e.g., fostering the growth of relatively more resilient plant or tree species in an area where trees have long featured but where traditional species are struggling because of changing environmental conditions);
- Relocating resources;
- Documenting resources in preparation to lose them in part or as a whole; and
- “Interpreting the change” (e.g., using a series of photographs to communicate to visitors how the environment and the resource are colliding).

St. Augustine should make use of something like the process shown in Figure 10 to order key decisions, including ultimately which adaptation options to adopt for particular historical resources.

St. Augustine should also consider a further change to the city’s plans to support the adaptation of its historic resources. This change would involve dividing the city’s existing privately held historical resource inventory in two. One designation would provide for long-term preservation, and would entitle the owners to special consideration for grants and other funds in support of (aesthetically consistent) adaptation efforts, relocation, and/or post-disaster restoration. The other designation would provide for preservation only until flooding of some sort had driven the costs of restoration/preservation higher than the owner wanted to pay. As with the more general suggestions for pre-disaster planning discussed in section 4.2.1 above, this would accomplish an important form of public education about expected future circumstances as well as enabling the city to explore fiscally and practically feasible protective engineering measures (e.g., berms and small canals) for portions of historic districts.

⁷⁴ *Id.* at 34–37.

Conclusion

This Adaptation Plan serves several purposes. It describes key features of the policy and legal frameworks that underlie adaptation efforts in Florida. Drawing on Dewberry’s Vulnerability Assessment and the discussion at the October 24, 2016 Preliminary Workshop in St. Augustine, it provides an overview of vulnerabilities and circumstances relevant to any effort to address those vulnerabilities. Finally, in addition to these descriptions, it provides suggestions for potential use by decision makers seeking to develop and implement adaptation measures. Those suggestions draw on inputs from St. Augustine officials, and on local and statewide efforts in Florida to identify opportunities to apply legal and policy tools to adaptation goals.

Appendices:

A. Legal Context

B. Methodology, Lessons Learned, & Recommendations

C. Preliminary Workshop Summary



Appendix A: Legal Context

Various aspects of the law governing St. Augustine compel, support, permit, or limit its authority to pursue an adaptation agenda. This appendix does not provide an exhaustive list of relevant legal structures and provisions, but it identifies several that are especially salient and that should or must be considered as St. Augustine takes steps to adapt to SLR.

Several features of Florida law, described briefly here, deserve special attention because they are both unique to Florida and significant to any adaptation agenda. They include local comprehensive plans, legal authority for the establishment of Adaptation Action Areas,⁷⁵ SB 1094 (“Peril of Flood”),⁷⁶ and the Bert Harris Jr. Private Property Rights Protection Act.⁷⁷

A.1. Comprehensive planning

Comprehensive plans have a constitutional quality for Florida localities.⁷⁸ Each Florida locality must maintain a comprehensive plan,⁷⁹ and all development in that locality must conform to the local Plan’s provisions.⁸⁰ Those provisions appear in particular “elements,” some of which are mandatory.⁸¹ Florida’s 2011 Community Planning Act removed several restrictions on local governments’ authority to revise elements of their comprehensive plans,⁸² a process that involves two public hearings and approvals by the local governing authority, as well as receipt and review of comments by state agencies and affected localities regarding potential adverse effects.⁸³ The rest of this subsection discusses: (i) particularly important planning elements and the statutory language that guides their formulation; (ii) data and analysis appropriate for planning; (iii) timeframes for planning; and (iv) Adaptation Action Areas—a form of zoning overlay that localities can use to coordinate adaptation plans and efforts.

⁷⁵ HB 7202, Florida Community Planning Act of 2011, *codified at* Fla. Stat. § 163.3177.

⁷⁶ SB 1094, *codified at* Fla. Stat. §§ 163.3178, 195.088.

⁷⁷ Fla. Stat. § 70.001.

⁷⁸ David L. Markell, *Emerging Legal and Institutional Responses to Sea-Level Rise in Florida and Beyond*, 42 Colum. J. Envtl. L. 1, 6–7 (2016) (citing *Machado v. Musgrove*, 519 So. 2d 629, 632 (Fla. 3d DCA 1987)).

⁷⁹ Fla. Stat. § 163.3167(1)(b)(2) (2015) (“Each local government shall maintain a comprehensive plan”). *See also id.* § 163.3177(1) (2015) (plans are meant to “provide the principles, guidelines, standards, and strategies for the orderly and balanced future economic, social, physical, environmental, and fiscal development of the area . . .” and to “establish meaningful and predictable standards for the use and development of land and provide meaningful guidelines for the content of more detailed land development and use regulations.”).

⁸⁰ *Id.* § 163.3161(6) (“no public or private development shall be permitted except in conformity with comprehensive plans”).

⁸¹ *Id.* § 163.3177(1)(a). Mandatory elements include: capital improvements; future land use; transportation; general sanitary sewer, solid waste, drainage, potable water, and natural groundwater aquifer recharge; conservation; recreation and open space; housing; intergovernmental coordination; and, for coastal localities, coastal management. *Id.* § 163.3177(6).

⁸² Fla. L. c. 77-331, Community Planning Act of 2011, *amending* F.S. §§ 163.3161, 163.3217.

⁸³ Fla. Stat. § 163.3184.

A.1.1. Key planning elements

Nearly all of St. Augustine's comprehensive plan elements relate to adaption efforts in some fashion, but this section focuses on two elements that are indispensable to the actions discussed in section 4 of this document: future land use and coastal management.

Future Land Use Plan Element. Florida law does not expressly instruct localities to incorporate consideration of SLR or adaptation goals into their future land use plan element, but several Florida Statutes provisions provide a solid legal basis for adding to or revising the existing element's Goals, Objectives, and Policies for that purpose. First and most fundamentally, a future land use element "shall establish the long-term end toward which land use programs and activities are ultimately directed."⁸⁴ This directive would support, for instance, including a Goal pursuant to which *St. Augustine shall ensure that land uses are compatible with sea level rise scenarios projected by the National Oceanic and Atmospheric Administration and the U.S. Army Corps of Engineers through 2050*. Other Florida Statutes provisions further buttress including language of this sort, whether as a Goal or Objective. Florida Statutes § 163.3177(6)(a)3, for instance, instructs that "[t]he future land use plan element shall include criteria to be used to: . . . Coordinate future land uses with the [sic] topography and soil conditions, and the availability of facilities and services." And, similarly, paragraph (6)(a)8 requires future land use map amendments to be based on "analysis of the suitability of the plan amendment for its proposed use considering the character of the undeveloped land, soils, topography, and historic resources on site."

Other statutory language would support more focused plan element amendments. For instance, section 163.3177(6)(a)3g, which directs that the "element shall include criteria to be used to: . . . Provide for the compatibility of adjacent land uses," has clear importance for shoreline armoring and coastal development permitting. Hard armoring is arguably incompatible with either soft armoring or a lack of armoring on adjacent parcels. Similarly, hard armoring or other forms of development reduce the buffering capacity of a shoreline vis-à-vis proximate landward property.

Some of the statutory provisions discouraging urban sprawl also lend themselves to plan element amendments focused on SLR adaptation. In particular, among the indicators of sprawl (which "the future land use plan element shall discourage"), are "[f]ail[ure] to adequately protect and conserve natural resources, such as wetlands, floodplains . . . shorelines, beaches, estuarine systems, and other significant natural systems;" and "[a]llow[ance] for land use patterns or timing which disproportionately increase the cost in time, money, and energy of providing and maintaining facilities and services"⁸⁵

⁸⁴ Fla. Stat. § 163.3177(6)(a).

⁸⁵ Fla. Stat. § (6)(a)9a(IV) & (VIII).

Conservation and Coastal Management Plan Element. The state-level legal underpinnings of this plan element are unique for *requiring* consideration of SLR. SB 1094, enacted in 2015, revised Florida Statutes to instruct coastal localities to include a redevelopment component in their coastal development plan element. Even prior to 2015, that element was to "outline[] the principles that must be used to eliminate inappropriate and unsafe development in the coastal areas when opportunities arise."⁸⁶ SB 1094 specified that the "principles, strategies, and engineering solutions" described in that component must address flood risk arising from several sources, *including SLR*. Although these requirements are phrased a bit elliptically, they can properly be read as providing state sanction for coastal localities seeking to limit—or even "eliminate"—development that is "inappropriate and unsafe" because it is foreseeably vulnerable to the adverse impacts of SLR.

A redevelopment component is the logical place to include guidelines and restrictions that do not take effect until they are triggered by an event, such as flooding of a particular depth, a natural disaster, or even just encroachment of the shoreline to a particular height. Florida's Department of Community Affairs has published a resource that can help inform such provisions, titled *Post-Disaster Redevelopment Planning: A Guide for Florida Communities*.⁸⁷ SB 1094's requirements provide communities with good reason to adopt such measures, and also with a potent tool for inoculating restrictions on development against takings claims (discussed below).

* * *

It is important to recognize that merely mentioning SLR in these and other comprehensive plan elements will not suffice to steer St. Augustine to adapt. A recent survey of references to SLR in plan elements across hundreds of Florida localities identified a number of instances where "SLR language appears in a comprehensive plan and indicates that a government 'shall' do something" but the language calling for action "is often not self-executing."⁸⁸ As a result, the local government's comprehensive plan language "appears more proactive than the tangible actions of a local government in day-to-day operations."⁸⁹ The University of Florida's Conservation Clinic has developed model planning language to help localities inclined to do more.⁹⁰ Their model makes the protect-accommodate-retreat rubric described above into the basis for planning zones: similar issues get different treatment in the managed retreat zone than

⁸⁶ Fla. Stat. § 163.3178(2)(f).

⁸⁷ Florida Department of Community Affairs, *Post-Disaster Redevelopment Planning: A Guide for Florida Communities* (Oct. 2010), <https://perma.cc/923X-V4R5>.

⁸⁸ Thomas Ruppert & Alexander Stewart, Summary and Commentary on Sea Level Rise Adaptation Language in Florida Local Government Comprehensive Plans and Ordinances 4 (July 2015), <http://perma.cc/7VU6-ZGF4>.

⁸⁹ *Id.*

⁹⁰ Macangdang & Newmons, *supra* note 55. Among other things, this model language formulates Goals, Objectives, and Policies for inclusion in planning elements based on the protect-accommodate-retreat rubric. *Id.* at 11.

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they do in the protect zone. Selections from that model, which are excerpted in several places below, can be useful even when taken out of that context.

A.1.2. Appropriate data and analysis for planning

Comprehensive plans must be informed by an analysis of “relevant and appropriate data,”⁹¹ which Florida law requires to be gathered from “professionally accepted sources” or generated by the local government itself “so long as methodologies [for gathering data] are professionally accepted.”⁹² Usable data thus include not just the Army Corps of Engineers and NOAA datasets underlying Dewberry’s Vulnerability Assessment but also data published by the Intergovernmental Panel on Climate Change, the Southeast Florida Regional Compact on Climate Change,⁹³ or other similarly authoritative sources.⁹⁴ Florida law also requires changes to comprehensive plans to be supported by analysis, and that such analysis must reflect reasonable and proportionate applications of the data cited.⁹⁵ “Scientific certainty” is *not* a required feature of supporting data or their analysis.⁹⁶

The flexibility given to localities regarding data and analysis means that Dewberry’s Vulnerability Analysis will not operate as either a “floor” or a “ceiling” for planning purposes. Should St. Augustine refer to the Vulnerability Assessment as supporting particular language or parameters, the city would only need to articulate a logical link between the Assessment and the action—it would not be legally prevented from adopting language that embodied more or less cautious expectations about SLR than contained in the Assessment.

A.1.3. Planning timeframes

Until the legislature enacted SB 1094 in 2015, Florida law instructed localities to use two time frames for planning: five years and ten years. This directive has allowed localities to effectively ignore slow-developing future circumstances that fall outside of this timeframe, such as SLR. SB 1094 changed this by providing that “[a]dditional planning periods for specific

⁹¹ Fla. Stat. § 163.3177(1)(f).

⁹² *Id.*

⁹³ Southeast Florida Regional Climate Compact, Unified Sea Level Rise Projection, (Oct. 2015), <https://perma.cc/49LA-WP6A>.

⁹⁴ FEMA flood insurance rate maps (FIRMs) would also be an authoritative source. However, FIRMs currently represent a snapshot in time that ignores SLR. FEMA, Coastal Frequently Asked Questions: Flood Hazard Mapping Questions, <https://perma.cc/HYN7-XMYS> (last updated Aug. 17, 2016) (“In accordance with the current Code of Federal Regulations, FEMA does not map flood hazards based on anticipated future sea levels or climate change.”). Unless and until FIRMs integrate SLR projections, their utility for planning purposes should be considered limited to the short term.

⁹⁵ The statutory language is somewhat muddier: “To be based on data means to react to it in an appropriate way and to the extent necessary indicated by the data available on that particular subject at the time of adoption of the plan or plan amendment at issue.” *Id.*

⁹⁶ See *Haire v. Florida Dep’t of Agric. & Consumer Servs.*, 870 So. 2d 774, 786 (Fla. 2004) (quoting approvingly from opinion below the proposition that “legislatures are not limited to acting only where there is scientific certainty.”).

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components, elements, land use amendments, or projects shall be permissible and accepted as part of the planning process.”⁹⁷ This invitation to designate time frames freely has vital implications for plans involving assets or facilities whose useful life exceeds 10 years and whose location makes them potentially vulnerable to SLR. Armed with this option, local governments considering the costs and benefits of infrastructure design parameters, planning restrictions, and capital investment options, among other things, can ensure that SLR projections inform their plans. The University of Florida’s Conservation Clinic has drafted model comprehensive plan language that ensures all adaptation planning employs an appropriate timeframe:

Policy 1.2.1: [Planning Horizon] Utilize a () year planning horizon when considering the adoption of any protection, accommodation, and managed retreat strategy within the City/County.⁹⁸

Notably, because SB 1094’s provisions do not *require* use of timeframes of more than 10 years, the law permits a locality to treat information about looming SLR impacts as beyond the mandatory planning timeframe. A locality looking to exclude consideration of SLR from consideration when making decisions about investments in, say, a facility or infrastructure asset with a 30- or 50-year useful life could therefore do so without legal consequence under this provision. Such an exclusion would be imprudent, however, given the certainty of some amount of future SLR, and given that Dewberry’s projections identify where and how much particular locations, assets, and systems are likely to become vulnerable over the coming decades. Such an exclusion might also subject a locality to other legal action. (See section A.2, below.)

A.1.4. Adaptation Action Areas

In addition to giving localities more flexibility and autonomy when updating their planning elements, the 2011 Comprehensive Planning Act also authorized localities to designate as Adaptation Action Areas (AAAs) locations “that experience coastal flooding due to extreme high tides and storm surge, and that are vulnerable to the related impacts of rising sea levels.”⁹⁹ The 2011 Act contemplates two purposes for this designation: “prioritizing funding for infrastructure needs” and “adaptation planning.”¹⁰⁰ Designating one or more AAAs could also serve St. Augustine by providing the basis for various forms of notice to all property owners, permittees, and others with investments or interests in land or assets encompassed by the AAA boundary regarding SLR-related vulnerabilities and potential future changes to land use restrictions. In short, an AAA is a highly flexible and potent version of a zoning overlay,¹⁰¹ which localities can

⁹⁷ Fla. Stat. § 163.3177(5)(a).

⁹⁸ Macangdang & Newmons, *supra* note 55.

⁹⁹ F.S. § 163.3164(1) (defining AAA).

¹⁰⁰ *Id.*

¹⁰¹ For descriptions of zoning overlays and examples of their application, see Siders, *supra* note 44, at 96–97; Jessica Grannis et al., A Model Sea-Level Rise Overlay Zone For Maryland Local Governments Expert Review Report v.3 (Nov. 2011), <https://perma.cc/67RX-PPWJ>; Douglas Codiga & Kylie Wager, Center for Island Climate

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rightly present to residents as expressly and specifically sanctioned by state law, and as a potentially important step toward seeking state and federal funds for adaptation efforts.

A further point about establishing the boundary of an AAA deserves further mention here. Florida law suggests but does not mandate criteria for AAA designation.¹⁰² Whether St. Augustine uses those suggested criteria and/or others, it should consider expressly stating that while the criteria for AAA designation will not change, the AAA's boundary will be reviewed and updated periodically (e.g., every five years, which would align with the schedule of St. Augustine's capital improvement element)¹⁰³ as underlying features change. Such a statement would serve as notice that the AAA is likely to expand or shift as SLR and related topographic changes proceed along current trend lines. It would also serve as notice that, even without revisions to the comprehensive plan, the substance of policies imposed within the AAA could eventually be applied to locations it did not initially encompass.

A.2. Litigation risk

Historically, local governments have sought to reduce the risk of legal challenges by simply maintaining the legal/planning status quo. Now, as SLR shifts the ground under local governments' feet, there is no way to maintain the status quo in both physical and legal/planning terms. The result is potentially a "damned if you do, damned if you don't" situation with respect to litigation risk. If local governments act to address SLR, they could be sued by property owners claiming injury from limitations on the property's use or adverse effects on property values.¹⁰⁴ But local governments could also be sued for *failing* to address SLR, either by persisting with a long-standing but imprudent approach to use of publicly owned land or facilities, or by failing to amplify spending or maintenance schedules to the degree made necessary by SLR to keep some element of coastal protection or infrastructure in good repair.¹⁰⁵ It is important not to overstate the risk of being sued for inaction, and the discussion in A.2.2 clarifies the particular legal

Adaptation and Policy, Sea-Level Rise and Coastal Land Use in Hawai'i: A Policy Tool Kit for State and Local Governments 24–26 (2011), <https://perma.cc/9QJR-HT25>.

¹⁰² Fla. Stat. § 163.3177(6)(g)10: "Criteria for the adaptation action area may include, but need not be limited to, areas for which the land elevations are below, at, or near mean higher high water, which have a hydrologic connection to coastal waters, or which are designated as evacuation zones for storm surge."

¹⁰³ Clearwater, Capital Improvements Element, at I-1, <https://perma.cc/UZ47-HVGB> (last updated Aug. 20, 2013).

¹⁰⁴ But see Thomas Ruppert et al., Sea-Level Rise Adaptation and the Bert J. Harris, Jr., Private Property Rights Protection Act 14–15 (2012) ("a local government defending regulations adapting to SLR should be able to make cogent arguments that, in light of such recently gained knowledge of SLR, reasonable expectations of development on low-lying coastal land should also change."), see also *id.* at 19–20 ("a local government confronted with a challenge to a land use regulation directed at adaptation to SLR might argue that the land involved is not 'suitable' for the use because of 'reasonably foreseeable' SLR that would render the land unsuitable for the proposed use.").

¹⁰⁵ This is a developing area of law. In general, governments are not to be held liable for nonfeasance. See DeShaney v. Winnebago County Department of Social Services, 489 U.S. 189 (1989). However, there have lately been departures from this premise in recent decisions requiring local governments to maintain infrastructure in the face of changing coastlines. See Thomas Ruppert & Carly Grimm, *Drowning in Place: Local Government Costs and Liabilities for Flooding Due to Sea-level Rise*, 87 Fla. Bar J. 29 (Nov. 2013), <https://perma.cc/6SUM-36Q9> (discussing *Jordan v. St. Johns County*).

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questions on this point that were raised and not fully answered by the *Jordan v. St. Johns County* case.

This subsection does not provide a thorough description of litigation risks related to adaptation, and is not intended to provide legal advice, but its summary of key factors highlights what courts may consider when deciding whether a government can be found liable for the effects of adaptation-related decisions.

A.2.1. Sovereign immunity

Sovereign immunity protects Florida local governments from legal challenge for some but not all of their actions.¹⁰⁶ Courts use four guideposts to determine whether a given action is immune, but "Florida courts have struggled to find consistency in their application of the waiver [of sovereign immunity]."¹⁰⁷ The first is the "operational/planning test" articulated by Florida's Supreme Court for determinations of whether an action by a state or local government reflects "quasi-legislative policy-making," which is immune from suit.¹⁰⁸ The test has four conjunctive parts, meaning that a government action must qualify in all four ways to merit sovereign immunity.¹⁰⁹ If all four answers are affirmative then the action involves "planning," is discretionary, and is immune from suit. If any of the answers is negative then the action is "operational," meaning that the law *prescribes* governmental conduct rather than leaving that conduct to the government's *discretion*, and does not immunize the government from suit for

¹⁰⁶ *Wallace v. Dean*, 3 So.3d 1035, 1045 (Fla. 2009) (citing Florida Constitution article II, § 3, which provides for separation of powers among coordinate government branches).

¹⁰⁷ James Wilkins, *Is Sea Level Risk "Foreseeable"? Does It Matter?*, 26 J. Land Use & Envtl. L. 437, 450 (2011). For a thorough discussion of sovereign immunity in Florida, see William N. Drake, Jr. & Thomas A. Bustin, *Governmental Tort Liability in Florida: A Tangled Web*, Fla. Bar J., Feb. 2003; Thomas A. Bustin & William N. Drake, Jr., *Judicial Tort Reform: Transforming Florida's Waiver of Sovereign Immunity Statute*, 32 Stetson L. Rev. 46 (2003).

¹⁰⁸ *Wallace v. Dean*, 3 So.3d at 1041 (citing *Commercial Carrier Corp. v. Indian River County*, 371 So.2d 1010 (Fla. 1979)).

¹⁰⁹ *Commercial Carrier*, 371 So.2d at 1018: 1) Does the challenged act, omission, or decision necessarily involve a basic governmental policy, program, or objective? 2) Is the questioned act, omission, or decision essential to the realization or accomplishment of that policy, program, or objective, as opposed to one which would not change the course or direction of the policy, program, or objective? 3) Does the act, omission, or decision require the exercise of basic policy evaluation, judgment, and expertise on the part of the governmental agency involved? And 4) Does the governmental agency involved possess the requisite constitutional, statutory, or lawful authority and duty to do or make the challenged act, omission, or decision?

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injury arising from that conduct.¹¹⁰ Florida courts' application of this test has not been especially consistent or predictable.¹¹¹

The second guidepost complicates the first. It divides governmental functions into four categories, two of which entail liability. They are 1) legislation, permitting, licensing, and executive functions; 2) law enforcement and protection of public safety; 3) capital improvements and property management; and 4) providing professional, educational, or general services for citizens' health and welfare.¹¹² The Florida Supreme Court has stated that governments engaged in the first two types of functions have no duties for which they might be liable,¹¹³ and that governments engaged in the fourth function—providing direct services—owe the same duties and bear the same risk of liability as private entities so engaged.¹¹⁴ As for the third function, it seeks to distinguish between (a) initial decisions to acquire, build, or upgrade a property or facility and (b) subsequent decisions to maintain that property or facility. Whereas governments' decisions to build or upgrade are immune, maintenance efforts carry liability just as they would for a private owner or operator.¹¹⁵

The third guidepost to note is actually an exception to the upgrade/maintain distinction just discussed. It relates to a government's duty to prevent or warn about dangerous conditions arising from a facility the government owns or operates. It applies if a government 1) creates a dangerous condition, which 2) is not readily apparent to whomever it injures, and 3) the government knew of the condition yet 4) failed to warn the public or avert the danger it created.¹¹⁶ Thus, even if a government demonstrates that it merely maintained a facility rather than upgrading it, it can nonetheless be found liable if a plaintiff's injury arises from facts consistent with these four conditions. Florida courts have also restated this third principle more generally: "Where a defendant's conduct creates a foreseeable zone of risk, the law generally will recognize a duty placed upon defendant either to lessen the risk or see that sufficient precautions are taken to protect others from the harm."¹¹⁷

¹¹⁰ *Cf.* United States v. Varig Airlines, 467 U.S. 797, 808 (1984) (describing basis for operational/planning distinction as follows: "The discretionary function exception . . . marks the boundary between Congress' willingness to impose tort liability on the United States and its desire to protect certain governmental activities from exposure to suit by private individuals.").

¹¹¹ See Theresa K. Bowley, *A Blanket of Immunity Will Not Keep Florida Dry: Proposed Adjustments to Florida's Drainage Regulations and Sovereign Immunity Laws to Account for Climate Change Impacts*, 10 Fla. A&M U.L. Rev. 387, 403 (2015), <https://perma.cc/F7BY-VX83>.

¹¹² *Tranion Park Condo. Ass'n v. City of Hialeah*, 468 So. 2d 912, 919 (Fla. 1985).

¹¹³ *Id.* at 921.

¹¹⁴ *Id.*

¹¹⁵ *Id.*; see also Thomas A. Sawaya, *Capital Improvements and Property Control Functions*, 6 Fla. Prac. Pers. Inj. & Wrongful Death Actions § 9:9 (2014).

¹¹⁶ Henry P. Trawick, Jr., *Modification of Planning Versus Operational Approach*, 4 Fla. Pl. & Pr. Forms § 37:3 (2015).

¹¹⁷ *Kaisner v. Kolb*, 543 So. 2d 732, 735 (Fla. 1989).

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A.2.2. Takings—including via inverse condemnation

Takings law protects private property owners from government actions that fail to provide them with "just compensation" for the condemnation or appropriation of their real property or for regulation that deprives their real property of all or almost all of its use and economic value. In Florida, there are two sources of takings law: the Fifth Amendment to the U.S. Constitution and the Bert Harris Private Property Rights Protection Act.¹¹⁸ This subsection does not provide an extensive explanation of takings law in relation to SLR; such explanations are available from other sources,¹¹⁹ and provide only limited value for discussions like this one of specific programmatic SLR adaptation efforts. Instead, this subsection covers two important points—one practical, one legal.

The practical point arises from takings law being complex, unpredictable in its application to particular cases, and the source of highly fact-specific legal disputes. These features have two important implications for localities. First, plaintiffs who feel strongly about their takings claim against the locality, or about their desire to remain where they are with all the services they have typically received, may bring a lawsuit even if the legal claim is tenuous. Second, fending off such claims will likely involve marshaling detailed factual information and expert testimony—expenses that a locality must incur even if it prevails in court unless the takings claim is so egregiously implausible that the court sees fit to award the locality attorneys' fees. In short: localities planning to undertake SLR adaptation measures should anticipate takings challenges.

The legal point relates to the decision in *Jordan v. St. Johns County*, a decision from Florida's Fifth District Court of Appeal.¹²⁰ That case dealt with the question of whether the county had committed an inverse condemnation and a taking with its temporary moratorium on maintenance on a 1.6-mile stretch of the only road, "Old A1A," that connected a housing subdivision on a barrier island to the mainland.¹²¹ Due to repeated storms and persistent erosion, that maintenance threatened to devour the whole of the county's annual transportation budget.¹²²

¹¹⁸ Fla. Stat. §§ 70.001.

¹¹⁹ See, e.g., Siders, *supra* note 44, at 13–17; Michael Allen Wolf, *Strategies for Making Sea-Level Rise Adaptation Tools "Takings-Proof"*, 28 J. Land Use 157 (2013), <https://perma.cc/WVH8-QZLP>; see also David Dana, *Incentivizing Municipalities to Adapt to Climate Change: Takings Liability and FEMA Reform as Possible Solutions*, 43 B.C. Envtl. Aff. L. Rev. 281 (2016), <https://perma.cc/KB7M-V3WJ>; J. Peter Byrne & Kathryn A. Zyla, *Climate Exactions*, 75 Md. L. Rev. 758 (2016), <https://perma.cc/SNYV-YNZK>; Sean Hecht, *Taking Background Principles Seriously in the Context of Sea-Level Rise*, 39 Vt. L. Rev. 781 (2014-2015), <https://perma.cc/YE5F-2RQN>; Christopher Serkin, *Passive Takings: The State's Affirmative Duty to Protect Property*, 113 Mich. L. Rev. 345 (2014), <https://perma.cc/W3RU-XH9B>.

¹²⁰ 63 So. 3d 835 (Fla. 5th DCA 2011), *rev. declined*, 77 So. 3d 647 (Fla. 2011).

¹²¹ *Jordan*, 63 So. 3d at 837; see also Rubano v. Dept. of Transp., 656 So.2d 1264, 1266-67 (Fla. 1995) ("A taking may occur when governmental action causes a lack of access to one's property even when there is no physical appropriation of the property itself").

¹²² Ruppert & Grimm, *supra* note 105, at 29 ("According to the county, the only feasible way to protect the road from the 'ravages of the ocean' was an expenditure by the county of more than \$13 million to elevate the height of the road by placing large amounts of sand along its entire length from the right-of-way down to the mean high-water mark. The county argued it would have to spend an additional \$5 to \$8 million every three to five years to maintain

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The court in that case agreed with the county that its temporary moratorium was rationally related to public safety and ruled that the moratorium did not amount to an inverse condemnation. The court also stated that Florida law does not give courts the authority to issue injunctions instructing perpetual performance of a duty. However, the court did not reject all of the plaintiff's arguments. It declared that "the County has a duty to reasonably maintain Old A1A as long as it is a public road dedicated to public use," and must ensure that the road provides "meaningful access."¹²³ It did not further define "reasonably maintain" or "meaningful access," and even stated that "[w]e do not hold that the County has the duty to maintain the road in a particular manner or at a particular level of accessibility."¹²⁴ It also left open the possibility that a future claim for taking via inverse condemnation *could* prevail: "governmental inaction—in the face of an affirmative duty to act—can support a claim for inverse condemnation."¹²⁵ Importantly, the court did not decide whether the county had actually fulfilled its duties or effectively abandoned the road, but remanded the case to the trial court to resolve the underlying factual disputes. Rather than continue the fight, the parties settled.

What does *Jordan v. St. Johns County* mean for St. Augustine? In addition to illustrating the likelihood of litigation arising from ad hoc deferrals or moratoria on maintenance for key roads and infrastructure, it also serves to highlight the value of addressing issues like prohibitively high maintenance costs in the context of the planning process. The *Jordan* decision took note of the fact that the county never formally voted to terminate road maintenance,¹²⁶ and hinted strongly to the parties that a formal decision to abandon the road would absolve the county of the duties on which the plaintiffs' claims were based.¹²⁷ Not only would addressing the issue legislatively have provided more legal cover, it would also been an opportunity to identify potential areas of compromise or settlement among the parties and to embody that compromise in a long-term plan for adapting (likely by eventually abandoning) both the road and barrier island.

Although *Jordan* dealt with a road, it is easy to imagine similar disputes over other types of infrastructure, such as electricity, stormwater, or wastewater. Thus St. Augustine might consider more than one application of some or all of the language in a model ordinance proposed in response to *Jordan* by Tom Ruppert and others—Florida attorneys who are expert in adaptation and land use.¹²⁸ That model ordinance creates a special category for roads like Old A1A: "any road categorized as 'environmentally compromised' under this ordinance shall be the subject of a

that protection. . . . more than the entire county budget for repair and maintenance of 800 miles of roads in the county.").

¹²³ *Jordan*, 63 So. 3d at 838.

¹²⁴ *Id.*

¹²⁵ *Id.* at 839.

¹²⁶ *Id.* at 838.

¹²⁷ *Id.*

¹²⁸ Thomas Ruppert et al., Environmentally Compromised Road Segments—A Model Ordinance, <https://perma.cc/3RLM-DY7K> (last visited Jan. 6, 2017).

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requested design/maintenance exception."¹²⁹ It provides thorough definitions of key terms, such as "environmentally challenging location" and "environmentally compromised local road segment," which support decisions to reduce a given road segment's level of service based on the cost of its upkeep relative to that of other local road segments. By making the relative cost of upkeep (rather than simple dollar-amounts) the threshold for level of service reduction, the approach taken by the model ordinance creates flexibility for a local government confronted with both budget constraints and multiple acute adaptation issues.

¹²⁹ *Id.* at para. 1.

Appendix B: Methodology, Lessons Learned, & Recommendations

This appendix contains three sections related to Task 2 of the pilot phase of the Community Resiliency Initiative, performed by the Sabin Center for Climate Change Law at Columbia Law School (“Sabin Center”). The first section describes the Sabin Center’s methodology for developing an Adaptation Plan for the City of St. Augustine. The second section describes lessons learned in the course of carrying out Task 2. The third section sets forth recommendations for the Florida Department of Economic Opportunity (“DEO”) as it decides whether and how to shift from the pilot phase to fuller implementation of the Community Resiliency Initiative.

1. Methodology

While Dewberry Consultants LLC (“Dewberry”) conducted Task 1, the Sabin Center conducted preliminary research into adaptation law and policy generally, adaptation law and policy as implemented by Florida localities, and Florida law related to comprehensive planning, climate change adaptation, takings, and municipal liability.

In advance of the October 2016 Preliminary Workshop, the Sabin Center reviewed Dewberry’s Vulnerability Assessment for St. Augustine, as well as St. Augustine’s comprehensive plan elements and various reports and documents that described its economic profile and recent hazard mitigation and/or disaster recovery efforts. This review informed the presentation the Sabin Center developed for the Preliminary Workshop, as well as its structuring of the discussion conducted at that Workshop.

The Sabin Center’s presentation to Preliminary Workshop participants, which covered adaptation policy and relevant areas of Florida law, provided the basis for a facilitated discussion of potential responses to the vulnerabilities identified by Dewberry’s Vulnerability Assessment and described in further detail by participants.

Following the Preliminary Workshop, the Sabin Center provided a summary document to participants (attached as Appendix B to the Adaptation Plan) and conducted further research into areas that local officials at the Preliminary Workshop and in subsequent communication characterized as pressing or especially important for St. Augustine. This research examined the academic literature and federal, state, and local governmental agency reports for discussions of those areas of consideration. It sought in particular to locate descriptions of how other jurisdictions had dealt with similar circumstances and issues. Using the original research and analysis conducted in advance of the Preliminary Workshop, details and insights collected from local officials during the Preliminary Workshop, and the articles and reports located through supplemental research, the Sabin Center developed St. Augustine’s draft Adaptation Plan and sought local officials’ feedback on that Plan.

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2. Lessons Learned

The following observations and insights are based on the experience of gathering information about and developing an Adaptation Plan for St. Augustine. They could be useful for future adaptation planning efforts by other Florida localities and/or DEO.

Coordination among project team members. Project team members from DEO, Dewberry, and the Sabin Center each had distinct perspectives and unique resources available to them. Coordination among team members with legal, engineering, and policy expertise is important for aligning approaches so as to achieve the project’s overarching goals.

Scoping. The scope of issues relevant to a locality’s options and goals for adaptation can be extremely wide. Similarly, it is possible to delve in great depth into particular issues—whether they are programmatic, procedural, legal, engineering, or other. The Adaptation Plan reflects an iterative process, which began with a kickoff call, continued with the Preliminary Workshop and follow-up documentation of that Workshop’s discussion, and wrapped up with feedback from St. Augustine on the draft Adaptation Plan. However, given the breadth and depth of possible approaches to adaptation, additional iterative steps might have been helpful to refine the scope of the Adaptation Plan. Additional iterative steps in subsequent efforts should include: two questionnaires, one sent before the Workshop to ask participants about their goals and expectations for the Workshop and the project as a whole, and another sent after the Workshop to ask participants about how they and/or their departments would like to make use of the Adaptation Plan.

Local officials want to better understand their options and constraints. St. Augustine officials were eager to learn about how Florida takings law could be expected to interact with the adoption of changes to a comprehensive plan element, of measures that apply to only part of the city, or of measures implemented by a departmental decision rather than formal regulatory process. They were also curious to know how localities elsewhere had responded to problems like those they were facing.

Gathering information. Plan elements, ordinances, and some locality-specific reports were publically available. However, details about important features of St. Augustine’s adaptation profile, approach to historic preservation, and regulatory decision making processes could only be gathered from local officials. While the Preliminary Workshop served as a good means of identifying and collecting much of that information, future adaptation planning efforts would be aided by the collection of a standard set of documents relating to:

- Applications of legal and other criteria to historic preservation sites in St. Augustine;
- St. Augustine’s budgeting process, particularly in relation to wastewater management systems;

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- St. Augustine's recent experiences with federally-funded disaster planning, mitigation, and recovery; and
- Examples of adaptation planning reports or materials developed by other localities that St. Augustine officials have found to be informative and/or worth imitating in part or as a whole.

Hurricane Matthew validated Dewberry's Vulnerability Assessment. Local officials reported that Hurricane Matthew, which struck while Task 2 was underway, resulted in impacts that were highly consistent with those anticipated by Dewberry's Vulnerability Assessment. This alignment suggested part of an answer to local officials' questions about how to communicate with the public about the city's vulnerabilities: by recording in detail the adverse impacts of flooding and recalling those impacts during presentations on or discussions of options for adaptation, it is possible to draw on the public's recent direct experiences to convey the value of adapting to avoid similar experiences in the future.

Framing the comprehensive nature of adaptation planning. Some local officials seemed to understand the task of adaptation planning as a temporary intervention in the normal course of business, rather than the first instance of an approach to land use and capital investment planning that would involve permanent changes relative to past practice. As discussed in the Adaptation Plan, the most basic and important aspect of adaptation is to recognize that the coastlines and climate of the future will not only depart from those of the past but will continue to change—and so will require coastal localities to adapt continuously. This point should be conveyed early in the process and reinforced at each stage. Doing so will help participants to make the best possible use of the time with and access to experts, chiefly by shaping the Vulnerability Assessment and Adaptation Plan generated in the course of the project to be maximally useful for St. Augustine.

3. Recommendations for DEO

Localities are well positioned to identify the vulnerabilities to which adaptation is necessary. They are also uniquely well-informed about how best to set priorities for addressing those vulnerabilities. However, leadership from a statewide authority like DEO, the Department of Environmental Protection, or the Department of Transportation is critical to the success of adaptation to sea level rise in Florida. Statewide leadership can facilitate coordinated and potentially synergistic efforts among multiple localities. It can take pressure off of local officials who might otherwise face insurmountable political hurdles. And it can help make useful information, expertise, and funding accessible to those in need of it in a way that individual localities generally cannot do. This leadership role is even more critical now, as the federal government agencies that have served these centralizing roles to date are being directed away from further engagement. Consistent with these essential objectives, DEO should:

- Create an online database that shares the experiences of Florida localities already engaged in adaptation planning and implementation. In contrast to databases

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maintained by the Georgetown Climate Center and the Climate Adaptation Knowledge Exchange,¹³⁰ a Florida-specific database would provide Florida localities with a manageable volume of resources, all of which reflect efforts to contend with similar challenges in the same legal and policy context. DEO might consider collaborating with the Southeast Florida Regional Climate Compact in this effort, as the Compact has already established a database of this sort.¹³¹

- Create a web portal that makes available technical information such as building codes, stormwater and wastewater equipment specifications, and disaster mitigation plans that have been shown to be especially effective in the face of rising seas and strengthening storms. Locating resources (or even just links to resources) like these in one place in an organized way would facilitate not just access but also comparisons of technical approaches across jurisdictions.

¹³⁰ Climate Adaptation Knowledge Exchange, <http://www.cakex.org/>; Georgetown Climate Center, State and Local Adaptation Plans, <http://www.georgetownclimate.org/adaptation/plans.html>.

¹³¹ Southeast Florida Regional Climate Change Compact, RCAP Database, <http://rcap.southeastfloridaclimatecompact.org/>.

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Appendix C: Preliminary Workshop Summary

Coastal Resiliency Initiative, Preliminary Workshop
St. Augustine, Florida | October 24, 2016

Summary

The Preliminary Workshop conducted on October 24, 2016 served several interwoven objectives, including:

1. Developing a common framework for understanding physical and policy options for adapting to sea level rise (SLR);
2. Characterizing the relationship between St. Augustine's historic district and buildings and its adaptation goals;
3. Characterizing particular adaptation issues in terms of their urgency, scale (physical and budgetary), relevance to particular constituencies, and ease or difficulty of address;
4. Identifying strategies suitable for addressing particular adaptation issues.

This summary organizes items covered during the Workshop in terms of those four objectives. It also notes several preliminary decisions taken, based in part on discussion of those items.

Framework for policy options

Responses to vulnerabilities resulting from SLR involves either (1) protecting current land uses and patterns of activity in vulnerable areas (protect), (2) reducing vulnerabilities by modifying those uses and patterns (accommodate), or steering clear of vulnerabilities by (3) moving existing people and structures (retreat) or (4) deciding against development (avoid). Implementing these approaches cost-effectively involves steering private decisions, as well as grounding decisions about the location and design of infrastructure in the best available information about future circumstances—topography, weather, and fiscal constraints, among others. Imposing restrictions on development can create legal risk for a locality. So too can the use of infrastructure funding to encourage accommodation, avoidance, or retreat from vulnerable locations. However, legal risks will increasingly also attend failures to do so.

Relationship between historic elements and adaptation goals

Rising sea levels confront St. Augustine with an existential conundrum. The city is a tourist destination in large part because of its historic district's buildings and their surrounding streets, squares, and waterfront. Unfortunately, those buildings stand in the path of increasingly frequent and severe flooding, and their material components make them highly susceptible to flood damage. Furthermore, efforts to make the city's historic buildings less vulnerable by elevating or relocating them would unravel significant aspects of the city's historic fabric and would be difficult to accomplish besides, as those buildings are largely unsuitable for either elevation or complete removal to a different location. This dire situation is not likely to inspire enthusiastic action on the part of residents and council members in response to calls for prudent steps toward adaptation—specifically, accommodation measures in the near term and at least partial retreat in the longer term. Notably, sharply rising property values are

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currently compounding this collision between enthusiasm for investing in St. Augustine as it is today and investing in adaptation.

Adaptation issues and responsive strategies

The Workshop's "structured discussion" segments considered adaptation issues and responsive strategies. The main issue areas covered were: stormwater and wastewater management; flood insurance and freeboard requirements; historic & archeological resources; roads and bridges; disaster recovery; and the related tasks of budgeting, maintaining revenues, and justifying adaptation planning measures to elected officials and the public. The following table, which is organized by issue area, lists key points from the participants' discussion. It is not an exhaustive record of that discussion. The arrows in the right column indicate that the paragraph relates to the issue at left.

<i>Issue area</i>	<i>Issues identified</i>	<i>Responsive strategies discussed</i>
Stormwater & wastewater management	- Stormwater control systems are being outfitted with backflow prevention valves, but currently facilitate nuisance flooding	➔ Complete installation of backflow preventers Identify additional measures likely to be required in near-/medium-term
	- Many of the pipes that carry stormwater are old	➔ Explore installing bioswales etc. in public rights of way in addition to promoting low impact development by imposing a stormwater utility fee
	- Adverse impacts of SLR owing to current stormwater management system are most acutely felt by private property owners whose lawns are killed at least once per year by saltwater inundation	➔ Armoring the WWTP would reduce its vulnerability for while, but would damage the adjacent marsh; participants also discussed what would be required to plan for the relocation of the WWTP inland—an expensive and unwelcome prospect
	- The wastewater treatment plant is highly vulnerable to flooding and coastal storm events; its remaining useful life would be 30-50 years but for SLR; it is located adjacent to marshlands	➔ The city will acquire mobile pumps and harden system elements, such as the pumps whose electrical panels shorted out amid flooding; here again, participants stated that the
	- The wastewater management system more generally is also vulnerable: flooding incidental	

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	to Hurricane Matthew inundated several wastewater pumps, shorting out their electric panels and making it impossible to operate them even after mobile generators were brought to supply backup power	expense, disruption, and fatal implication of relocating wastewater system elements made such a step unwelcome
Flood insurance and freeboard	- FEMA's proposed revision to the city's flood insurance rate maps (FIRMs) would <i>reduce</i> the extent of flood zones and thereby undermine the existing base flood elevation (BFE) requirements that have caused numerous property owners to elevate their residences or businesses - Flooding incidental to Hurricane Matthew reached to precisely the levels predicted by existing FIRMs and related BFE requirements	→ Consider requesting reconsideration by FEMA. FIRM mapping builds on data from randomly selected past flood events; reconsideration can therefore easily prompt revision/correction to inappropriately rosy maps → Push ahead with imposition of freeboard and consider requiring more than 1' Collect elevation certificates to support changes to freeboard requirement, Community Rating System
Historic & archeological resources	- Flooding incidental to Hurricane Matthew did significant damage to historic interiors in particular; several building owners have sought permission to gut their buildings and replace historical interiors; more post-Matthew requests for full or partial demolition are expected - There is general recognition that historic buildings – and character of the historic district – are vulnerable and will only become more so	→ Explore options for restricting and/or steering rebuilding Examine opportunities for buyouts, downzoning → The public must be involved in the process of prioritizing buildings (or facades) to save using protective and/or retreat measures, as well as in determining how much to spend on doing so, and when to implement those measures

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	- Numerous archaeological sites will be inundated and thereby compromised for study	→ Two types of decisions required: (1) which sites to excavate quickly, and (2) whether and how much to attempt the digital mapping and recording of information, including at sites that will not be fully excavated
Roads, bridges	- Several roads are failing due to age and also to repeated inundation - Most thoroughfares and bridges are state owned and the state has made decisions about their design and upkeep that reflect no consideration for sea level rise - City council is currently engaged in an effort to promote pedestrian and bicycle access	→ Consider revising approach to budgeting that captures added costs of keeping up roads amid flooding (this will support specification of the "costs" side of a cost-benefit analysis that examines whether to discontinue maintaining a given road → Raise concerns with the state about their design decisions; propose alternatives, framing issue in cost terms → Look for ways to integrate mobility and flood control priorities, such as bioswales in the ROW or permeable pavements in locations beyond Flagler campus
Disaster recovery	- Flood waters amid Hurricane Matthew reached predicted levels - Wastewater system was impaired and overwhelmed, and now requires substantial repair	→ Hurricane Matthew and the process of recovering from it provide an opportunity to engage the public about the reasons for adaptation and what adaptation will require → Matthew is also a source of data about costs of restoring buildings and assets that are not resilient; capturing those data can support restrictions and requirements that avoid similar future costs; in relation to the WWTP, such data should inform cost and timing components of plans to repair vs. decommission the existing plant

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	→ Identify properties that could be or become targets for living shorelines, whether in collaboration with property owner or through buyout → Use combo of Matthew and SB 1094 as prompting to draft redevelopment component of coastal management element - Use restrictions to make up (somewhat at least) for changes to flood maps → Query FEMA re basis for this preference; ask about degree of flexibility available, and note that relevant statutes don't require complete fidelity to pre-disaster conditions¹
	- Flooding amid Matthew was especially pronounced in predictable areas - City currently has no ordinance that directly addresses post-disaster redevelopment - FEMA seems to want plans that restore rather than plans that improve resiliency (HMGP grant requirements require post-disaster restoration of pre-disaster conditions)
Justifying adaptation measures	→ Begin capturing costs of business as usual (BAU) for use as a baseline; likely examples are road maintenance and repair/restoration of wastewater system; Build objective triggers, such as Mean High High Water levels, into planning elements so that difficult steps follow from circumstance and not from the judgment call made by a given person or office → Capture the costs to private property owners and public budgets from Matthew, nuisance flooding, e.g., by surveying property owners for annual spending on lawn care and replacement, comparing damage in St. Augustine with damage in St. Johns county (where tighter coastal development restrictions apply)
	- Costs of adaptation are daunting, in addition to adaptation itself entailing unwelcome changes - Real estate prices are currently rising

¹ See Gundlach & Jones (2016), available at <http://wordpress.ei.columbia.edu/climate-change-law/files/2016/06/Gundlach-and-Jones-2016-04-Climate-Change-Integration-in-HUD-Program.pdf>.

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- How to choose what to call an Adaptation Action Area? - Bert Harris Act threatens restrictions on development	→ Explain the introduction of Adaptation Action Areas (or just one large Area) as serving several purposes, including some that narrowly relevant and some that are more general—and so will allow flexibility to respond to changing physical or political circumstances by tightening restrictions on (re)development in the AAA → Recognize that key language is “inordinate burden” and make the “burden” both data-based and standard for all similarly situated property owners
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Decisions

- Should the work product submitted to St. Augustine be a free-standing document that identifies and analyzes a range of adaptation options? or should it be broken into components intended for specific uses in some planning Elements but not others?
Preliminary answer: freestanding document.
- How should priorities be set for choosing among adaptation strategies?
Preliminary answer: selection criteria include feasibility, salience for the public, urgency, cost.
- What adaptation issues, options and strategies should take priority?
Preliminary answer: Formulation of an approach to decisions about how to respond as historic resources in vulnerable areas come under increasing threat. Also, wastewater management system planning and restrictions on redevelopment with an eye to (i) more cost-effective disaster recovery and (ii) lower maintenance costs.
- Are legislative changes necessary to enable or support preferred strategies?

Appendix C: Preliminary Workshop Summary

Preliminary answer: Legislative approval from the City Council will be necessary to implement some but not all strategies. No new state-level legislation seems to be required.

6.5. Example Vulnerability Analysis

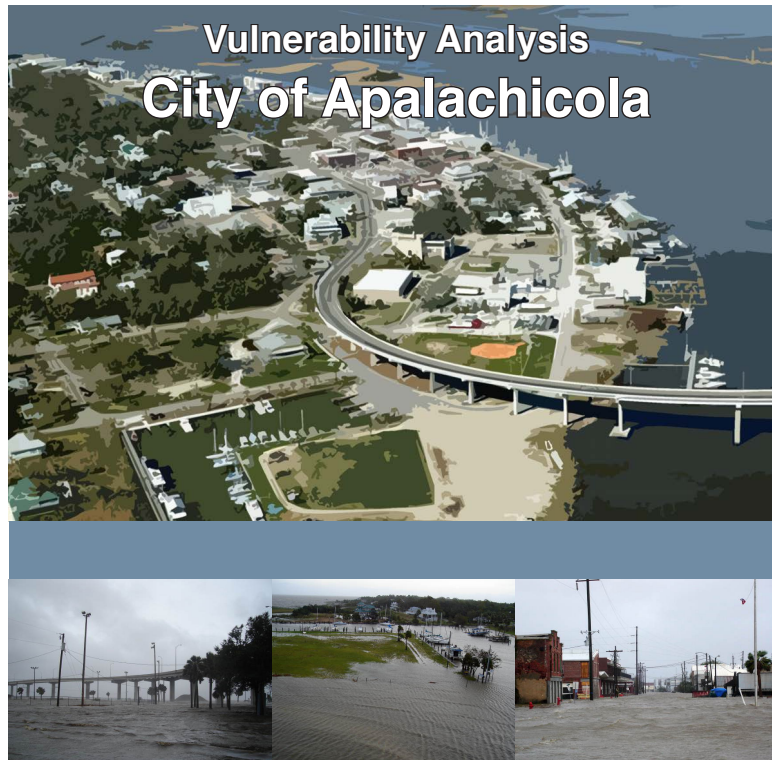
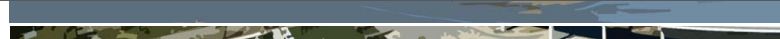


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Vulnerability Analysis Map Disclaimer

The City of Apalachicola Vulnerability Analysis data and maps are for planning, education and awareness purposes only. The information contained herein should not be used for site-specific analysis, navigation and flood rates or permitting. The City of Apalachicola makes no warranty explicit or implied, regarding the accuracy or use of this information. The purpose of this data is to provide a preliminary look at Sea Level Rise (SLR), erosion and coastal flooding impacts. The data and maps in this report illustrate the scale of potential flooding, not the exact location. The inundation areas depicted in the SLR analysis are not as precise as they may appear. The data, maps and information provided should be used only as a screening-level tool for management decisions.

About this Collection

These data illustrate potential flooding from future sea level rise—from current mean higher high water to a six-foot rise. Mapping confidence layers highlight errors related to elevation and water height data. All data are based on the best available elevation data at the time of their creation. These data are used in NOAA's Sea Level Rise and Coastal Flooding Impacts Viewer, a screening-level tool that uses nationally consistent data sets and analyses. The viewer can be accessed at <https://coast.noaa.gov/digitalcoast/tools/slr>

Limitations and Notes

Working with Elevation Data. There are different methods of modeling and mapping coastal inundation. The NOAA models used as part of this study are considered still water (or "bathtub") models are coarse approaches that use water level and topographical data and apply sea level rise scenarios at constant elevations but do not include other factors such as erosion, tide, storm surge, wave dynamics, landform responses, or interaction with stormwater management systems. Maps generated from these models provide the basis for applying the sea level rise scenarios to assess potential extent and severity of flooding. While they have many limitations and should not be used for site-specific analysis, bathtub models are useful for visualizing potential extents of future high water levels for initial consideration of vulnerabilities.

These data illustrate the scale of potential flooding, not the exact location, and do not account for erosion, subsidence, or future construction. Inundation is shown as it would appear during the highest high tides (excludes wind driven tides) with the sea level rise amount. These data should be used only as a screening-level tool for management decisions. As with all remotely sensed data, all features should be verified with a site visit. The data are provided "as is," without warranty to their performance, merchantable state, or fitness for any particular purpose. The entire risk associated with the results and performance of these data is assumed by the user. These data should be used strictly as a planning reference and not for navigation, permitting, or other legal purposes.

The mapping does not incorporate future changes in coastal geomorphology and the digital elevation model used to map sea level rise does not incorporate a detailed pipe network analysis. However, applied at the appropriate scale, the use of the data contained herein provides a useful indicator of potentially vulnerable infrastructure under various SLR and tidal scenarios.



About The City

Vulnerability Analysis

The City of Apalachicola is located in Northwest Florida west of the junction of the Apalachicola River and Apalachicola Bay. The influx of freshwater from the Apalachicola River forms the Apalachicola National Estuary and is considered to be one of the most resource rich ecological systems in the United States. The Apalachicola Bay estuarine system constitutes the most environmentally sensitive area within Franklin County. Apalachicola is located approximately 60 miles east of Panama City and approximately 80 miles southwest of Tallahassee. Access to Apalachicola can only be achieved via State Highway 98 which runs east to west through the City. State Highway 98 is the only means of evacuation from the City.

The City covers approximately 2.0 square miles, approximately 1050 acres. It is bound on the east by the Apalachicola River, on the south by Apalachicola Bay, on the north by Scipio Creek, and the west by rural development and undeveloped forest land.

Elevations within the City generally range between 0 and 16 feet. The City is generally low relief in terms of elevation. Some areas are located in lower elevations close to sea level and some areas are on broad, low hills. The higher elevations coincide with sandy, well drained hills. The lower elevations are generally poorly drained. The lower elevations are also more prone to flooding. The lower elevations are along the shoreline and inland for two blocks, generally. The City has approximately 20,000 linear feet of shoreline.

City of Apalachicola Vulnerability Analysis

Overview of Vulnerability and Methodology

The vulnerability analysis portion of this report utilizes hazard-specific data to determine the short and long-term vulnerabilities of Sea Level Rise facing critical infrastructure, coastal properties and historic resources within the City Apalachicola. Much of this analysis focuses on the C-1, C-4 and RF zoning districts of the City's downtown historic district. For the purposes of this analysis, these districts represent a Focus Area where, upon review of the vulnerabilities, the City may wish to consider it a designated Adaptation Action Area to implement adaptation strategies for mitigating coastal flooding impacts.

Using Geographic Information System (GIS) data provided by the City of Apalachicola Planning Department, the Franklin County Property Appraiser's Office, SLR Model data from the National Oceanic and Atmospheric Administration (NOAA), and the Federal Emergency Management Agency (FEMA), the City was able to determine vulnerabilities from five perspectives.

1. Citywide Anticipated Impact. This series of GIS-based SLR modeling maps show the anticipated impacts of SLR on the City as evidenced by the low, medium and high inundation areas.
2. Critical Facility Exposure. This map details the critical facilities within the City that will be impacted by low, medium and high inundation levels.
3. City-owned and Publicly-owned Property Exposure. This map and data details those City and public-ly-owned properties that will be impacted by low, medium and high inundations levels.
4. Financial Exposure. The financial exposure hazard analysis determines the property value of those parcels within the City's C-1, C-4 and RF district that will be impacted by low, medium and high inundation levels.
5. Historic Resource Exposure. This analysis identifies the impact to the City's historic resources as identified on the Florida State Master Site File within the low, medium and high inundation areas.

Using the Model

Six NOAA SLR inundation model datasets (1-6 foot increments) were imported into the City's GIS map to illustrate the potential inundation of floodwaters to the City. The results illustrate the vulnerability of the town's critical facilities, infrastructure, property and historic resources. For the purpose of this study, the zero to two (0-2) foot model datasets represent low inundation, the zero to four (0-4) foot model data sets represent medium inundation and the zero to six (0-6) foot model datasets represents high inundation. Isolated pockets of SLR are found inland of the coastal inundation areas and are represented separately on the map as ALFL_MOB_TLH2 layers. These areas represent low-lying elevations of the City and are not a model anomaly.

The tables and maps within this analysis reflect the acreage affected by low, medium and high inundation.

Table 1. Apalachicola Parcel Exposure to Sea Level Rise Projections

SLR Inundation	Parcel Acreage
Low	21.57 acres
Medium	47.71 acres
High	58.95 acres

Low Level Inundation - 38.51 acres

The total area of low level inundation was calculated around the City, not including marshes, to be 38.51 acres. This area includes roads, alleys, and unconstructed, platted roads. The total impact area to platted lots was calculated at 21.57 acres.

The projected low level of inundation would primarily affect parcels located along the extreme north (Wharf Lot I, Lots 38-49) and south end of the riverfront along Water Street (Wharf Lots 4-11 and a portion of Battery Park) and along the bayfront marsh along Bay Avenue (portions of blocks 192-198).

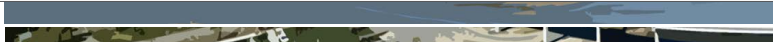
Many of the riverfront parcels affected between Avenue H north to Scipio Creek are already either wetlands or submerged and not suitable for development. There is a two block area between Market Street and Water street and Avenue I and J (Blocks K-1 and K-2) that also show inundation effects. The GIS wetlands parcel indicate wetlands on these parcels but a windshield survey disputes that. Block K-1 parcel is where the Water Street Hotel is located and K-2 parcel contains vacant cleared commercial property and the City parking lot. The FEMA flood zones for the riverfront lots range from AE12 at the north end to VE15 at the south end of Water Street.

Riverfront businesses along the northern and southern riverfront would be potentially inundated. A significant percentage of the commercial development within the impacted area have been built since the City adopted its initial floodplain management regulations in the early 80s' and are elevated to the required BFE levels in place at that time. Those older businesses in the impact area are primarily water-dependent businesses such as commercial seafood businesses which are designed to handle a certain amount of flow-through water. It is conceivable that ground-level equipment for all businesses along the riverfront inundation area may be impacted.

Along the Bay Avenue blocks, the projected inundation area primarily encompasses a thick fringe of existing wetlands. The FEMA flood zones for those areas fluctuates between VE14 and VE15. Without exception, all of the development along the bay inundation area is residential in nature and all have been built in compliance with floodplain management regulations in effect since the early 80s.

Medium Level Inundation - 94.20 acres

The total area of medium level inundation was calculated around the City, not including marshes, to be 94.20 acres. This area includes roads, alleys, and unconstructed, platted roads. The total impact area to platted lots was calculated at 47.71 acres.



The projected medium level of inundation would affect more than twice the low level projection area, basically expanding a wider band along the City's Riverfront and bayfront. Along the riverfront, the inundation area expands south to Avenue E (Highway 98) east from the River to Market Street. The broader band includes Wharf lots 23 through 49 as well as entire blocks G1, G2, H1, H2, J1, J2, K1, K2k, L, M, N, O, P & Q up through the City's Scipio Creek area. Interestingly, the expansion is not as pronounced at the southern end of the river, expanding only halfway into blocks A-1 and B-1and including most of the Battery Park area. The FEMA flood zones for the expanded commercial areas ranges from AE12 to the V zone classifications.

The projected medium level inundation area encompasses a greater number of downtown commercial buildings and critical infrastructure. There are a number of historic resources located within this inundation zone. Many of the commercial buildings are pre-firm construction and do not meet current FEMA required base flood elevations.

Along the bayfront, the inundation absorbs more of the same blocks (blocks 192-198) noted in the low level projection. The FEMA Flood Zones for those areas fluctuates between VE14 and VE15. All of the residential homes located in this exclusively residential area are elevated and are probably compliant with current FEMA base flood elevation requirements.

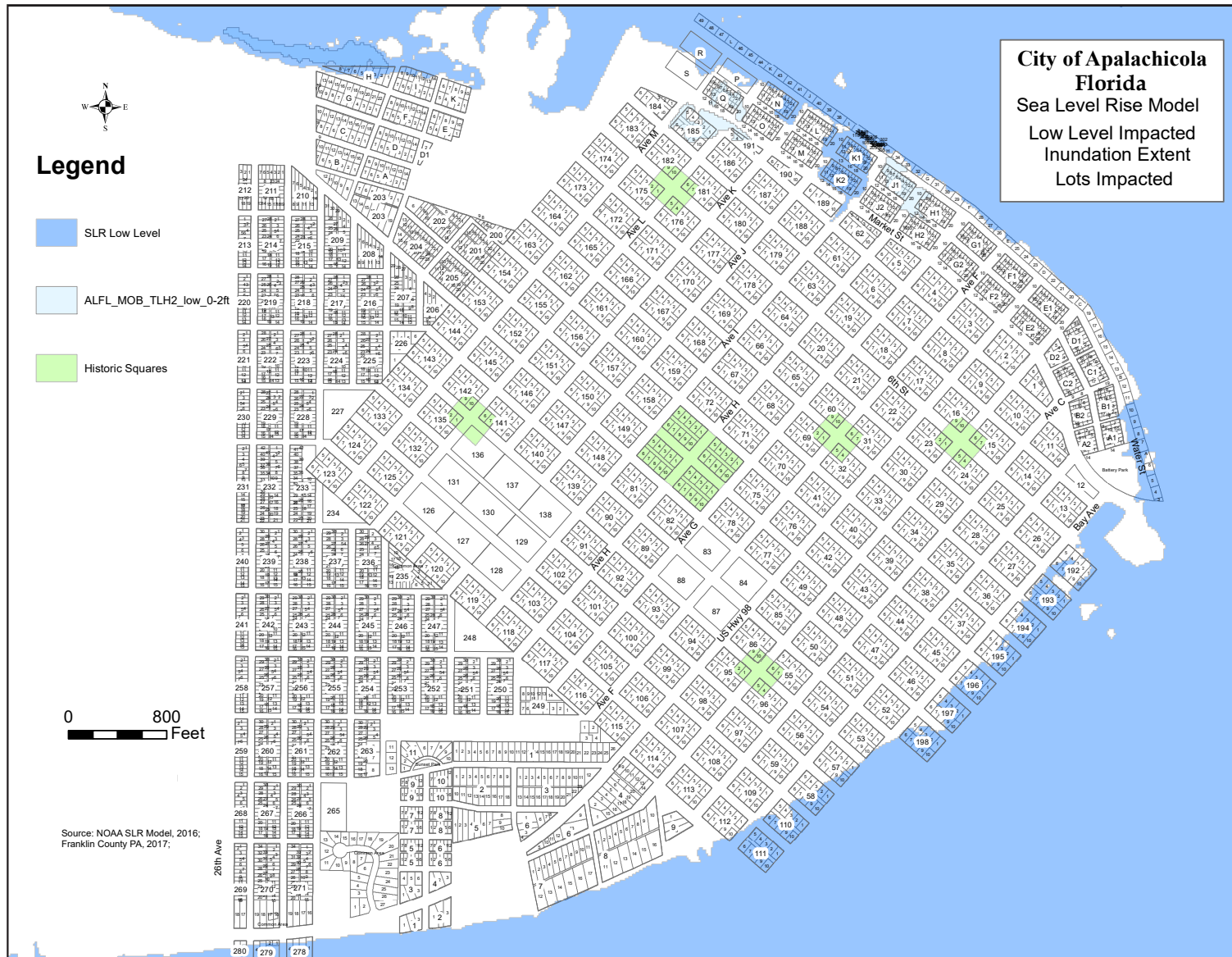
High Level Inundation - 119.85 acres

The total area of low level inundation was calculated around the City, not including marshes, to be 116.22 acres. This area includes roads, alleys, and unconstructed, platted roads. The total impact area to platted lots was calculated at 62.58 acres. This area includes two isolated areas of inundation.

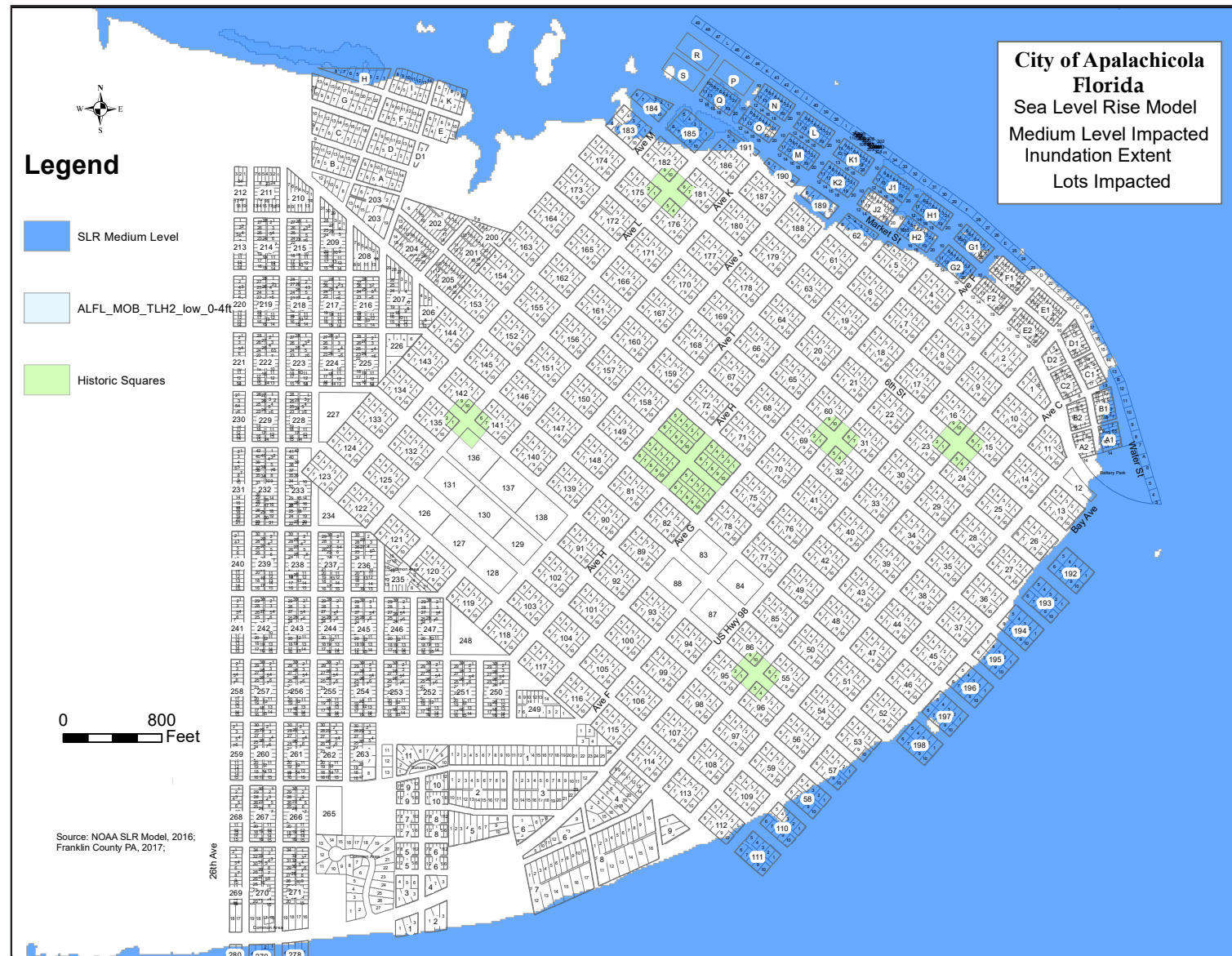
The projected high level of inundation - defined as the six (6) foot inundation model - would expand the impact area within the City to over 1169 acres. Surprisingly, the expansion would not grow significantly in terms of area but the inundation level would be higher in those areas already impacted by the low and medium inundation model projections. Along the downtown commercial district, inundation levels would no doubt impact pre-firm construction, historic resources would be compromised and even post FIRM structures may possibly be impacted from the inundation. The model projects an area of inundation would expand from the river upland to 5th street at the north end of the City impacting blocks 183 through 185 - an area with a FEMA flood zone rating of AE11.

Along the bayfront, the impact area spreads into more of the FEMA zone VE15 area affecting Blocks 53, 57, 58, 110 and 111. It is possible some of the pre-firm residential development in this area could be affected.

Map 1. Low Projected Inundation



Map 2. Medium Projected Inundation



Critical Facility Vulnerability Analysis

Analysis of the effects of low, medium and high inundation on the critical facilities within the City

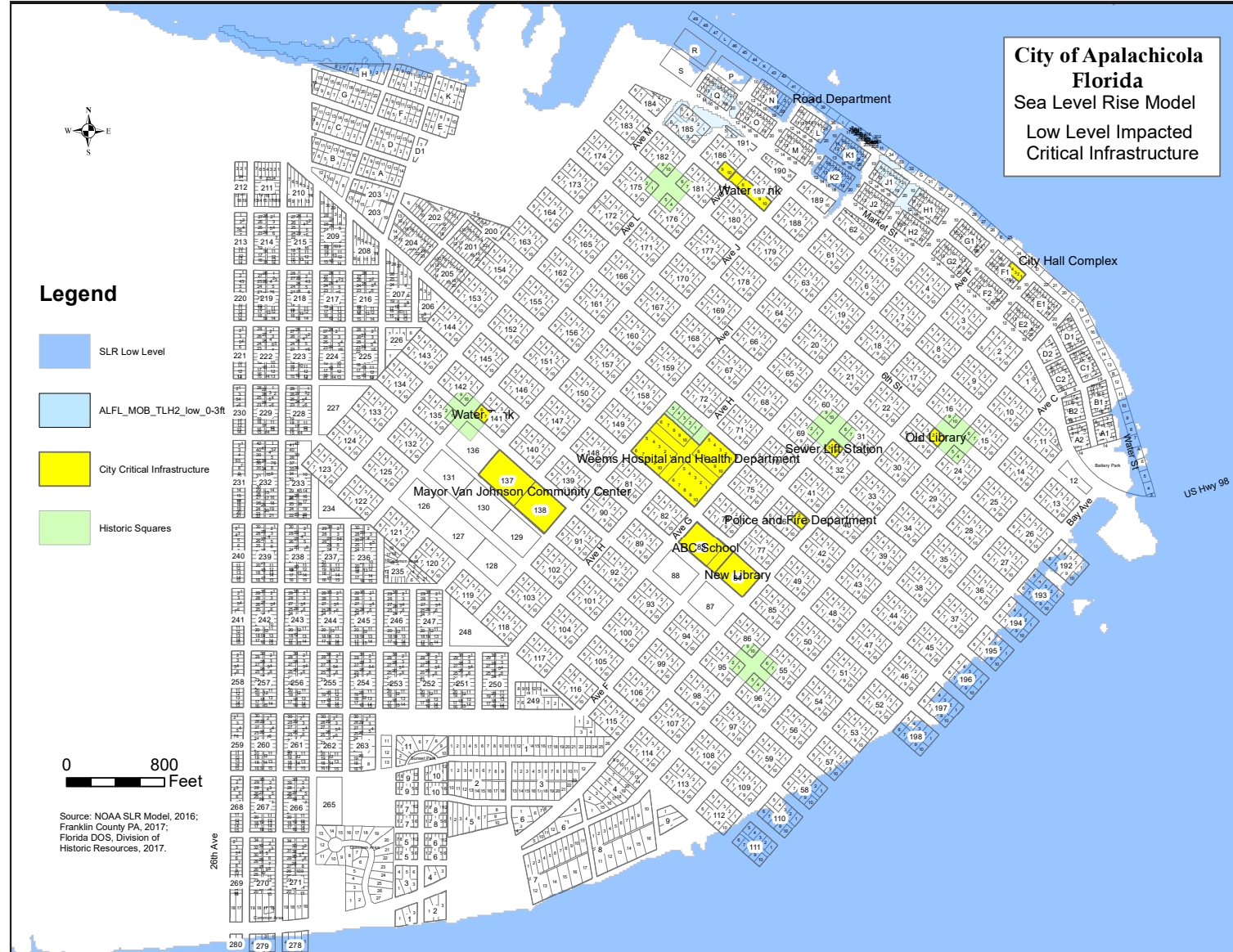
Table 2. Critical Facility Exposure to SLR Inundation

Facility Name	Type	Low SLR Inundation	Med SLR Inundation	High SLR Inundation
City Hall	Admin			x
Public Works	Admin			
Fire Dept.	Fire			
Public Library	Library			
Police Dept.	Police			
WW Trt. Plant	Infrastructure			
Water Plant	Infrastructure			
City Complex	Admin			
Hospital	Hospital			
ABC School	School			
Roadways				
US Highway 98			x	x
Water Street			x	x
Commerce Street			x	x
Market Street			x	x
Bay Avenue			x	x
Forbes Street			x	x
Leslie Street			x	x
Panton Street			x	x
Avenue D				
Avenue E				
Avenue F				
Avenue G				
Avenue H				
Avenue I				
Avenue J				
Avenue K				
Avenue L				
Avenue M				

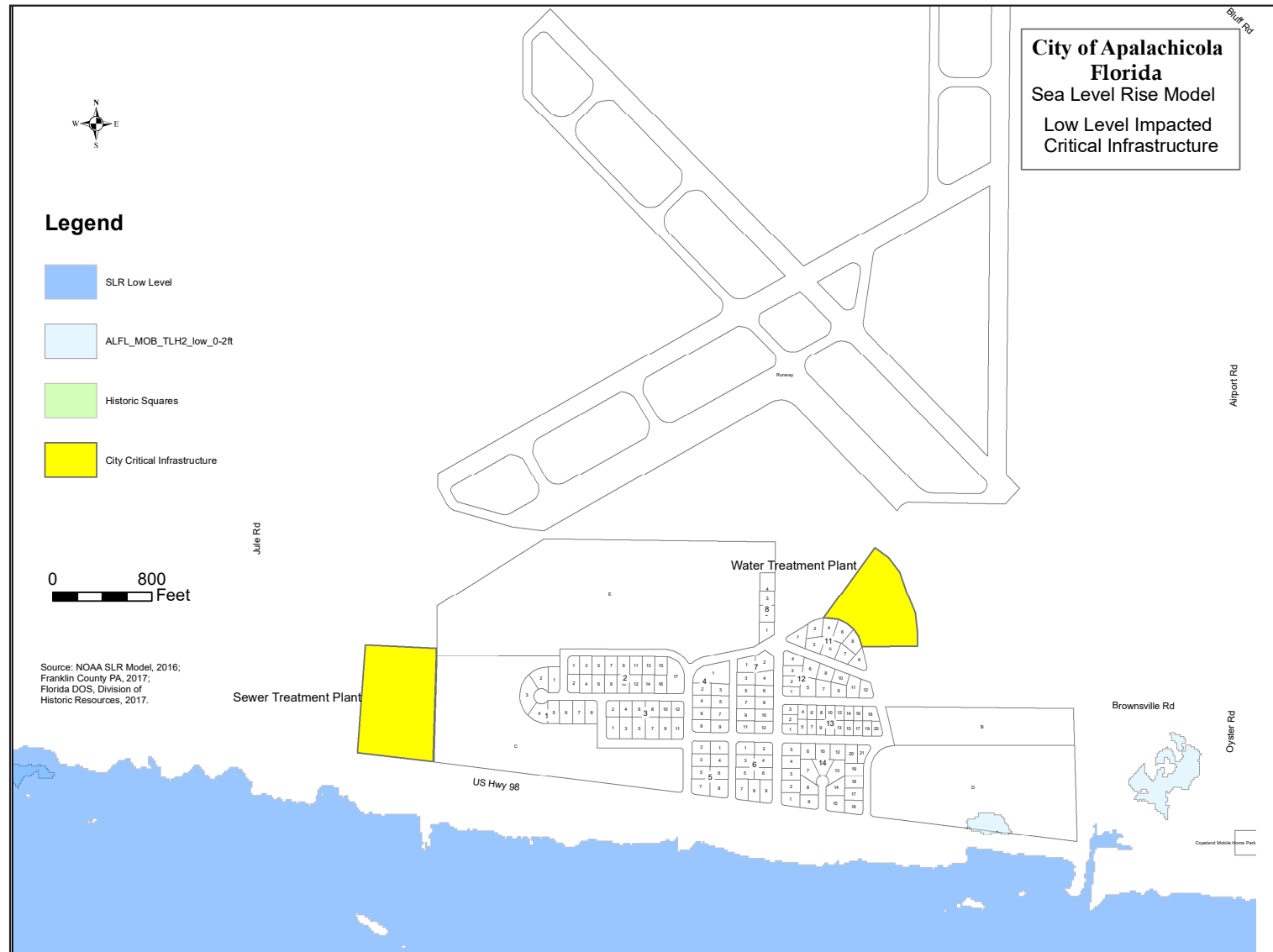
Analysis of Facilities

Based on the models, City Hall (1 Avenue E) is located in the high inundation area. Other critical infrastructure facilities are not shown to be affected by any of the proposed inundation levels. See maps 4-6.

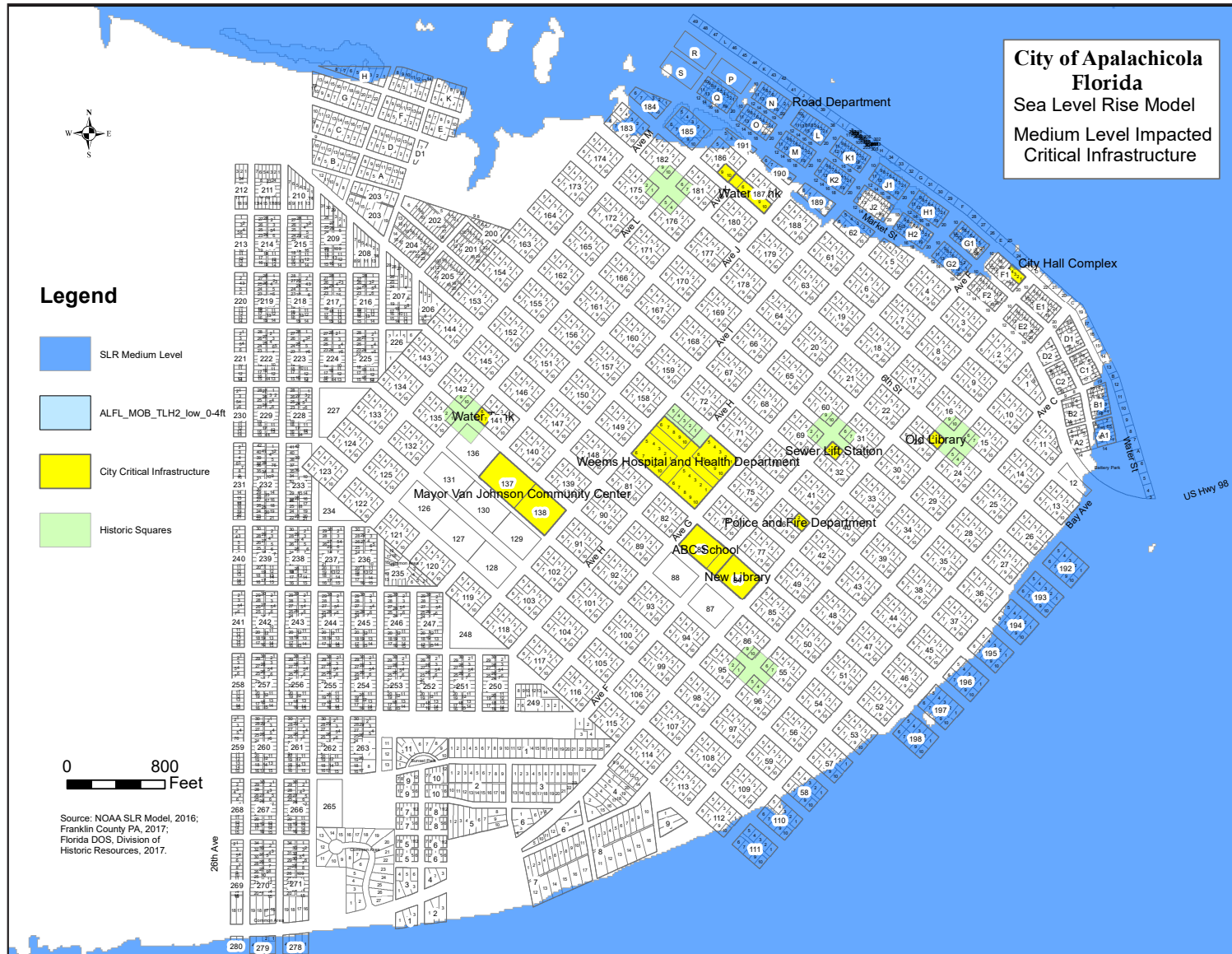
Map 4. Low Projected Inundation - Critical Infrastructure



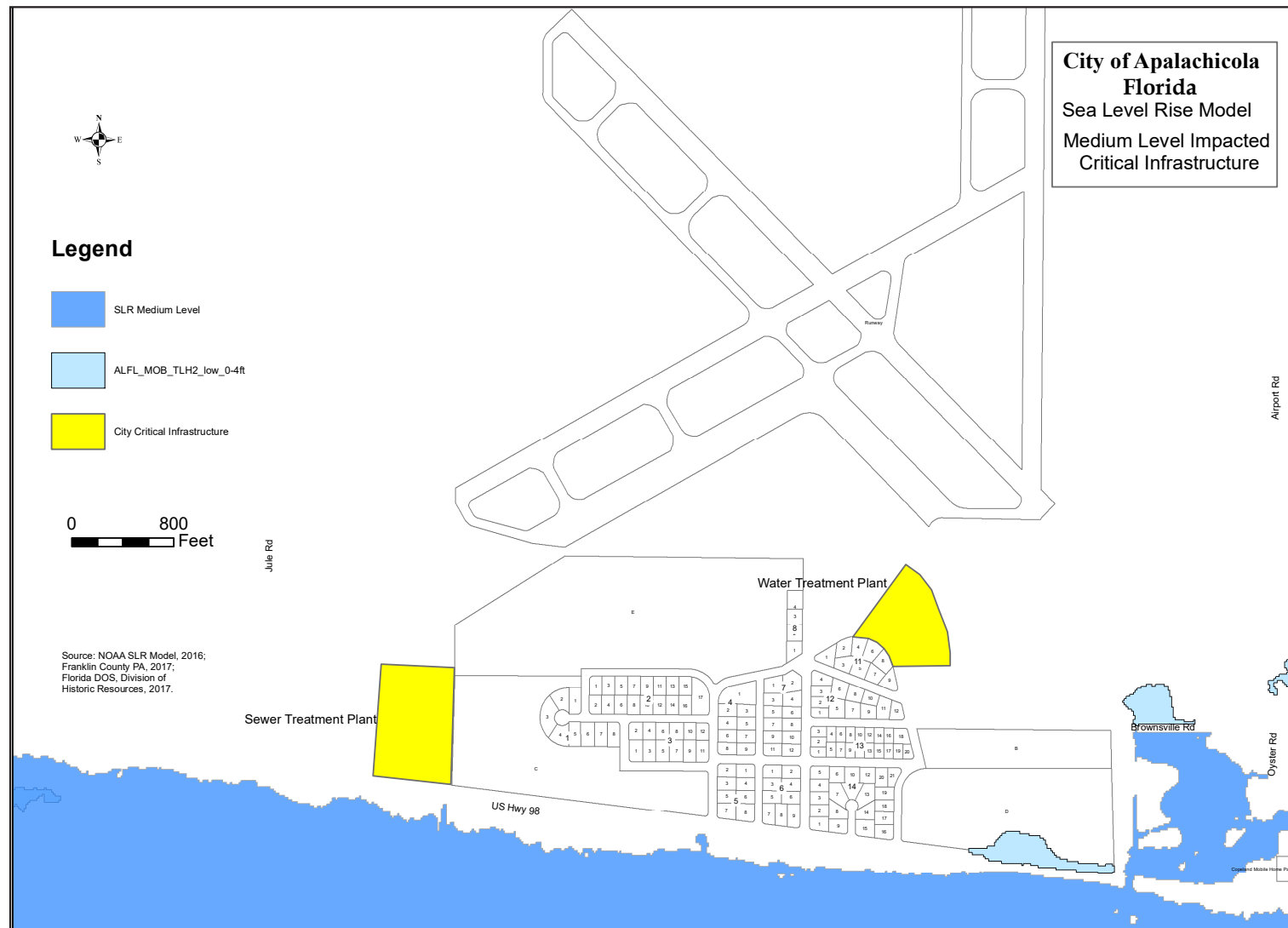
Map 4a. Low Projected Inundation - Critical Infrastructure - Detail



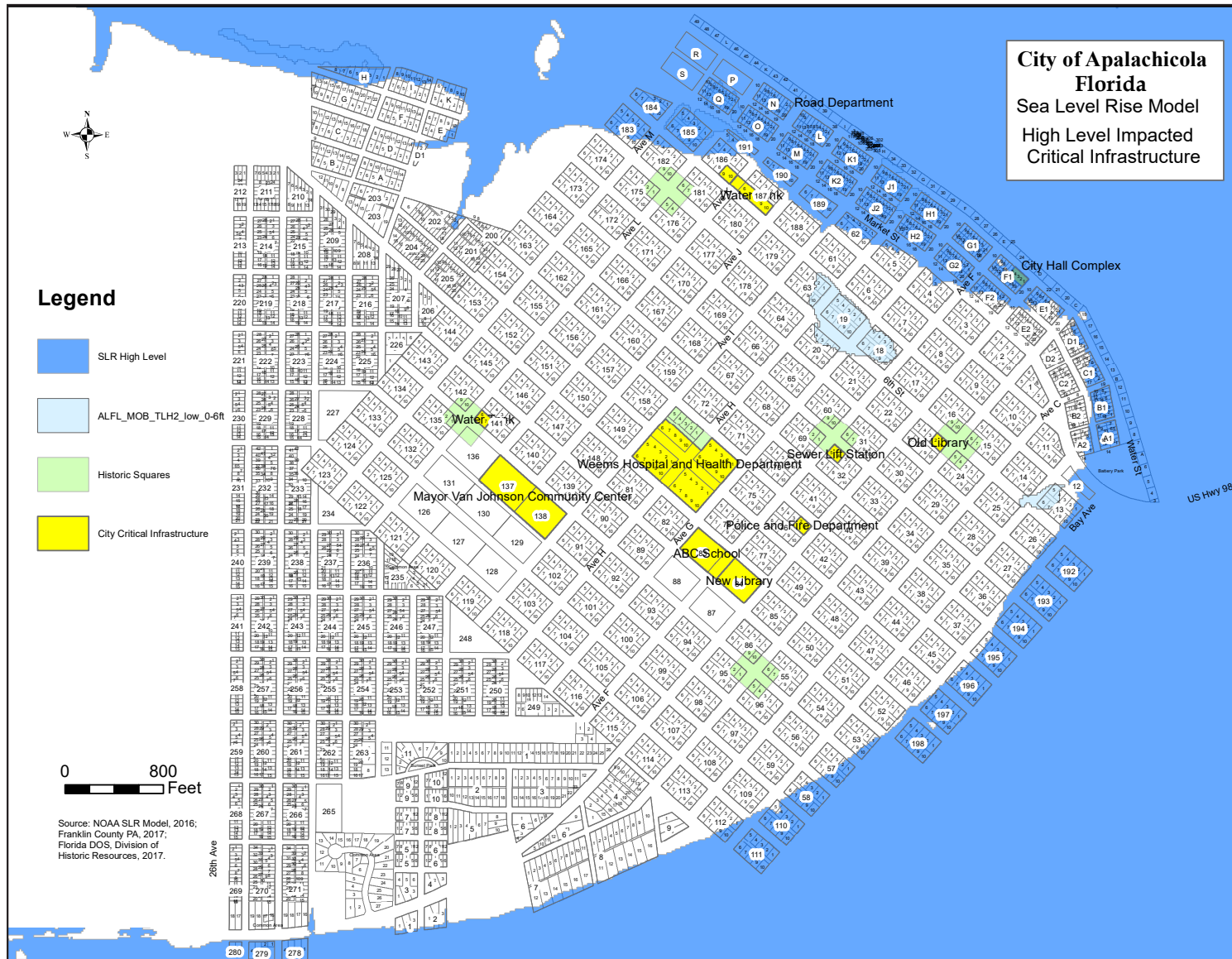
Map 5. Medium Projected Inundation - Critical Infrastructure



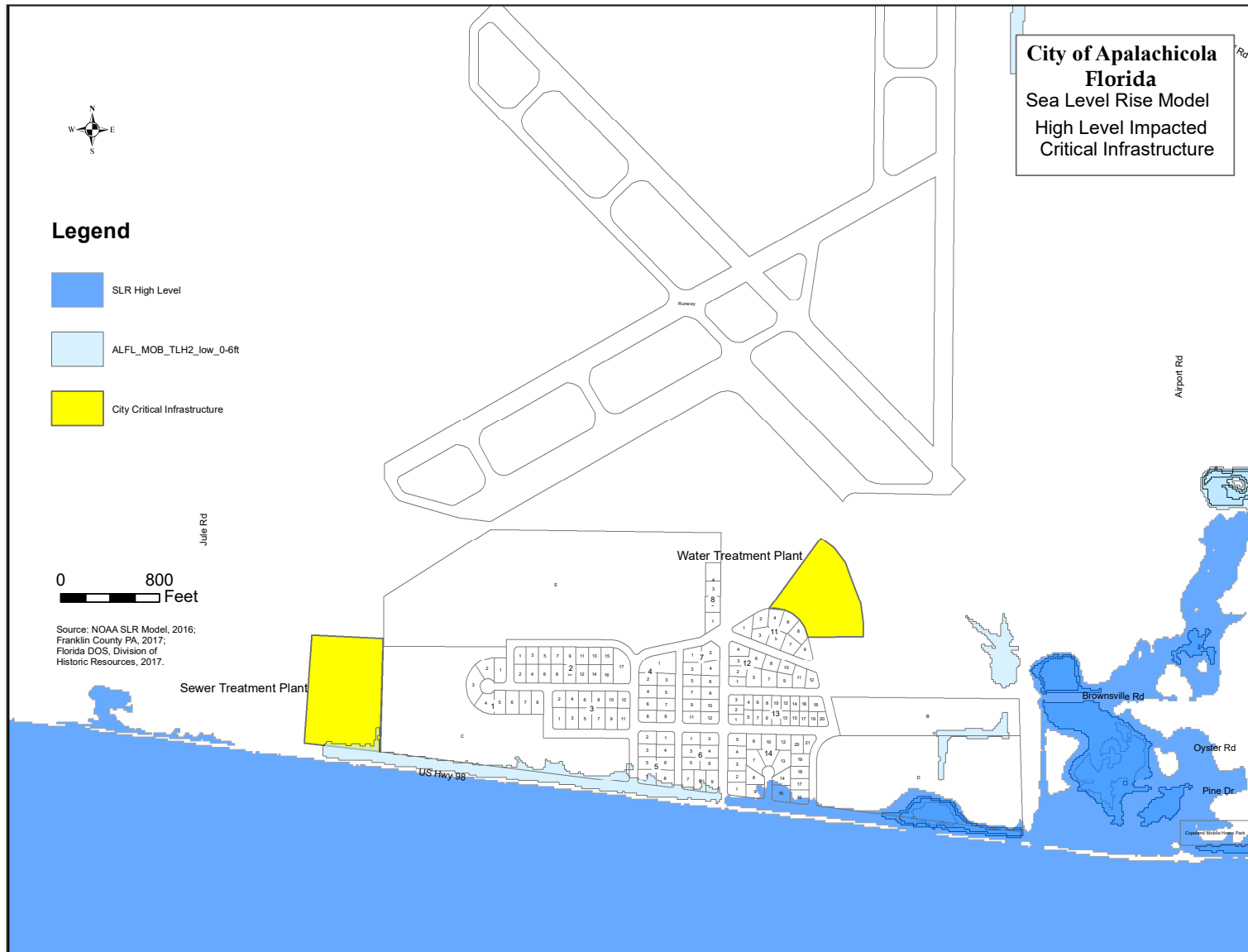
Map 5a. Medium Projected Inundation - Critical Infrastructure - Detail



Map 6. High Projected Inundation - Critical Infrastructure



Map 6a. High Projected Inundation - Critical Infrastructure



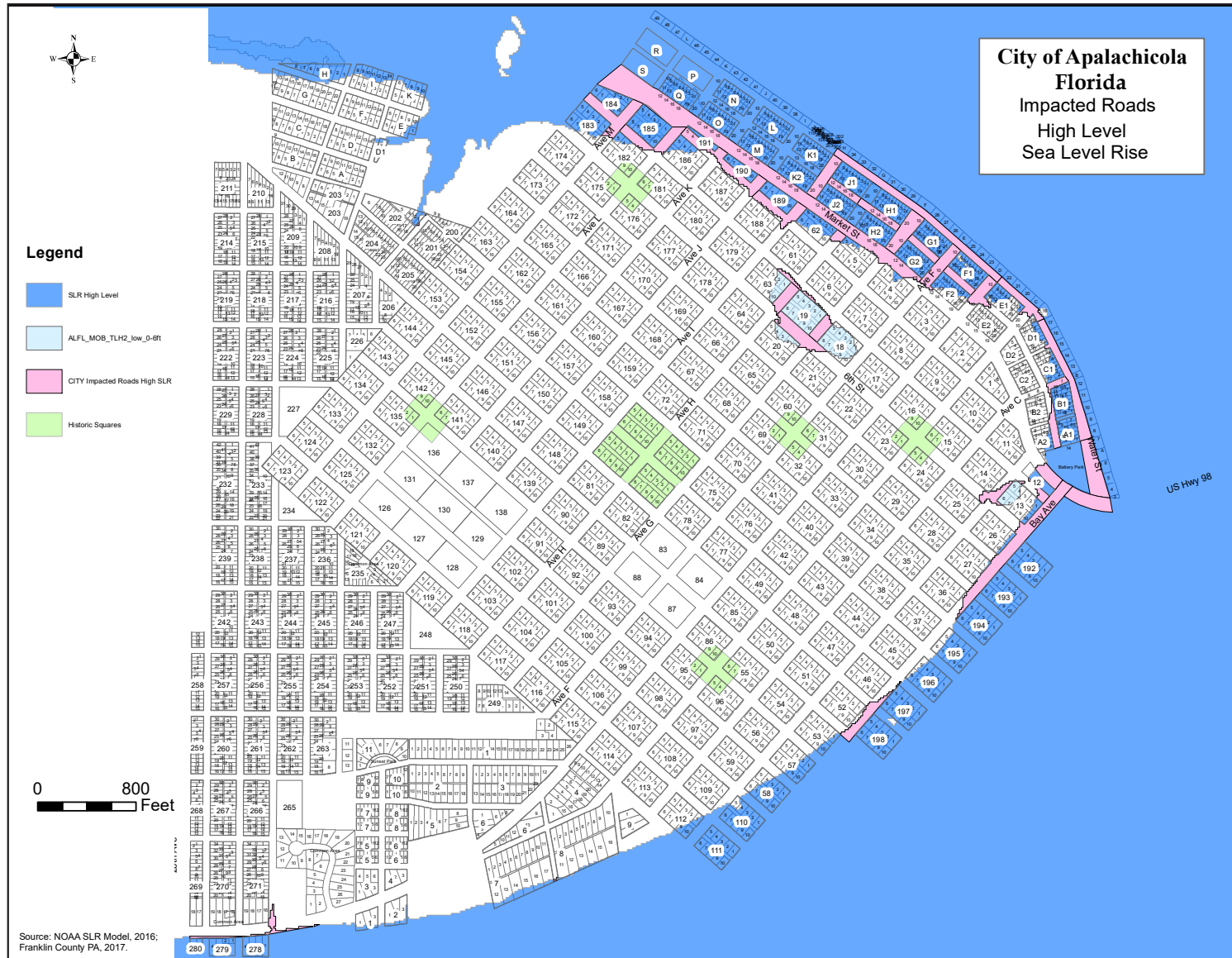
Map 7. Low Projected Inundation - Roadways



Map 8. Medium Projected Inundation - Roadways



Map 9. High Projected Inundation - Roadways



Roadway Vulnerability Analysis

Analysis of the effects of low, medium and high inundation on the roads within the City

Analysis of Roadways

The low inundation area will impact 3.79 acres of roadway.

The medium inundation area will impact 21.79 acres of roadway.

The high inundation area will impact 33.19 acres of roadway.

The impacts of low level inundation on the City's roads consist of the area at the far eastern point along Water Street and patchy areas northwesterly along Water Street and Commerce Street. Medium level inundation affects additional areas of the Water Street and Commerce Street area, as well as portions of Market Street, 4th Street and 5th Street in the northwestern part of the City. Bay Avenue is inundated close to Battery Park in the medium inundation scenario.

In the low and medium inundations, U.S. Highway 98 is not affected. Under the high level inundation, U.S. Highway 98 has a small area of impact in the far western part of town. Water Street is completely impacted and Bay Avenue is more impacted than in low and medium inundations. An isolated area at the confluence of 5th and 6th Streets and Avenue G and Avenue H is also impacted at a low area of elevation. Under both the medium and high level inundations, the U.S. Highway 98 bridge is flooded under the bridge, but does not affect the roadway. Water Street, Commerce Street and Market Street are the primary commercial downtown roadways that serve the commercial district. All three streets have impacts under the medium and high impacts. Smaller side streets Leslie, Pantan and Forbes are affected nominally by the medium and high inundation areas, mostly where they intersect Water Street. All the Avenues from D through I are shown to be impacted, again mostly where they intersect with Water Street in the high inundation areas. Avenues E through I are impacted by medium level inundations.

It is important to note that the City layout contains many roads that, though platted, have never been developed. For the purposes of this report, if a platted road has not been built, it is not counted in the roadway impact acreage. Areas in the northwestern part of Water Street and Commerce Street especially have roads that are shown on the City plat that have not been constructed.

City & Publically-Owned Property Exposure

Analysis of the effects of low, medium and high inundation on the City and Publically-owned Properties within the City

This matrix details those City and publically-owned properties potentially impacted by low, medium and high inundation levels as evidenced by the NOAA SLR modeling.

There are more than 80 publically-owned properties in the City. Fifty four parcels belong to the City of Apalachicola, 11 belong to the County and 18 are owned by either state or other public organizations. All publically-owned parcels and the inundation levels are identified on Maps 8-10.

Table 3. Publically-owned Properties

Block	Lot	Owned By
A	LOT 3	DOT
A	LOT 4	CITY
A	5 & SE 1/2 LOT 6	CITY
A	NW 1/2 LOT 6	CITY
A	LOT A	CITY
A	LOT 7	CITY
A1	LOT 10	COUNTY
A1	LOT11-13	COUNTY
A1	LOT 14	COUNTY
A2	LOT 1-7 8 9 10 11-14	COUNTY
B1	NE 60 FT LOT 1 & ALL LOTS 2 THRU 14	COUNTY
B1	LOTS 15-16-17	COUNTY
B1	SW 30 FT LOT 1 & ALL LOT 18	COUNTY
B2	LOT 1-16	DOT
C	LOT C	CITY
C	SE 60 FT WHARF LOT 20	CITY
C	WHARF LOT 20 & WHARF LOT 21 & 22	CITY
C	NW 60 FT WHARF LOT 22	CITY
D	LOT D	CITY
D2	LOTS 1-5 & 6-9	DOT
E	WHARF LOT E	US COAST GUARD
E	NW 1/2 WHARF LOT E	CITY
E1	LOT 12	CITY
F1	LOT 1-5 & 16-17	CITY
G	LOT G	CITY
H2	LOT 5	COUNTY
J2	LOT 2-19	CITY
K2	LOT 1-20	CITY
L & I	Partial 1, 2, 3, 4, 17	CITY
M	18-19-20	CITY
L	1-5, partial 6, 7, 16, 17 -20	CITY
L	9, 12 partial, 10-11	CITY
K-1	37 partial, 38, 39 Wharf lot 1	CITY
191	LOT 1-5	CITY
190	LOT 6-10	CITY
189	LOT 6-10	CITY
62	LOT 1	DOT
5	NW 1/2 LOT 3 & SE 1/2 LOT 4	CITY
3	NW 40 FT LOT 4 & ALL LOT 5	CITY
9	LOT 1 & SE 1/2 LOT 2	TIITF/DEPT OF MILITARY AFFAIRS APALACH ARMORY
9	LOT 2 3 & SE 1/2 LOT 4	TIITF/DEPT OF MILITARY AFFAIRS APALACH ARMORY
9	LOT 6-8	FIRST METHODIST CHURCH

Table 3. Publicly-owned Properties

16	LOT 6-8	PROTESTANT EPISCOPAL CH DIOCESE CENT GULF COAST
30	LOT 6 & 7	MOUNT ZION BAPTIST CHURCH C/O CARL BAILEY
76	LOT 1 & 2	CITY
99	LOT 9 & 10	EPISCOPAL CHURCH
184	LOTS 6 7 8 & LOT 9	CITY
182	LOT 9 & 10	CITY
181	LOT 6 & 7	CITY
175	LOT 1 & 2	CITY
176	LOT 4-10	CITY
15	LOT 6 & 7	TIITF/REC & PARKS JOHN GORRIE MUSEUM ST PARK
24	LOT 3-5	TIITF/DEP-REC & PARKS JOHN GORRIE MUSEUM ST PARK
23	LOT 1 & 2	CITY
22	LOT 6-10	CITY
31	LOT 1 - 10	CITY
Block	Lot	Owned By
60	LOT 9 & 10	CITY
69	LOT 1 & 2	CITY
32	LOT 4-7	CITY
55	LOT 6 & 7	CITY
96	LOT 4 & 5	CITY
86	LOT 9 & 10	CITY
95	LOT 1 & 2	CITY
84	Partial	CITY
84	Partial	BOARD OF PUBLIC INSTRUCTION
83	ALL OF BLOCK ORB	BOARD OF PUBLIC INSTRUCTION
88	ALL OF BLOCK	BOARD OF PUBLIC INSTRUCTION
87	LOTS 1 - 10	BOARD OF PUBLIC INSTRUCTION
WEEMS	LOT 4 & LOTS 1-3 LOT8-9-10 LOT 7	COUNTY
73	Partial	COUNTY
79 & 80	1-5 & 1/28 ALL 9 & 10 LESS	COUNTY
80	LOTS 6-7 AND 1/2 LOT 8 LOTS 3-4-5	APALACHEE COMMENTAL HEALTH
141	LOT 6 & 7	CITY
142	LOT 9 & 10	CITY
135	LOT 1 & 2	CITY
E	LOT 1 - 5	CITY
I	ALL LESS RR/RW COTTAGE HILL	CITY
F	ALL COTTAGE HILL	CITY
G	ALL COTTAGE HILL	CITY
C	COTTAGE HILL	CITY
B	COTTAGE HILL	CITY
203	LOT 8-12	CITY
1 9S	8W 8 ACRES IN NW 1/4	CITY

Map 11. Low Projected Inundation - Public Properties



Map 12. Medium Projected Inundation - Public Properties



Map 13. High Projected Inundation - Public Properties



C-1, C-4 & RF Financial Exposure Analysis

Analysis of the economic impacts of inundation and coastal flooding within C-1, C-4 & RF districts

The financial exposure hazard analysis determines the total land value, building value, assessed property value and taxable property valued located within the C-1, C-4 and RF zoning district. The matrix further analyzes the percentage of property located within Areas of Special Flood Hazard (Rated AE and V zones).

The C-1, C-4 and RF zoning districts represent the heart of Apalachicola's downtown commercial area. The lot sizes within most of these three districts (except the RF wharf lots) are smaller than most of the platted residential lots adjacent to the district. C-1 and C-4 lots are generally 30x 80 and the development standards within these districts allows for a more dense and intense use of land. Proximity to the town's scenic riverfront, congregation of tourism-related businesses and wealth of historic resources within these districts results in higher property values than other commercial areas throughout the City. And, because of the downtown district's proximity to the Apalachicola River and Apalachicola Bay, much of the downtown commercial area is located within FEMA's Area of Special Flood Hazard - rated AE & V zones. The area is economically valuable and vulnerable at the same time. Development interests are challenged to find the economic sweet spot for developing this vulnerable, protected and historically significant area of the City.

Value of Property

There are 314 lots located within the City's C-1 district representing 22.99 acres. There are 258 lots with structural improvements and 56 vacant lots. 3 of the vacant lots are owned by the City. The total assessed value of property in this district is \$21,859,047 (A parcel value breakdown is identified in Table 4)

There are 240 lots located within the City's C-4 district representing 13.63 acres. There are 138 lots with structural improvements and 102 vacant lots. 40 of the vacant lots are owned by the City. The total assessed value of property in this district is \$5,678,843 (A parcel value breakdown is identified in Table 4)

There are 58 lots located within the City's RF district representing 9.07 acres. There are 50 lots with structural improvements and 8 vacant lots. The 8 vacant lots are owned by the City and County. The total assessed value of property in this district is \$11,107,898 (A parcel value breakdown is identified in Table 4)

Table 4. Property Value C-1, C-4, R-F

C-1 - Block A1	JUST VALUE	LAND VALUE	BUILDING VALUE	ASSESSED VALUE	TAXABLE VALUE
Lots 1-4	\$171,314	\$96,000	\$71,035	\$122,093	\$122,093
Lots 5-7	\$72,000	\$72,000	\$0	\$12,579	\$12,579
Lots 8-9	\$66,408	\$48,000	\$18,408	\$30,785	\$30,785
Lot 10	\$24,000	\$24,000	\$0	\$2,795	\$0
Lots 11-13	\$72,000	\$72,000	\$0	\$12,038	\$0
Lot 14	\$24,000	\$24,000	\$0	\$24,000	\$0
C-1 Block A2					
1-10 Parcel					
11-14 County	\$354,495	\$354,495	\$0	\$39,729	\$0
C-1 B1					
1-14 Parcels	\$420,000	\$420,000	\$0	\$420,000	\$0
15-17 Parcels	\$119,753	\$90,000	\$29,753	\$119,753	\$0
18	\$30,000	\$30,000	\$0	\$30,000	\$0
C-1 B2					
1-8 Parcel	\$480,010	\$480,000	\$0	\$480,000	\$0
9-16 Parcel	\$210,000	\$210,000	\$0	\$210,000	\$0
C-1 C1					
1-4 Parcel	\$223,552	\$144,000	\$68,739	\$193,107	\$193,107
5-7 Parcel	\$135,000	\$135,000	\$0	\$58,897	\$58,897
8-9 Parcel	\$108,000	\$108,000	\$0	\$47,117	\$47,117
10-11 Parcel	\$179,046	\$108,000	\$67,769	\$151,738	\$151,738
12-13 Parcel	\$134,650	\$90,000	\$43,077	\$134,650	\$134,650
14-15 Parcel	\$111,336	\$90,000	\$18,273	\$36,120	\$11,120
Lot 16	\$229,725	\$144,000	\$82,404	\$201,904	\$201,904
C-1 C2					
1-2 Parcel	\$195,685	\$108,000	\$87,331	\$176,326	\$176,326
Lot 3	\$69,323	\$54,000	\$15,168	\$54,841	\$54,841
4-7 Parcel	\$216,000	\$216,000	\$0	\$145,200	\$145,200
Lot 8	\$54,000	\$54,000	\$0	\$54,000	\$54,000
9-12 Parcel	\$256,182	\$216,000	\$38,472	\$193,820	\$193,820
Lot 13	\$216,256	\$54,000	\$161,716	\$204,054	\$204,054
14-16 Parcel	\$249,919	\$144,000	\$104,500	\$207,393	\$228,132
C-1 D1					
LOTS 1-2 16 -17	\$108,000	\$108,000	\$0	\$87,120	\$87,120
Lot 3	\$54,000	\$54,000	\$0	\$43,560	\$43,560
4-5 Parcel	\$108,000	\$108,000	\$0	\$87,120	\$87,120
6-9 Parcel	\$213,933	\$162,000	\$39,987	\$194,326	\$194,326
10-12 Parcel	\$213,819	\$129,600	\$83,861	\$206,449	\$206,449
13-14 Parcel	\$86,000	\$86,400	\$0	\$58,080	\$58,080
Lot 15	\$54,000	\$54,000	\$0	\$36,300	\$36,300
LOT 1,2,16,17	\$115,958	\$108,000	\$7,958	\$55,574	\$55,574
C-1 D2					
LOTS 1 -5 & 6 -9	\$360,010	\$360,000	\$0	\$242,012	\$0
LOTS 6 - 9	\$439,240	\$118,800	\$316,532	\$277,786	\$277,786
Lot 1	\$122,324	\$54,000	\$68,324	\$122,324	\$122,324
Lot 2	\$54,000	\$54,000	\$0	\$43,560	\$43,560
Lot 3	\$167,801	\$51,300	\$116,501	\$167,801	\$167,801
LOTS 3-4-5-16	\$541,820	\$214,200	\$321,553	\$541,820	\$541,820
LOTS 6 & 15	\$149,490	\$115,200	\$0	\$134,419	\$134,419
LOTS 7, 13, 14	\$168,480	\$162,000	\$0	\$138,521	\$138,521
Lot 8	\$103,679	\$54,000	\$47,761	\$98,207	\$98,207
Lot 9	\$54,000	\$54,000	\$0	\$43,560	\$0
Lot 10	\$54,000	\$54,000	\$0	\$43,560	\$43,560
Lot 11	\$111,453	\$54,000	\$57,165	\$106,632	\$106,632
Lot 12	\$54,000	\$54,000	\$0	\$36,300	\$0
Lot 19	\$247,260	\$54,000	\$180,910	\$247,260	\$247,260
Lot 20	\$231,248	\$54,000	\$176,575	\$231,248	\$231,248

Table 4. Property Value C-1, C-4, RF

	JUST VALUE	LAND VALUE	BUILDING VALUE	ASSESSED VALUE	TAXABLE VALUE
C-1 E2					
LOTS 1-2 LOT 3	\$337,853	\$72,000	\$264,701	\$158,442	\$158,442
LOTS 1-2-3	\$67,881	\$43,200	\$24,681	\$59,554	\$59,554
LOTS 1-2-3	\$61,735	\$43,200	\$18,535	\$51,955	\$51,955
LOT 3-4	\$223,636	\$74,700	\$148,936	\$223,636	\$223,636
LOT 5-6	\$156,471	\$74,700	\$81,771	\$154,105	\$154,105
LOTS 8-9-10	\$889,772	\$329,400	\$560,372	\$889,772	\$889,772
LOT 13-14	\$112,364	\$52,200	\$60,164	\$109,854	\$109,854
LOT 16-17-18	\$128,519	\$79,200	\$49,319	\$114,337	\$114,337
LOT 18-19	\$114,919	\$50,400	\$64,519	\$113,760	\$113,760
LOT 19 & 20	\$284,330	\$90,000	\$194,330	\$284,330	\$284,330
LOTS 1-5&20	\$604,820	\$271,800	\$333,020	\$604,820	\$0
LOT 6	\$140,001	\$1	\$140,001	\$140,001	\$140,001
1/2 LOT 6	\$190,001	\$1	\$190,001	\$190,001	\$190,001
1/2 LOT 7	\$140,001	\$1	\$140,001	\$140,001	\$140,001
1/2 LOT 7	\$190,001	\$1	\$190,001	\$190,001	\$190,001
1/2 LOT 8	\$140,001	\$1	\$140,001	\$140,001	\$140,001
1/2 LOT 8	\$190,001	\$1	\$190,001	\$190,001	\$190,001
1/2 LOT 9	\$140,001	\$1	\$140,001	\$140,001	\$140,001
1/2 LOT 9	\$190,001	\$1	\$190,001	\$190,001	\$190,001
1/2 LOT 10	\$140,001	\$1	\$140,001	\$140,001	\$140,001
1/2 LOT 10	\$190,001	\$1	\$190,001	\$190,001	\$190,001
LOT 11 AND 20	\$140,001	\$1	\$140,001	\$140,001	\$140,001
LOT 13-14	\$140,001	\$1	\$140,001	\$140,001	\$140,001
LOT 15	\$140,001	\$1	\$140,001	\$140,001	\$140,001
LOTS 16-17	\$108,000	\$108,000	\$0	\$72,600	\$0
LOT 18	\$54,000	\$54,000	\$0	\$36,300	\$36,300
LOT 19	\$245,826	\$84,000	\$160,326	\$244,041	\$244,041
C-1 F2					
LOTS 1-2-3-4	\$208,671	\$111,600	\$97,071	\$163,110	\$163,110
LOTS 1-4	\$406,210	\$88,200	\$318,010	\$406,210	\$0
LOT 5	\$152,922	\$108,000	\$44,922	\$119,208	\$119,208
LOTS 6, 7	\$108,000	\$108,000	\$0	\$108,000	\$0
LOT 8	\$54,000	\$54,000	\$0	\$54,000	\$0
9-12 Parcel	\$287,000	\$216,000	\$0	\$216,000	\$216,000
LOT 15	\$27,000	\$27,000	\$0	\$27,000	\$27,000
LOT 16 & LOT 5	\$268,794	\$54,000	\$213,894	\$268,794	\$268,794
LOT 17	\$105,516	\$54,000	\$51,375	\$98,635	\$98,635
18-20 Parcel	\$331,826	\$216,000	\$115,198	\$158,632	\$158,632
C-1 G1					
LOT 1	\$99,377	\$54,000	\$45,377	\$70,601	\$70,601
2-4 Parcel	\$181,874	\$162,000	\$19,874	\$154,727	\$154,727
LOT 5 & 16	\$91,464	\$54,000	\$37,464	\$88,891	\$88,891
LOT 6	\$100,104	\$54,000	\$46,081	\$99,345	\$99,345
LOT 7	\$54,000	\$54,000	\$0	\$43,560	\$43,560
8-9 Parcel	\$75,612	\$73,440	\$0	\$75,612	\$75,612
LOT 10	\$58,890	\$54,000	\$4,550	\$49,235	\$49,235
LOT 10	\$34,632	\$32,400	\$2,232	\$18,208	\$18,208
LOT 11	\$173,339	\$54,000	\$119,339	\$167,729	\$167,729
12-13 Parcel	\$115,218	\$108,000	\$7,218	\$81,334	\$81,334
LOT 14	\$65,082	\$54,000	\$10,159	\$49,709	\$49,709
LOT 15	\$54,000	\$54,000	\$0	\$36,300	\$36,300
LOT 16 & 17	\$83,192	\$75,600	\$7,430	\$60,006	\$60,006
LOT 17-20	\$311,611	\$221,400	\$80,521	\$259,896	\$259,896
C-1 G2					
1-18	\$486,000	\$486,000	\$0	\$110,276	\$110,276
LOT 19	\$54,000	\$54,000	\$0	\$36,300	\$36,300
LOT 20	\$273,818	\$54,000	\$219,818	\$273,818	\$273,818

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City of Apalachicola Analysis

Table 4. Property Value C-1, C-4, RF

	JUST VALUE	LAND VALUE	BUILDING VALUE	ASSESSED VALUE	TAXABLE VALUE
C-1 1					
1-2 Parcel	\$3,000	\$3,000	\$0	\$3,000	\$3,000
Lot 3	\$59,529	\$36,000	\$47,874	\$84,539	\$84,539
4-5 Parcel	\$167,993	\$57,600	\$71,444	\$129,593	\$129,593
LOTS 1-3	\$790,782	\$161,500	\$622,757	\$790,782	\$790,782
LOTS 4-7	\$150,102	\$110,500	\$15,952	\$150,102	\$150,102
LOT 4&5	\$109,527	\$51,000	\$225,058	\$310,353	\$310,353
Lot 1	\$51,000	\$51,000	\$0	\$48,315	\$48,315
3-5 Parcel	\$385,908	\$153,000	\$213,803	\$385,908	\$385,908
C-1 2					
LOT 1	\$644,179	\$97,750	\$543,722	\$644,179	\$644,179
LOT 1&2	\$115,602	\$31,875	\$83,727	\$115,602	\$115,602
LOT 2	\$303,553	\$31,875	\$264,580	\$303,553	\$303,553
Lot 3	\$119,933	\$51,000	\$68,933	\$119,933	\$119,933
LOT 4	\$24,526	\$22,100	\$190	\$18,305	\$18,305
LOT 4	\$157,386	\$25,500	\$131,886	\$157,386	\$157,386
LOTS 4 & 5	\$113,816	\$54,400	\$59,416	\$113,816	\$113,816
LOT 5	\$253,860	\$38,250	\$215,167	\$196,669	\$196,669
LOT 5-7	\$154,016	\$85,000	\$58,637	\$154,016	\$154,016
LOT 7	\$25,500	\$25,500	\$0	\$17,848	\$17,848
LOT 8-10	\$318,703	\$89,250	\$228,406	\$318,703	\$318,703
LOT 1&2	\$54,010	\$54,000	\$0	\$54,010	\$54,010
LOT 2-4	\$75,600	\$72,000	\$0	\$75,600	\$75,600
LOT 4&5	\$87,974	\$42,500	\$42,151	\$87,974	\$87,974
C-1 3					
LOT 1&2	\$72,248	\$68,000	\$0	\$72,248	\$72,248
LOT 2-4	\$102,655	\$102,000	\$0	\$102,655	\$102,655
LOT 4&5	\$189,829	\$85,000	\$102,591	\$189,829	\$189,829
LOT 6	\$48,695	\$15,750	\$32,191	\$47,790	\$47,790
LOT 6 & 7	\$226,224	\$42,000	\$182,954	\$202,947	\$152,447
LOT 7 & 8	\$159,328	\$36,750	\$118,609	\$159,328	\$109,328
9-10 Parcel	\$310,638	\$82,500	\$212,634	\$310,638	\$310,638
1-2 Parcel	\$221,966	\$82,500	\$130,446	\$221,966	\$221,966
Lot 3	\$98,744	\$31,500	\$62,772	\$97,068	\$97,068
4-5 Parcel	\$195,250	\$63,000	\$126,167	\$191,675	\$191,675
C-1 4					
1-3 Parcel	\$250,738	\$180,000	\$64,198	\$250,738	\$250,738
4-5 Parcel	\$80,023	\$63,000	\$12,761	\$59,436	\$25,000
LOT 6	\$31,500	\$31,500	\$0	\$23,100	\$23,100
LOT 6	\$55,651	\$15,750	\$38,369	\$50,754	\$25,000
LOT 7	\$69,290	\$31,500	\$32,201	\$64,669	\$64,669
LOT 8	\$65,082	\$31,500	\$29,232	\$48,822	\$23,822
9-10 Parcel	\$140,140	\$63,000	\$62,552	\$131,054	\$131,054
C-1 5					
LOT 10	\$40,415	\$5,220	\$35,195	\$40,415	\$40,415
8-9 Parcel	\$10,440	\$10,440	\$0	\$10,440	\$10,440
LOT 7	\$5,220	\$5,220	\$0	\$5,220	\$5,220
LOT 6	\$5,220	\$5,220	\$0	\$5,220	\$5,220
LOT 10	\$5,220	\$5,220	\$0	\$5,220	\$5,220
LOT 9	\$18,856	\$5,220	\$13,636	\$18,856	\$0
LOT 3&8	\$24,709	\$7,412	\$17,115	\$24,257	\$0
LOT 6-7	\$17,344	\$10,544	\$6,800	\$17,344	\$17,344
6-10 Parcel	\$105,000	\$105,000	\$0	\$38,213	\$0
1-6 & 15-20	\$144,000	\$144,000	\$0	\$51,654	\$51,654

City of Apalachicola Vulnerability Analysis

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Table 4. Property Value C-1, C-4, RF

C-4 H1	JUST VALUE	LAND VALUE	BUILDING VALUE	ASSESSED VALUE	TAXABLE VALUE
LOT 1-6 & 15-20	\$144,000	\$144,000	\$0	\$51,654	\$51,654
LOT 7-15	\$96,000	\$96,000	\$0	\$34,436	\$34,436
C-4 H2					
LOT 1-4	\$84,000	\$84,000	\$0	\$17,218	\$17,218
Lot 5	\$21,000	\$21,000	\$0	\$4,304	\$0
6-8	\$68,290	\$63,000	\$4,510	\$21,128	\$21,128
9-10	\$42,000	\$42,000	\$0	\$8,610	\$8,610
11-20	\$210,000	\$210,000	\$0	\$43,044	\$43,044
C-4 H5					
LOT 1 & 2	\$55,755	\$47,250	\$24,255	\$45,933	\$45,933
LOT 3 & 4	\$6,920	\$5,220	\$0	\$6,920	\$0
NW 1/2 LOT 4	\$5,913	\$2,610	\$3,303	\$5,913	\$5,913
NW 1/2 LOT 4	\$5,913	\$2,610	\$3,303	\$5,913	\$5,913
Lot 5 \$34,308	\$34,308	\$5,220	\$26,887	\$34,308	\$9,308
C-4 J1					
LOT 1-20	\$204,000	\$204,000	\$0	\$62,414	\$62,414
C-4 J2					
1 & 20	\$42,000	\$42,000	\$0	\$12,210	\$12,210
LOT 2-19	\$378,000	\$378,000	\$0	\$271,990	\$0
C-4 62					
Lot 1	\$5,220	\$5,220	\$0	\$5,220	\$0
Lot 2	\$2,766	\$2,766	\$0	\$2,766	\$2,766
Lot 3 & 8	\$24,709	\$7,412	\$17,115	\$24,257	\$0
LOT 4-7	\$17,344	\$10,544	\$6,800	\$17,344	\$17,344
C-4 K1					
LOT 1-4 & 17-20	\$883,200	\$883,200	\$0	\$883,200	\$0
C-4 K2					
LOT 1-20	\$420,000	\$420,000	\$0	\$420,000	\$0
C-4 L1					
WHARF LOTS I-J	\$890,334	\$391,680	\$446,841	\$890,334	\$890,334
C-4 M1					
WHARF LOTS L-O	\$890,334	\$391,680	\$446,841	\$890,334	\$890,334
C-4 190					
LOT 6-10	\$105,000	\$105,000	\$0	\$33,246	\$0
C-4 O					
WHARF LOTS I-J-	\$890,334	\$391,680	\$446,841	\$890,334	\$890,334
C-4 191					
LOT 1-5	\$105,000	\$105,000	\$0	\$13,375	\$0
C-4 Q					
LOT 20	\$454,374	\$264,000	\$155,248	\$454,374	\$454,374
C-4 S					
LOTS 3-5 4-7	\$528,064	\$240,000	\$265,779	\$528,064	\$528,064

Table 4. Property Value C-1, C-4, RF

RF - N	JUST VALUE	LAND VALUE	BUILDING VALUE	ASSESSED VALUE	TAXABLE VALUE
LOT 20	\$454,374	\$264,000	\$155,248	\$454,374	\$454,374
RF - P					
LOT 1.32 AC	\$273,602	\$210,000	\$54,783	\$179,961	\$179,961
RF - R					
LOTS 3 4 5	\$1,779,000	\$1,779,000	\$0	\$646,840	\$0
RF 1-49					
LOT 1-2	\$320,000	\$320,000	\$0	\$320,000	\$0
Lot 3	\$160,000	\$160,000	\$0	\$160,000	\$0
Lot 4	\$174,208	\$160,000	\$0	\$174,208	\$0
LOTS 5 & 6	\$240,000	\$240,000	\$0	\$240,000	\$0
NW 1/2 LOT 6	\$80,000	\$80,000	\$0	\$80,000	\$0
WHARF LOT A	\$80,000	\$80,000	\$0	\$80,000	\$0
Lot 7	\$206,253	\$160,000	\$35,417	\$206,253	\$0
Lot 8	\$225,047	\$160,000	\$26,498	\$225,047	\$225,047
WHARF LOT 9	\$72,000	\$72,000	\$0	\$72,000	\$72,000
WHARF LOT 9	\$124,525	\$88,000	\$31,517	\$124,525	\$124,525
Lot 10	\$120,197	\$80,000	\$17,798	\$120,197	\$120,197
WHARF LOT 11	\$280,203	\$128,000	\$152,188	\$280,203	\$280,203
WHARF LOT 12	\$289,665	\$192,000	\$63,512	\$289,665	\$289,665
WHARF LOT B	\$80,000	\$80,000	\$0	\$80,000	\$0
LOT 13-14	\$654,008	\$256,000	\$370,093	\$654,008	\$654,008
Lot 15	\$280,003	\$160,000	\$100,142	\$280,003	\$280,003
Lot 16	\$446,762	\$160,000	\$285,027	\$446,762	\$446,762
WHARF 17&19	\$172,701	\$156,160	\$11,080	\$172,701	\$172,701
WHARF 19	\$341,812	\$124,800	\$185,014	\$341,812	\$291,812
WHARF LOT C	\$162,880	\$160,000	\$0	\$162,880	\$0
WHARF LOT 20	\$104,248	\$96,000	\$8,242	\$104,248	\$0
WHARF 21&22	\$289,000	\$288,000	\$0	\$289,000	\$0
WHARF LOT 22	\$96,587	\$96,000	\$0	\$96,587	\$0
WHARF LOT D	\$162,880	\$160,000	\$0	\$162,880	\$0
LOT 23-25	\$355,086	\$288,000	\$33,864	\$355,086	\$355,086
1/2 WHARF E	\$94,458	\$80,000	\$5,090	\$94,458	\$0
1/2 WHARF E	\$80,000	\$80,000	\$0	\$57,685	\$0
WHARF 26 & 27	\$326,841	\$240,000	\$77,262	\$326,841	\$326,841
WHARF 27 & 28	\$337,279	\$240,000	\$90,991	\$337,279	\$237,279
WHARF F & 29	\$252,172	\$236,800	\$0	\$252,172	\$252,172
WHARF 29-31	\$732,836	\$403,200	\$279,748	\$686,157	\$686,157
WHARF G	\$160,000	\$160,000	\$0	\$160,000	\$0
Lot 32	\$223,986	\$160,000	\$25,830	\$223,986	\$223,986
WHARF 33&34	\$179,200	\$179,200	\$0	\$179,200	\$179,200
WHARF 34	\$171,346	\$140,800	\$14,360	\$171,346	\$171,346
LOTS 1-4 & 18-20	\$883,200	\$883,200	\$0	\$883,200	\$0
WHARF LOTS I-J	\$890,334	\$391,680	\$446,841	\$890,334	\$890,334
WHARF 41 & 49	\$16,000	\$16,000	\$0	\$16,000	\$0

Historic Resource Exposure Analysis

Analysis of the impacts to historic resources within C-1, C-4 & RF districts

The historic resource exposure analysis determines the number of historic resources that are located in the low, medium or high inundation areas within the C-1, C-4 and RF districts which may be threatened by coastal flooding. The historic resources listed in the Table 5 below are those sites that as listed on the Master Site File of historic sources with the Florida Division of Historic Resources. The historic resources are mapped on maps 10-16.

Table 5. Historic Resource Inventory

Site Number	Lot & Block	Name	Address	SLR L	SLR M	SLR H
8FR163	Lots 3-5, 16-18 - Blk E-1	J. E. Grady & Co.	200-204 Water St		X	
8FR174	Lots 1-3 Blk G-1	Wefing's Marine	Ave F & Water St		X	
8FR176	Lot 6 BLOCK 18	Stevens House	76 Ave G		X	
8FR266		Hutchinson House	121 6th St		X	
8FR275		Block H-2	162 Commerce St (Vacant)		X	
8FR282	NW 1/2 Wharf Lot E	Power Plant	265 N Water St	X	X	
FR283	Lot 20 Blk G-1	Willis Warehouse	F & Commerce		X	
FR285	Lot 29 Blk 122 FT Wharf Lot F	Wharf		X	X	
8FR286	Wharf Lot 16	Marine Ways	Water St		X	
8FR288	Oyster Packing House	Water Street & Gorrie Bridge		X	X	
8FR303	Lot 12-13 Blk G-1	Demo George & Co. 155 Commerce St			X	
8FR304	Block H-2	160 Commerce St (Vacant)			X	
8FR305	Lot 6-9 Block G-2	Vacant		X	X	
8FR307	Lot 11 Blk G-1	Economy Cash Store 159 Commerce St			X	
8FR308	Lot 10 Blk G-1	The Peoples Ice Co. 280 Water St			X	
8FR309	Lot 1 & SE 20 Ft Lot 2	Block G-2	132 Commerce St (Vacant)		X	
8FR310	Lot 9-20 Blk H-2	Blok H-2 (Vacant)			X	
8FR312	City of Apalachicola	near Wharf lots 1-2	Battery Park (Vacant)	X	X	
8FR326	City of Apalachicola	Blocks A1 & A2	Battery Park (Vacant)	X	X	
8FR329	Lot 11 Blk E-1	Sponge Exchange	Commerce Street		X	
8FR339	Lot 9 Blk E-1	Structure	218 Water Street		X	
8FR344	Lot 1-5, 16&17 & partial Lot 20	City Hall	222 Water Street		X	
8FR378	Lot 5-7 Blk G-1	Marine Supply	Water Street	X	X	
8FR385	Lot 18 & 19 Blk F-1	Commercial	Commerce Street		X	
8FR405	Lot 1 Blk 18	Residential	102 5th Street		X	
8FR406	Partial lot 3 Blk 18	Residential	5th Street		X	
8FR407	Lot 4 Blk 18	Residential	5th Street		X	
8FR414	Lot 2 Blk 19	Residential	124 5th St		X	
8FR425	Lot 8 Blk 18	Residential	111 6th St		X	
8FR427	Lot 7 Partial, Blk 18	Residential	113 6th St		X	
8FR642	Lot 5-7 Blk A-1	Vacant	16 Forbes St	X	X	
8FR643	Lot 1 Partial, Lots 2-14 Blk B-1	Franklin Co. Jail	Leslie St		X	
8FR687	Lots 11-12 Partial, Blk G-2	Riverside Cafe	280 Water St	X	X	
8FR690	Blk 18 Partial	Residential	Ave. G		X	
8FR691	Lot 6 Blk 18	Residential	72 Ave. G		X	
8FR700	Lots 6-8 Partial, Blk 19	Residential	Ave H		X	
8FR00992		Sea Dream	Penton and Water St		X	
FR01262		Baltimore Building	131 Market Street		X	
8FR306	Lots 6-9 Blk G-2	Ruin	Structure on Lot 9		X	

Analysis of Historic Resource Impact

There are 51 properties located within the City's C-1, C-4 and RF Area of Special Flood Hazard (Rated A&V zones). See Map 14. However, not all historic resources in the rated A & V zones may be impacted by rising coastal waters associated with the model projections. Of the 51 properties identified in the City's areas of special flood hazard, 38 are projected for potential impact. (See maps 15-17). Note that map 14A indicates 11 historic structures in the impact area that are not within the C-1, C-4 or RF project areas. It is also important to note that a significant number of the historic sites referenced by the Master Site numbers do not feature any structures on the parcels any longer. A lot by lot ground truthing of the parcels identified is necessary to identify and document such vacant historic sites.

Low Level Inundation

There are four historic resources located within the low inundation area. All four of the historic sites are located directly adjacent to the Apalachicola River. Three of the sites (FR285, 8FR326 & 8FR312) on Water Street are no longer in existence. The fourth site 8FR288 is the site of a City-owned structure once slated as the future home of the Apalachicola Maritime Museum. The metal building on pilings is already mostly over water - not much of the building's footprint remains on uplands. It is not clear that the low inundation will significantly impact more than one historic resource which is already a water-dependent structure.

Level of Impact:

It is not clear that the low inundation will significantly impact more than one historic resource which is already a water-dependent structure.

Medium Level Inundation

According to the medium level inundation models, there will be 18 historic sites and structures impacted by rising coastal waters. With the exception of a parcel currently occupied by the Leavins Seafood Processing company, all of the impacted sites are located north of Avenue F between Water Street and Market Street. Included in the list of impacted structures are several wood frame and brick commercial structures currently used for various commercial retail purposes. Among the structures potentially impacted by a medium level inundation are the following historic buildings (as referenced by their historic use): Wefing's Marine Bldg, Intra-coastal Marine Supply, power plant, Willis Warehouse, Marine Ways, People's Ice Company (Riverside Cafe), Economy Cash Store and the Demo George & Co. building.

Level of Impact:

The individual topography of the parcel on which the historic resource is located will determine the impact. Much of the City's downtown commercial lots range in elevation from 5 to 12 feet. A medium inundation level flood of 3-4 feet may not impact those parcels with existing elevations of five feet or more. For those sites located in particularly low elevations, flood-proofing commercial structures is an option.

High Level Inundation

There are 39 historic properties projected to be impacted within the high inundation area. There is an interesting anomaly within the high inundation area. In addition to the water adjacent properties projected for impact, there is also a cluster of inland property (and 11 historic resources) up 5th Avenue between Avenues F and H that show up as an inundation area when the high (5-6 foot model) is activated. It is possible that this cluster is located within what was originally a creek bed that once flowed through town from up near Scipio Creek down through the 8-9th Street area south to the Battery Park. The low elevations are referenced on FEMA flood maps and all development within these areas are part of the special flood hazard district that require elevation. The 11 inland



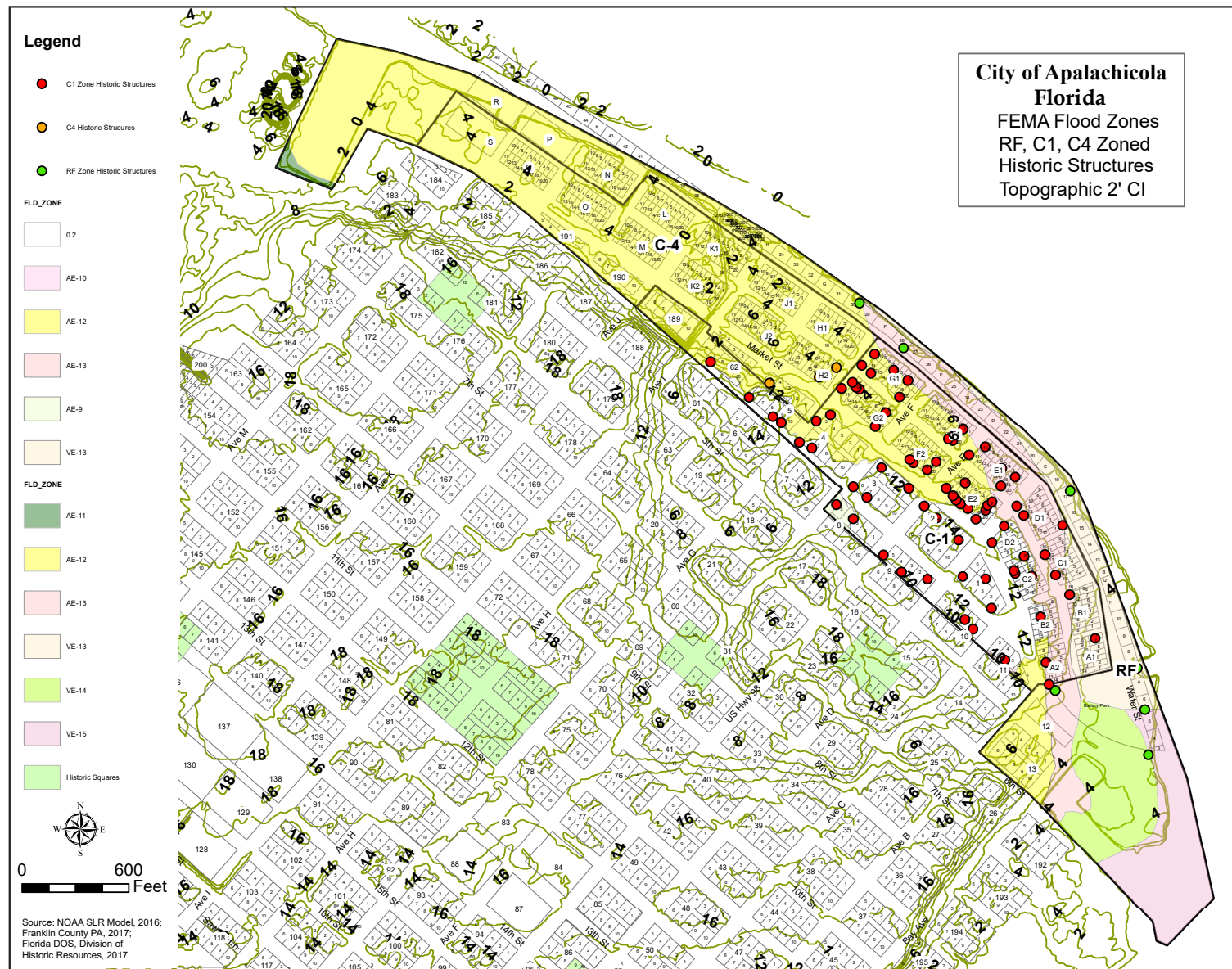
historic properties are identified in Table 5 but not analyzed here because they do not fall within the C-1, C-4 or R-F study area.

The 10 additional commercial properties proposed to be impacted are in the same general area as the medium inundation area with similar characteristics. Included in the inundation zone for this category include some City-owned public buildings including City Hall, the City's Center for History, Culture and Art as well as privately-owned historic buildings including the Baltimore Building, the Sponge Exchange and the Bowery Inn building.

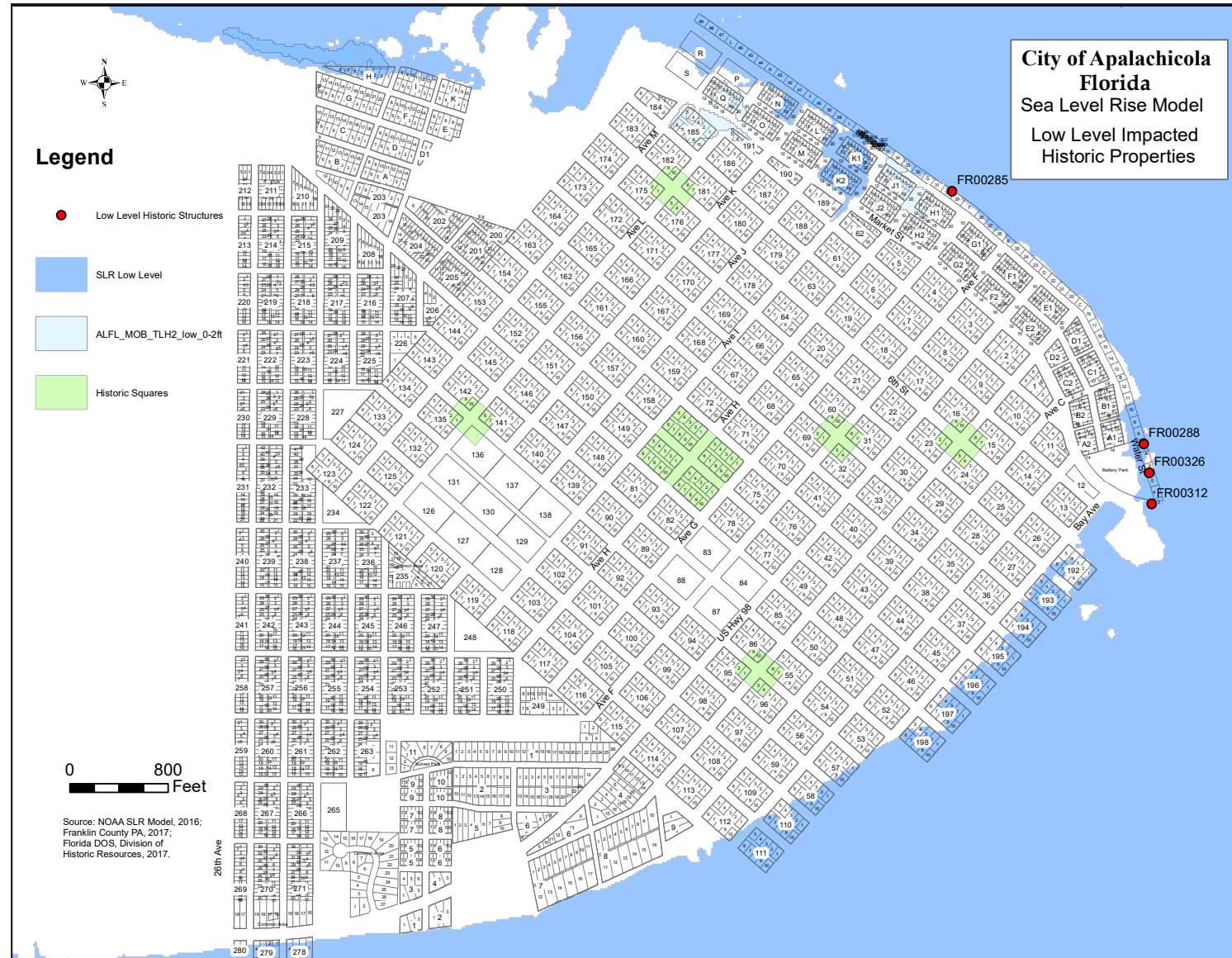
Level of Impact:

The individual topography of the parcel on which the historic resource is located will determine the impact. Much of the City's downtown commercial lots range in elevation from 5 to 12 feet. A high inundation level flood of 5-6 may impact parcels with existing elevations of five feet or less. For those sites located in particularly low elevations, flood-proofing commercial structures is an option.

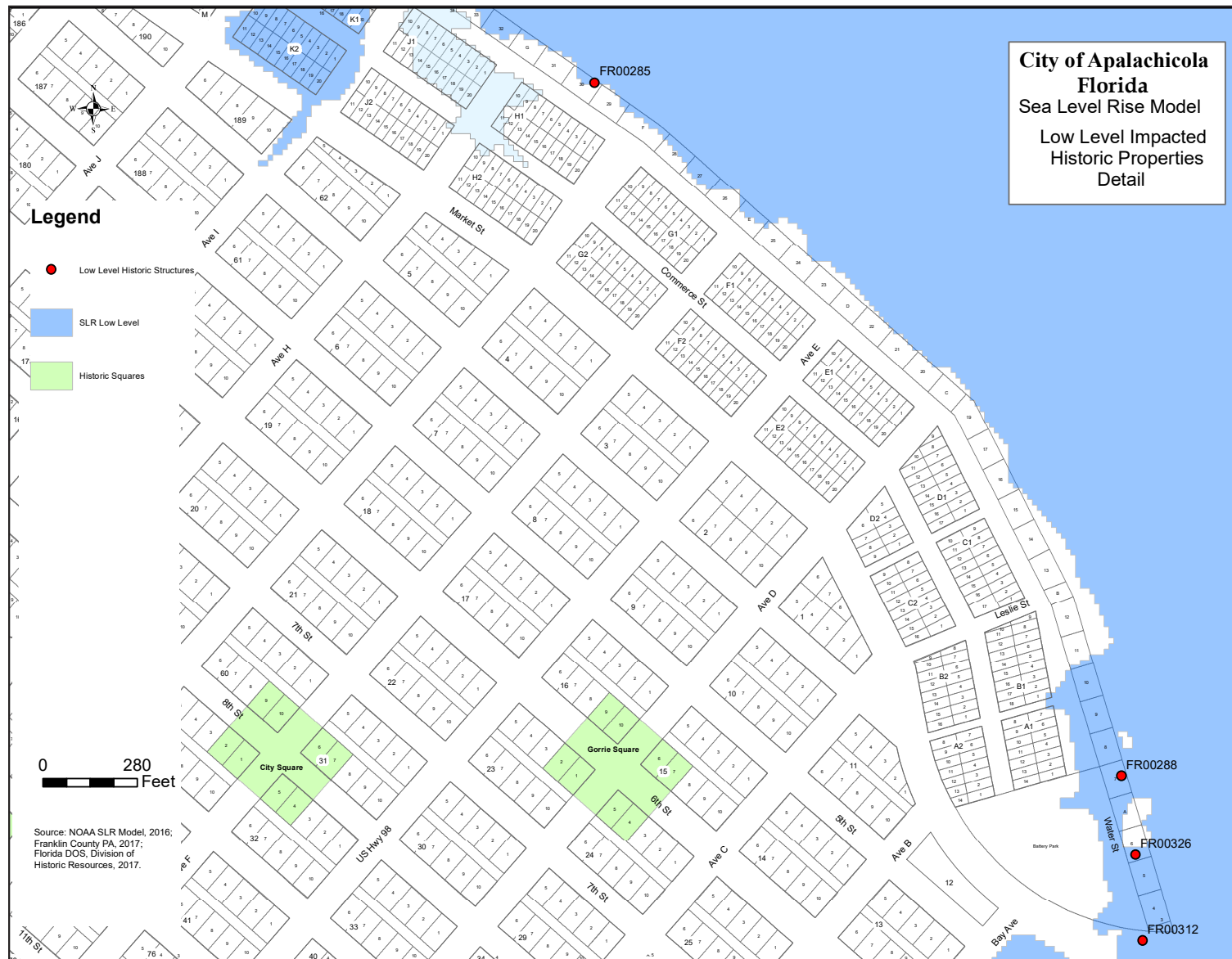
Map 14. Historic Resources in the City's Area of Special Flood Hazard (Rated A & V zones)



Map 15. Low Projected Inundation - Historic Resources



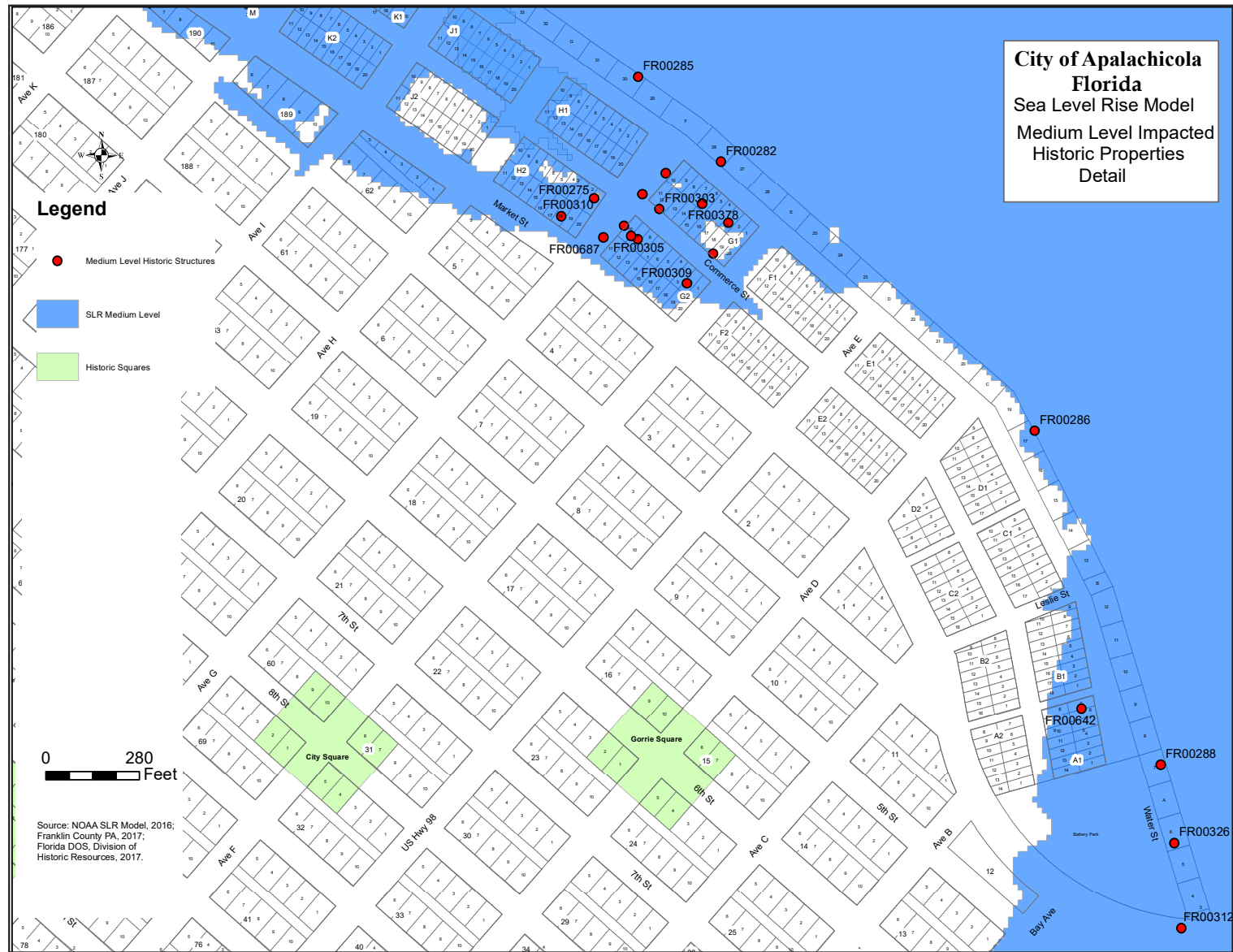
Map 15a. Low Projected Inundation - Historic Resources - Detail



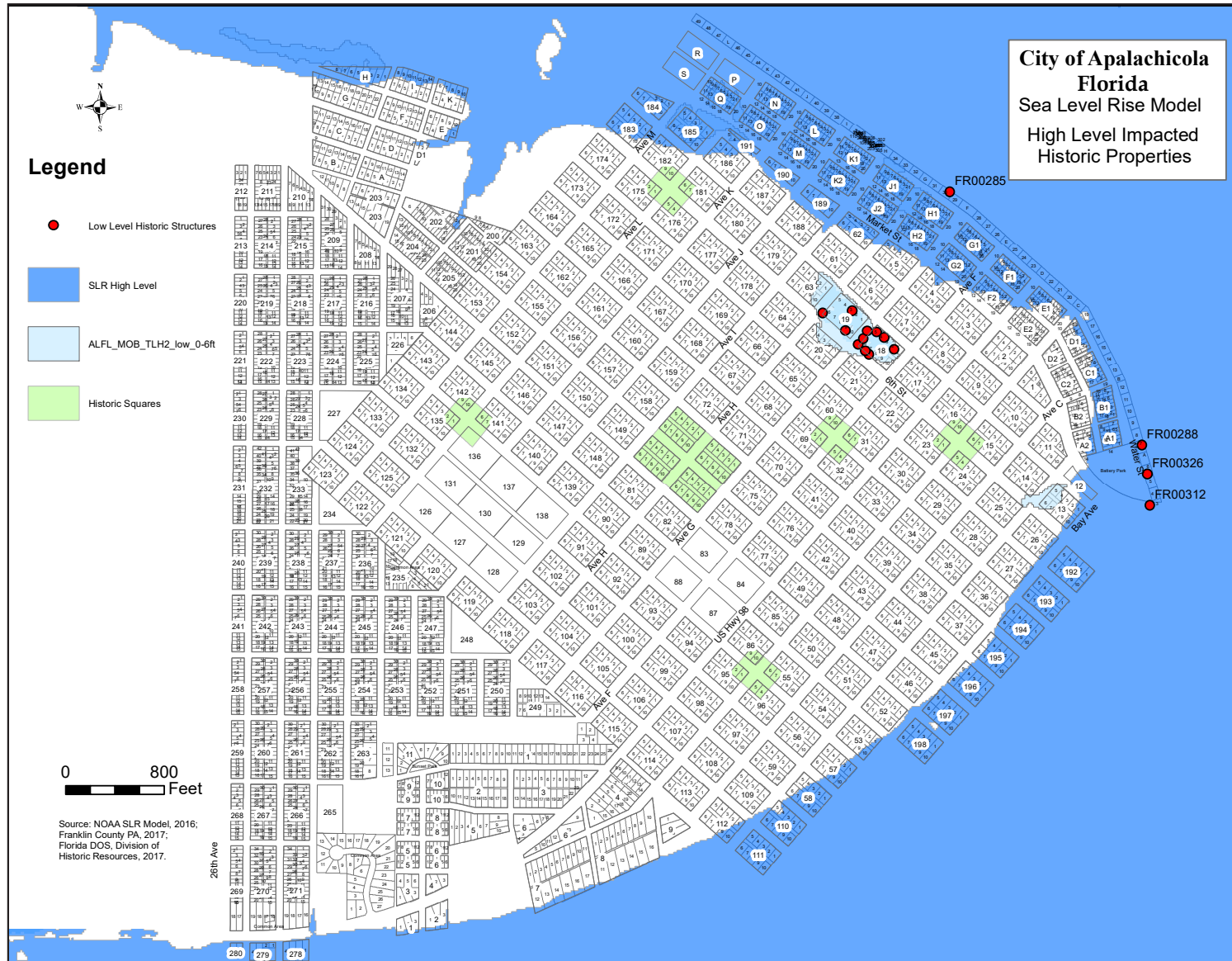
Map 16. Medium Projected Inundation - Historic Resources



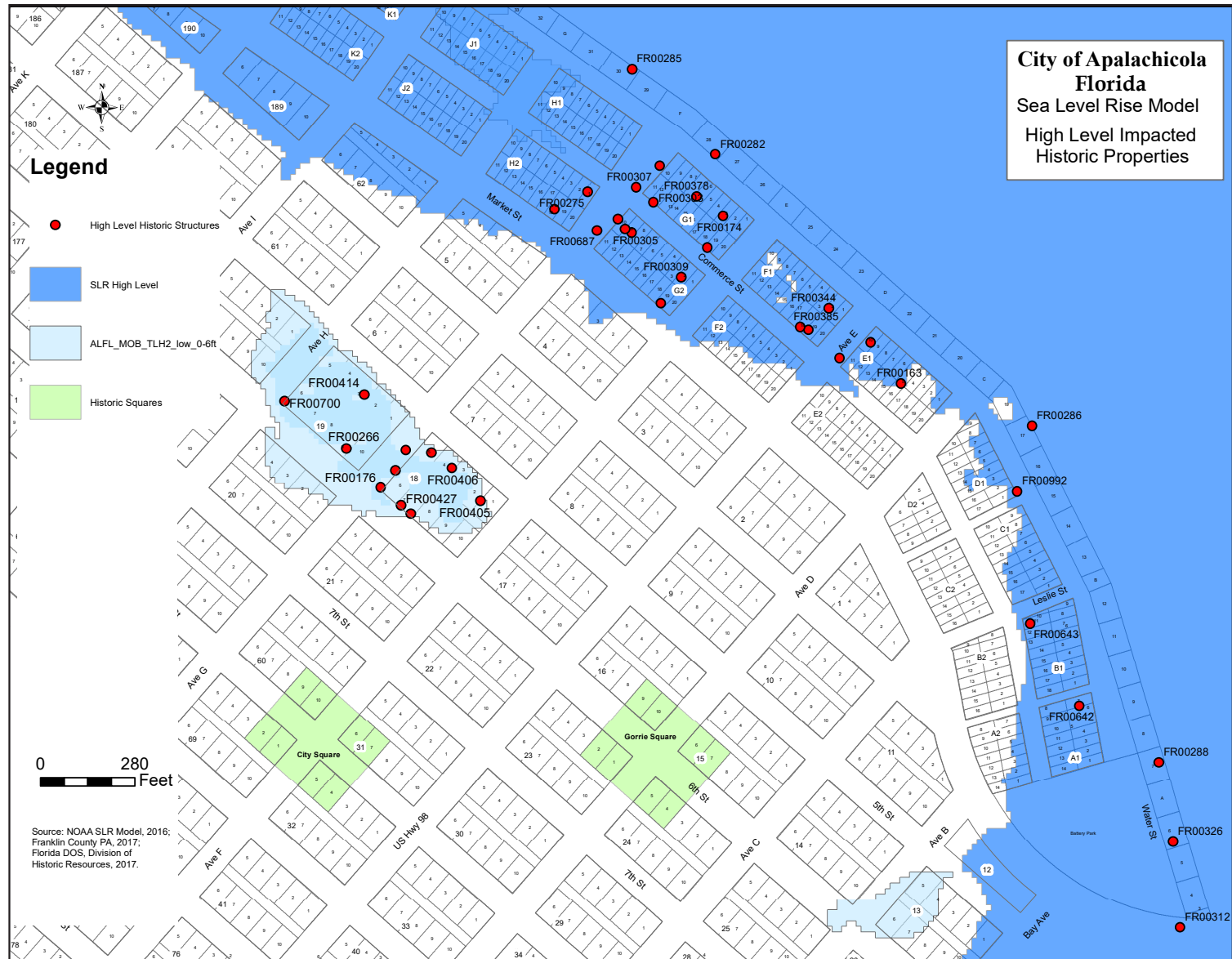
Map 16a. Medium Projected Inundation - Historic Resources - Detail



Map 17. High Projected Inundation - Historic Resources



Map 17a. High Projected Inundation - Historic Resources - Detail





Current and Future Exposure to Coastal Flood Hazard

Analysis of the Focus Area Topography and FEMA Elevation Requirements

Most of the downtown commercial district is located in FEMA's Area of Special Flood Hazard (Rated AE & V zones) See map 14. A small percentage of the low level inundation model areas include the Areas of Special Flood Hazard. All of the medium and high level inundation model areas include the Areas of Special Flood Hazard.

The topography of the C-1, C-4 and RF districts ranges from 2-6 feet. The required elevations range from 13' to 15' depending on the FIRM zone in which an individual parcel is located.

The majority of the C-1 and C-4 property falls within the AE12 and 13 zones with an elevation requirement of 13 and 14 feet respectively. Most of the C-1 and C-4 property in this zone averages between 4-6 feet in elevation although there is an area directly adjacent to the river with a 2 foot elevation.

The V zone property is located along south Water Street and affects the lots directly adjacent to the river. The elevation of this property is lower, averaging between 2-4 feet.

Not unexpectedly, most of the C-1, C-4 and RF districts are currently subject to coastal flooding. The SLR projected inundation model exacerbates the potential vulnerability of the area.

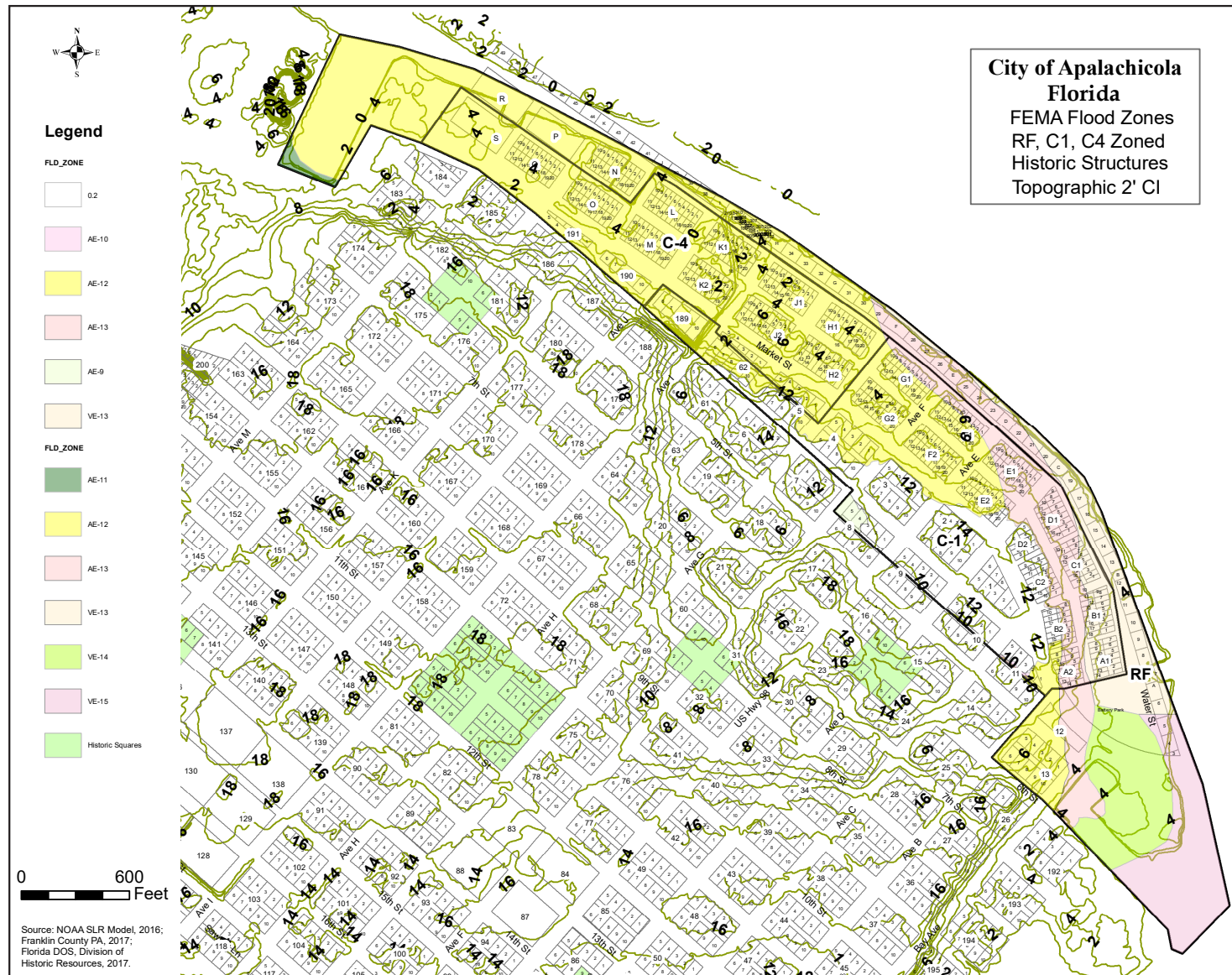
The City adopted its most recent Floodplain Management Ordinance in 2013. In it, the City adopted provisions that require a one foot free-board above the required base flood elevation requirements. All new construction within the City is required to meet and exceed the required BFE by one foot.

Table 6 shows the required elevation necessary in each of the FEMA Flood Zones for the C-1, C-4 and RF district.

Table 6. FEMA Zones in C-1, C-4, RF and Require Elevations

FEMA Zone	Existing Topographic Elevations	Required Elevation
AE12	0, 2, 4, 6	13'
AE13	6	14'
VE13	4	14'
VE14	2	15'

Map 18. Topography and FEMA FIRM zones.





Economic and Cultural Impacts

Economic Impacts

Property owners within the downtown commercial district's Area of Special Flood Hazard are already impacted economically based on the property's location within area subject to flooding. Strict building code requirements within flood-prone areas and high flood insurance premiums increase the cost of development within these areas and make development an economic challenge. Complete inundation based on projected models may result in some parcels being totally submerged and therefore undevelopable.

Cultural Impacts

The cultural impacts of coastal vulnerability are connected to the economic impacts. Owners of many of the traditional waterfront uses such as seafood processing and water-dependent businesses are no longer able to afford the economic burden of insurance and increased development costs. Many traditional seafood processing plants have been shuttered and replaced with more profitable tourism-based development with new owners that are able to afford the higher costs associated with coastal development. The impacts of projected models could result in a further loss of the traditional water-dependent maritime and seafood related businesses.



Adaptation Action Area Consideration

"Adaptation Action Area" or "Adaptation Area" means a designation in the coastal management element of a local government's comprehensive plan which identifies one or more areas that experience coastal flooding due to extreme high tides and storm surge, and that are vulnerable to the related impacts of rising sea ..."

Adaptation Strategy Concepts

Adaptation is fundamentally a risk management strategy; risk is a combination of the likelihood of sea level rise impacts and the magnitude of the potential consequences. Response options are evaluated for their feasibility and potential effectiveness at reducing the identified risk(s). The City of Apalachicola has not yet adopted policies relating to Adaptation Action Area planning. The City's Comprehensive Plan has not been updated for several years and it would first be recommended that the City's plan data and analysis, along with its Goals, Objectives and Policies be updated before advanced. It is possible that the entire C-1, C-4 and RF district could be considered as a focus area for adaptation planning.

The implementation of Adaptation Action Area within Apalachicola's C-1, C-4 and RF district would allow the City to gradually plan for adaptation to current and future sea level rise and other potential impacts. The four optional strategies (protection, accommodation, retreat and avoidance) of adaptation provide an avenue for the City to address the four major impacts of concern.

Protection strategies may be appropriate for the downtown areas that are location-dependent and cannot be significantly altered or relocated, such as historical resources, or water-dependent uses. Protection could include shoreline armoring that is either natural or man-made. Examples include: seawalls and bulkheads, living shorelines, tide gates and saltwater intrusion barriers.

Accommodation strategies aim to reduce potential risks rather than seeking to prevent flooding or inundation entirely. Examples include: the flood proofing of nonresidential structures, vertical elevation of structures; using structural fill to raise grade elevations; limit development in projected hazard zones; planting salt water tolerant plant species. If a critical facility in a high risk area requires substantial upgrades, it might be cost-effective in terms of hazard avoidance to relocate the facility.

Managed Retreat or Relocation strategies may involve the transition of vulnerable lands from private to public ownership, but may also include a combination other strategies such as transfer of development rights (TDRs), purchase of development rights and conservation easements. Examples include infrastructure relocation/removal; and, transfer of development rights to upland sending areas that are characterized by lower vulnerabilities to coastal hazards.

Avoidance strategies may involve identifying opportunities for future conservation or low density development areas within local government planning documents. A wide range of planning tools may be identified, facilitating a local decision to limit development in areas subject to moderate to high risk. Regulatory tools may include the designation of lands for low density or passive uses. An avoidance strategy may include land acquisition or tools such as a land trusts, zoning codes, and overlay zones.