



# ADAPTATION PLANNING FOR HISTORIC PROPERTIES

A PRODUCT OF THE COMMUNITY RESILIENCY INITIATIVE





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## *Acknowledgements*

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The Community Resiliency Initiative would like to express appreciation to the following individuals for their comments and review:

Adrienne Burke

Ann Horowitz

Tim Parsons

Roger Smith

Deena Woodward

This publication was funded in part, through a grant agreement from the Florida Department of Environmental Protection, Florida Coastal Management Program, by a grant provided by the Office of Ocean and Coastal Resource Management under the Coastal Zone Management Act of 1972, as amended, National Oceanic and Atmospheric Administration Award No. NA12NOS4190028. The views, statements, findings, conclusions and recommendations expressed herein are those of the author(s) and do not necessarily reflect the views of the State of Florida, NOAA or any of their sub-agencies.

Completed: May 2015

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## The Community Resiliency Initiative

The Florida Department of Economic Opportunity (DEO), with generous funding support from NOAA through the Florida Department of Environmental Planning's Florida Coastal Office, initiated the five-year Community Resiliency Initiative in response to several Florida communities expressing strong interest in receiving guidance on and technical assistance with adapting to rising sea levels. The Community Resiliency Initiative focuses on coordinating planning efforts throughout the State and integrating sea level rise adaptation into existing planning mechanisms, including local comprehensive plans, local hazard mitigation plans, and disaster redevelopment plans. The Community Resiliency Initiative has worked to examine existing data and practices related to current sea level rise adaptation planning efforts and develop guidance for agencies and communities to consider as they plan for and implement adaptation strategies.

The Community Resiliency Initiative is guided by a commitment to collaborate with individuals and groups to determine what guidance is needed for sea level rise adaptation efforts and what resources and information are needed to make this guidance useful or operative. As such, the Initiative is steered by the Community Resiliency Focus Group, a group of Florida-based coastal hazard experts and stakeholders.



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## Chapter 1. Introduction

### Florida's Historic Coast

Florida has 1,350 miles of coastline and no point in Florida is more than sixty miles from seawater<sup>1</sup>. Florida's dependence on its coastline has been evident throughout its history, from the time the first people entered Florida to modern times, as generations of Floridians have chosen to congregate near the coast. Historical evidence reveals that the Native Americans who inhabited Florida prior to European arrival have historical records illustrating their maritime interests and links to the coast through their reliance on marine resources for both food and transportation. Later European settlers settled along the coastline and continued the trend of dependence on the coast, as sailing ships were the only method available to settlers of communicating with and traveling to and from other parts of the globe. Even into the Second Spanish Period (1784- 1821) and the Territorial Period (1821-1845), the interior of the Florida peninsula remained largely unsettled, while ports around the State were developed and used for transporting timber, cotton, and other goods on a large scale to the northern states and to Europe. After becoming a state and on through modern times, Florida maintained and continues to maintain its dependence on maritime resources, as illustrated by the contributions made by major ports in the State in creating and building a role for Florida in international trade. In addition to this important role in trade, Florida has become increasingly settled and active over time. Water has become the featured resource for a variety of recreational activities and an active fishing industry<sup>2</sup>.



Man shows grandson how to fix a fishing net.  
Naples, FL, Circa 1953.<sup>2</sup>

With so much activity occurring on Florida's coastline, it is no wonder that there are many coastal properties that are considered historic and valued cultural resources either by the National Register of Historic Places or as defined locally. In the future, as communities plan for adaptation to rising sea levels, these historic and cultural resources will have unique needs that will need to be addressed if these resources are to survive for future generations to use, learn from, and enjoy.



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## Purpose of Guidebook

The Department of Economic Opportunity (DEO) recognizes both the [importance of historic properties in Florida](#) and the emphasis put on protecting these properties in the planning frameworks of many of the State's communities and agencies. Due to the State's strong maritime connection, many of Florida's historic properties are located near the coast in areas vulnerable to the impacts of sea level rise. These historic properties have stood the test of time but may now face new challenges resulting from sea level rise-related impacts. The most effective way of ensuring these historic properties' continued existence is to consider their vulnerability to sea level rise and how to address this vulnerability through adaptation planning.

This guidebook describes adaptation planning for historic properties both within the larger adaptation planning process and as its own standalone planning process. Historic properties have unique needs that communities may choose to address when planning for adaptation to sea level rise. This guidebook discusses the challenges associated with adapting historic properties to sea level rise and provides guidance on how to protect vulnerable historic properties to communities engaged in adaptation planning. This guidebook is intended to be useful to a wide variety of audiences, including planners interested or currently engaged in adaptation planning and the historic preservation community.

## Guidebook Sections

This guidebook includes four chapters and an appendix. Chapter 1, the *Introduction*, includes background information and foundational concepts. Chapter 2, *Challenges of Adaptation*, discusses the unique considerations that differentiate adaptation planning for historic resources from adaptation planning for non-historic resources. This chapter includes an overview on the delicate balance between adaptation and historic integrity as well as an overview of the legal framework that guides the process of altering historic properties. Chapter 3, *The Adaptation Planning Process*, provides a flexible framework for adaptation planning and an explanation of how adaptation planning for historic properties fits within this framework, which was developed by the Community Resiliency Initiative. This chapter covers topics such as formulating goals and objectives, identifying historic resources, conducting a vulnerability assessment, prioritizing properties, conducting an alternatives analysis of different potential adaptation strategies, and implementing adaptation strategies. Chapter 4, *Strategies for Adaptation*, discusses a variety of adaptation strategies for historic resources in terms of scale; the types of historic properties for which each may be applicable; implications for usage on historic properties; and general advantages and disadvantages. This chapter is followed by some concluding remarks and two appendices, which provide detail about potential funding mechanisms for adapting historic properties to the effects of sea level rise as well as the potential impacts of sea level rise on properties in Florida listed on the National Register of Historic Places.

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## Foundational Concepts and Definitions

### Sea Level Rise

Sea level rise may existing coastal hazards and have additional negative impacts. Some examples of impacts that communities may experience include:

- Increased flooding and drainage issues;
- Destruction of natural resource habitats;
- Higher storm surge levels;
- Increased evacuation areas and evacuation time frames;
- Increased shoreline erosion;
- Saltwater intrusion;
- Loss of viable infrastructure and existing development; and
- Destruction, loss, or alteration of valued cultural and historic resources and the economic and community base they bring to an area.

### Resilience

Resilience is the “capacity of a social-ecological system to cope with disturbance, responding or reorganizing in ways that maintain its essential function, identity and structure, whilst also maintaining the capacity for adaptation, learning and transformation”<sup>3</sup>. Resiliency requires understanding the risks and potential events that may cause disruption of local processes as well as understanding the development of local capacity to meet future challenges.

### Adaptation Planning

Recognizing Florida’s exposure to hazardous events and potential vulnerability to sea level rise, agencies and organizations at all scales have launched a variety of adaptation initiatives. Adaption planning consists of the steps a community takes toward becoming more resilient to the impacts of rising sea levels over a period of time. The actions a community may take to mitigate vulnerability to flooding hazards are similar to those a community may take to adapt to sea level rise. The main difference between the two processes is that adaptation to sea level rise involves consideration of a longer timeframe for impact and, therefore, a longer timeframe for increased vulnerability and implementation. Adaptation to sea level rise may also implicitly assume that areas subject to sea level rise related-hazards, such as coastal flooding, will become increasingly vulnerable to these hazards in the future as sea level rise accelerates.

Adaptation strategies often take the form of one of three categories: protection, accommodation, or retreat.

**PROTECTION** – Hard and soft structurally defensive measures to mitigate the impacts of rising seas (e.g., floodwalls, levees, seawalls, beach renourishment, living shorelines). Protection decreases vulnerability while allowing structures to remain unaltered.

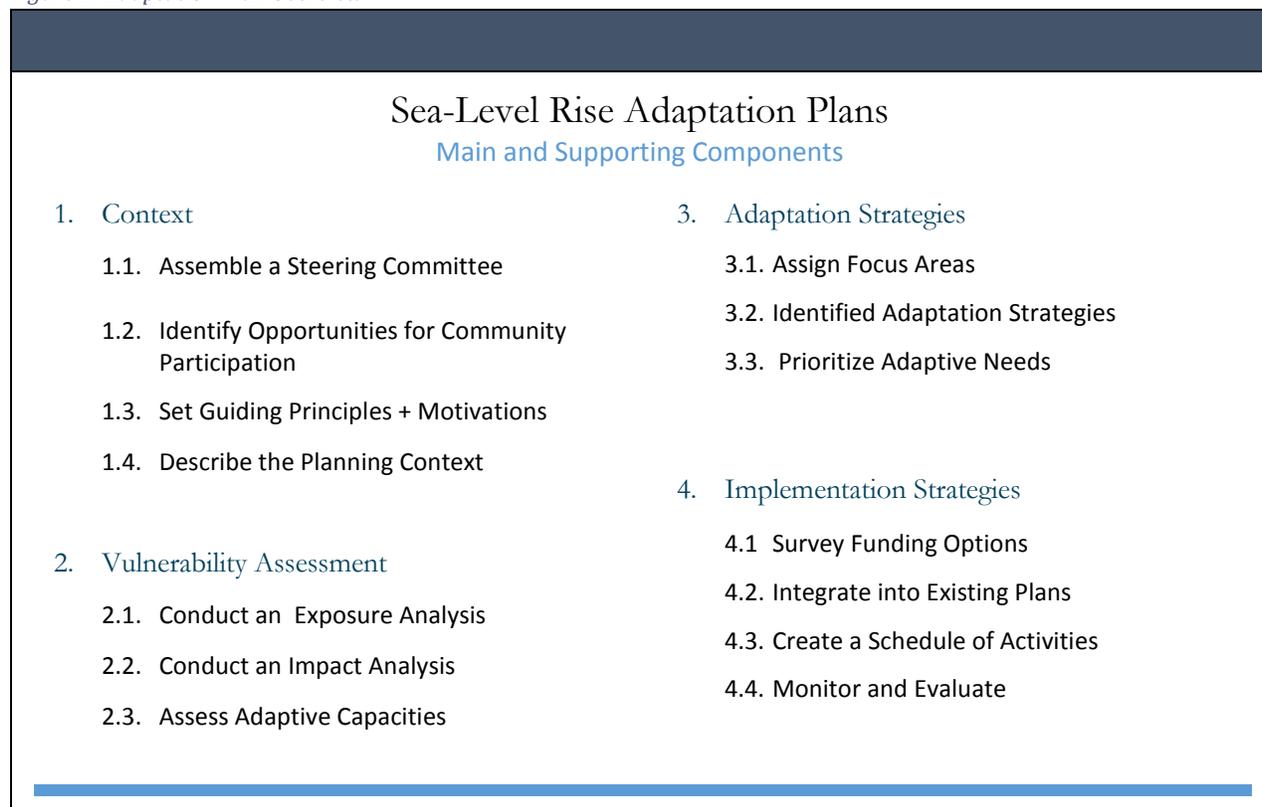
**ACCOMMODATION** – Physical design alterations allowing a structure or land use to remain in place (e.g., elevation, floodable development, drainage improvements).

**MANAGED RETREAT** – Relocation of existing development from areas of high risk to areas of lower risk. This also includes limitations of future development in high risk areas (e.g., rolling easements or relocation).

## Components of an Adaptation Plan

In its ongoing efforts to provide guidance for communities who are new to or who looking to enhance their efforts at adaptation planning, the Community Resiliency Initiative has produced a resource entitled *Components of an Adaptation Plan*. This guidebook outlines major components of planning for adaptation to sea level rise and associated support activities (subcomponents). It is intended to ass communities, via scientific and participatory best practices, as they undertake resiliency planning efforts. The components and subcomponents are presented below in figure 1. These components are described in further detail in Chapter 2, which provides an overview of the adaptation planning process.

Figure 1: Adaptation Plan Overview





## Preservation Terminology

While not every property that is historically and culturally significant is listed on the National Register of Historic Places, the characteristics of a property implied by its inclusion on National Register are true of almost all historic properties. The following definitions and concepts are adapted from the National Register of Historic Places.

Historic Context - “Those patterns or trends in history by which a specific occurrence, property, or site is understood and its meaning (and ultimately its significance) within history or prehistory is made clear”<sup>4</sup>.

Significance - In order for a property to qualify for listing on the National Register, the property must be significant, meaning that it must represent a significant part of the history, architecture, engineering, or culture of an area. The significance of a property is dependent and evaluated upon its historic context and is displayed through physical features that convey the property’s historic context.

## Importance of Historic Integrity

Integrity is defined as the ability of a property to convey its significance. It is grounded in an understanding of a property’s physical features and how they relate to the property’s significance<sup>5</sup>. Properties change over time, both organically and due to intentional retrofitting, but maintaining the physical features of historic properties is essential to maintaining their integrity. These features help to convey historic identity, in terms of both *why* and *when* a property was significant. The National Register considers seven facets to define the integrity of a historic property.

- 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<sup>6</sup>.



## Categories of Historic Properties

The National Register list six types of historically and culturally significant properties. The following lists and defines the categories of property that can be nominated to the National Register.

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”<sup>7</sup>. For the purpose of this paper, historic property is used interchangeably with “historic resource.”

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<sup>8</sup>.

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, lighthouses, silos, trolley cars, and windmills.<sup>9</sup>

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<sup>10</sup>.

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<sup>11</sup>.

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”<sup>12</sup>.



## Chapter 2. Challenges Facing Adaptation Efforts

*Adaptation related to historic properties in vulnerable areas is part of historic preservation because without adaptation, the historic integrity of a property, as well as its very existence and its place in a community, may be at risk.*

The adaptation planning and decision-making frameworks for historic properties are different from corresponding frameworks for non-historic properties. Historic properties have unique needs related to preserving their historic significance and context and thus require supplemental policy and legal frameworks. This section describes the special needs that, to ensure optimal planning outcomes, must be considered when choosing adaptation strategies for historic properties, including the desirability of retaining historic integrity, the existing guidance available regarding retrofitting historic properties, and the relevant legal framework, which impacts both decision-making and the actual adaptation process.

### Retaining Historic Integrity

Historic properties are unique because they possess historic integrity, which depends upon the maintenance of essential physical features that convey a particular property's significance. When deciding which adaptation strategy is best for an individual historic property, communities will likely want to consider how different adaptation strategies may impact that property's historic integrity. The need to maintain a property's historic integrity may need to be balanced with the need to alter the property to increase its resilience. On one hand, a community may want to reduce vulnerability as much as possible, which can lead to actions that make major changes to the property. Major changes have a higher potential to affect a property's integrity. On the other hand, the typical preservation context motivates actions that limit changes to historic properties as much as possible. Blanket limitations on alterations to historic properties may put some properties at greater risk of future loss of integrity (through flood damage). Attempting to find a balance between potential actions is a major part of the decision-making context when choosing an appropriate adaptation strategy for a historic property.

Choosing adaptation strategies that reduce the vulnerability of a property while retaining as many of its essential significance-conveying physical features as possible is the objective of adaptation planning for historic properties. As each history property is unique, there is no blanket solution for adapting historic properties to sea level rise. For example, a historic property defined by the integrity of its setting and location will need to be adapted differently than a historic property with integrity dependent upon its design and workmanship. Even two historic properties with, for instance, integrity of design might call for different adaptation strategies to best balance the preservation of their integrity with the need for adaptation. Decisions will always need to be made on a case-by-case basis that takes into consideration multiple factors, including the integrity of the resource, costs associated with different adaptation strategies, and the resource's unique vulnerability.



## The Secretary of the Interior's Standards for the Treatment of Historic Places

While decisions about which adaptation strategy is best for individual historic properties are best made on a case-by-case basis, standards and guidance on general approaches for protecting historic properties are available. The Secretary of the Interior's Standards for the Treatment of Historic Places provides overarching guidance to historic property owners, managers, preservation consultants, architects, contractors, and project reviewers. This guidance should be reviewed prior to making any treatment decisions.

The Standards for the Treatment of Historic Properties are divided into four sections:

- Preservation,
- Rehabilitation,
- Restoration, and
- Reconstruction.

The Standards for Rehabilitation are the most applicable of the Secretary of the Interior's Standards to adaptation planning, as these Standards recognize the need to alter and/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<sup>13</sup>. Rehabilitation is defined by the Secretary of the Interior as "the act or process of making possible a compatible use for a property through repair, alterations, and additions while preserving those portions or features which convey its historical, cultural, or architectural values"<sup>14</sup>. The Standards for Rehabilitation can be found at: <http://www.nps.gov/tps/standards/rehabilitation.htm>

The Standards also offer advice on rehabilitating properties, including guidelines to assist in the application of the standards as well as more specific guidelines regarding exterior materials, exterior features, interior features, site, setting, and special requirements (*e.g.*, energy efficiency, new additions, accessibility, or health and safety). The specific guidelines apply the more general guidelines and provide a list of recommendations as well as a list of actions that are not recommended.

The Secretary of Interior's Standards for Rehabilitation and associated approach guidelines provide generalized advice aimed at protecting historic properties and their historic significance. When considering the range of available adaptation options, these Standards can be used as guidance for protecting the integrity of historic properties. Consultations with preservation experts may be used to supplement this guidance when making adaptation planning decisions about specific historic properties.



## The Secretary of the Interior's Standards for Rehabilitation

1. A property will be used as it was historically or be given a new use that requires minimal change to its distinctive materials, features, spaces, and spatial relationships.
2. The historic character of a property will be retained and preserved. The removal of distinctive materials or alteration of features, spaces, and spatial relationships that characterize a property will be avoided.
3. Each property will be recognized as a physical record of its time, place, and use. Changes that create a false sense of historical development, such as adding conjectural features or elements from other historic properties, will not be undertaken.
4. Changes to a property that have acquired historic significance in their own right will be retained and preserved.
5. Distinctive materials, features, finishes, and construction techniques or examples of craftsmanship that characterize a property will be preserved.
6. Deteriorated historic features will be repaired rather than replaced. Where the severity of deterioration requires replacement of a distinctive feature, the new feature will match the old in design, color, texture, and, where possible, materials. Replacement of missing features will be substantiated by documentary and physical evidence.
7. Chemical or physical treatments, if appropriate, will be undertaken using the gentlest means possible. Treatments that cause damage to historic materials will not be used.
8. Archeological resources will be protected and preserved in place. If such resources must be disturbed, mitigation measures will be undertaken.
9. New additions, exterior alterations, or related new construction will not destroy historic materials, features, and spatial relationships that characterize the property. The new work shall be differentiated from the old and will be compatible with the historic materials, features, size, scale and proportion, and massing to protect the integrity of the property and its environment.
10. New additions and adjacent or related new construction will be undertaken in such a manner that, if removed in the future, the essential form and integrity of the historic property and its environment would be unimpaired.<sup>15</sup>

## The Legal Framework

In addition to voluntary consultations of relevant experts, there is a legal framework that serves to encourage the maintenance of the historic character of historic properties. These laws often mandate historical review processes aimed at encouraging the protection of these historic characteristics.

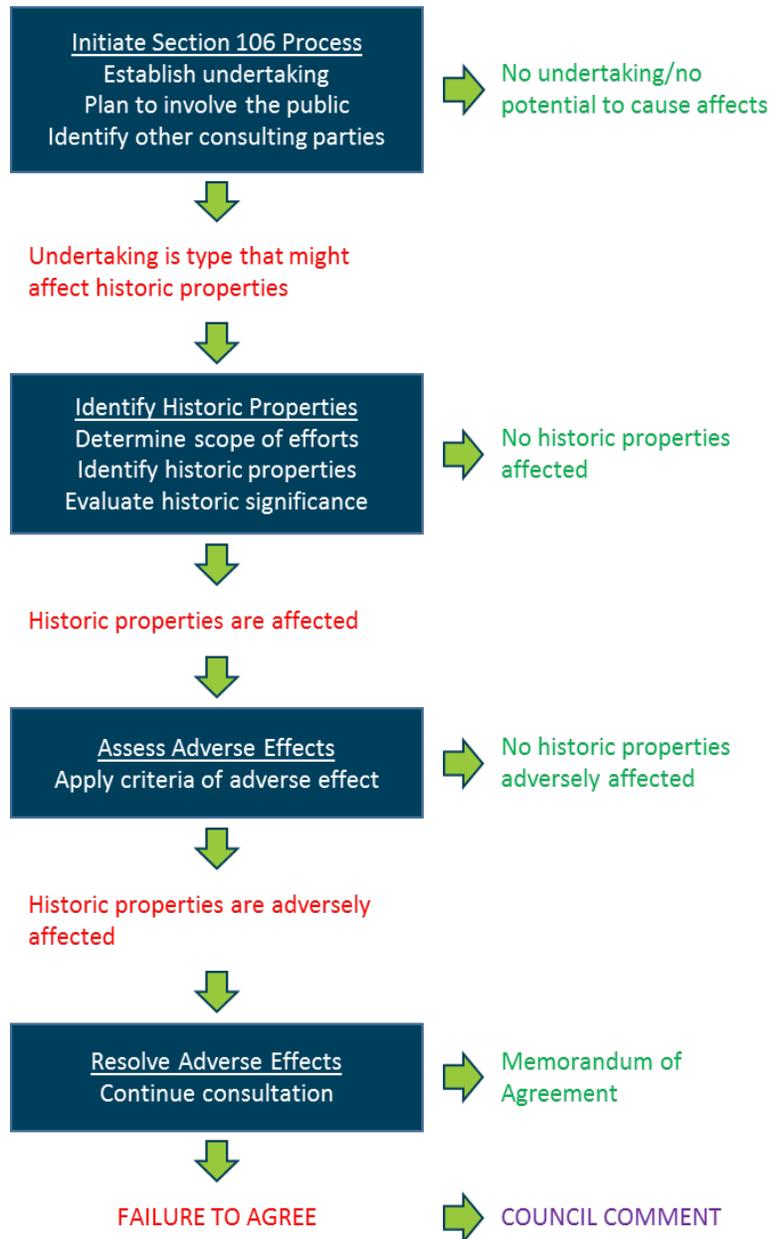
### National Historic Preservation Act of 1966

The National Historic Preservation Act of 1966 (NHPA) mandates a review process aimed at encouraging the protection of historic characteristics of historic properties. This review process is established in section 106 of the law, which requires Federal agencies to take into account the effects of their actions on historic properties. Any time a Federal agency carries out, funds, or approves an action (*e.g.*, permitting, licensing, or other approval mechanism), the agency must go through the section 106 historic preservation review process<sup>16</sup>.

The Advisory Council on Historic Preservation lists the following steps in Title 36 of the Code of Federal Regulations (CFR), Part 800 as the steps for Section 106 review:

- 1) **Initiate Section 106 Process** – This step begins with the determination by a Federal agency of whether an action it is undertaking could affect historic properties. 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.
  - 2) **Identify Historic Properties.**
  - 3) **Assess Adverse Effects** - An adverse effect is considered to exist if the proposed project may alter characteristics that qualify a property for inclusion in the National Register in a manner that diminishes the integrity of a property. Adverse effects may include physical destruction or damage; alterations inconsistent with the Secretary of Interior's Standards for the Treatment of Historic Properties; relocation of the property; change in the character of the property's use or setting; introduction of incompatible visual, atmospheric, or audible elements; neglect and deterioration; or the transfer, lease, or sale of a historic property out of Federal control without adequate preservation restrictions.
  - 4) **Resolve Adverse Effects** - If an adverse effect is found, the agency begins consultations aimed at identifying ways to avoid, minimize, or mitigate the adverse effects. These consultations usually result in a Memorandum of Agreement.
  - 5) **Implementation**<sup>17</sup>.
-

The goal of the Section 106 review process is to encourage, but not mandate, preservation. If a project is proposed to adapt a historic property to the effects of sea level rise that involves any Federal engagement, than the Section 106 process will be initiated. During this process, the mandated consultations with the State Historic Preservation Officer (SHPO) or Tribal Historic Preservation Officer (THPO) may help historic property owners identify ways to mitigate and minimize any adverse effects.



*Figure 2: Section 106 Regulations Flowchart<sup>1</sup>*

## Florida Statutes, Chapter 267: Historic Resources

The State of Florida has its own historic resources Statute that mirrors the National Historic Preservation Act (NHPA), except that the Florida Statute requires review for State, as opposed to Federal, undertakings. The Statute mandates a similar review process to that outlined in Section 106 for any State agency project that may adversely impact either a resource listed on the National Register of Historic Places or a historic resource that may be eligible for listing on the Register that is on State lands, receives State funding, or requires a permit from a State agency (see § 267.061(2), Fla. Stat., (2014)). The State agency must also provide the Division of Historic Resources with a reasonable opportunity to comment on a proposed undertaking. Similar to the Section 106 process, if there is an adverse effect on the character, form, integrity, or other qualities which contribute to the historical, architectural, or archaeological value of a property, then other feasible actions must be considered, in addition to steps to avoid or mitigate the adverse effects (see § 267.061(2)(b), Fla. Stat., (2014)).

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. This will allow for consultation between the Division and the owner looking to potentially alter the property.

### Local Preservation Ordinances

In addition to Section 106 and Chapter 267, local preservation ordinances are also part of the legal framework that governs adaptation actions made to 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<sup>18</sup>. Under the National Park Service and Florida Division of Historic Resources Certified Local Government Program, all [Certified Local Governments](#) (CLG) are required to have a preservation ordinance to obtain Certified Local Governments status, though local governments not participating in the CLG program may also have local preservation ordinances<sup>19</sup>. As per Federal regulations, communities that participate in the Certified Local Government program are automatically prioritized for funding allocations annually from the Division. All adaptation project managers are encouraged to consult with the local planning board and/or building department to determine the extent and applicability of local ordinances to the project(s).

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<sup>1</sup> Flowchart derived from the flowchart provided by the Advisory Council on Historic Preservation. More information can be found at: <http://www.achp.gov/regsflow.html>

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## Laws Protecting Archaeological Sites

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 made to 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.

## Other Laws

Another legal consideration relevant to adapting historic properties for sea level rise are laws, besides those that mandate historical reviews with Federal, State, or local review boards, that may impact what can and cannot be done when making adaptation-related changes to historic properties.

One example is the Florida Building Code. The Florida Building Code is similar to international building codes but is tailored to Florida's specific needs, especially regarding planning for wind and flood load forces. In the *Florida Building Code, Existing Buildings*, Chapter 11 is dedicated to design standards for historic buildings. The design standards for historic buildings are flexible in recognition of the need to maintain the historic character of these buildings. Historic buildings are defined in the Florida Building Code as those listed in the National Register, those that are contributing property in a National Register listed historic district, and those designated as an individual or contributing historic properties by local, State, or special district, or those determined eligible for listing on the National Register by the State Historic Preservation Officer (2010 FBC, Existing Buildings, Sec. 1101).

In addition to following the requirements set forth in the Florida Building code, adaptation of some historic buildings will have to meet additional more stringent requirements if the buildings are in a high velocity hurricane zone (primarily Miami-Dade and Broward Counties) or in a windborne debris region. When researching materials ("products") to incorporate into the sea level adaptation strategy for a historic building, project managers will need to consider local building officials' requirements in addition to the product approval that most projects on historic properties within the State must obtain from the Florida Building Commission. One example of local regulation, in addition to requirements from the State, comes from Miami-Dade County. For projects located in a high velocity hurricane zone, the proposed building products must be approved by the Florida Building Commission. For other, non-hurricane zone projects, the building products must be approved by the Miami-Dade Building Code Compliance Office<sup>20</sup>.

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Floodplain management ordinances may also constitute a potential source of historic property regulation. Nearly all Florida communities have adopted a local floodplain management ordinance. When communities adopt such an ordinance, they determine whether proposed development activities in FEMA-designated flood hazard areas involving a historic structure will be exempt from all requirements of the floodplain ordinance or if the community will require deviations from the ordinance to obtain variance approvals by a local board. The distinction between exemption and a variance consists of the following:

- Exemption: When a historic structure is exempt from all flood ordinance requirements, flood-resistant construction methods that are necessary for protecting the structure from flood damages are not required to be incorporated into the building plans.
- Variance: When the issuance of variances is required for proposed deviations from the local floodplain management ordinance, local variance review boards have the ability to determine which requirements of the ordinance the proposed work has or does not have to meet.

For example, if a local floodplain management ordinance states that for a particular non-historic building the required vertical flood elevation building protection level is six feet above the highest adjacent grade, an exemption would allow a historic building to remain substantially below the required protection level (*e.g.*, on grade). However, a variance would allow the local board to balance the requirements and historic preservation, by requiring that the historic building be raised to four feet so as to provide additional flood protection while not drastically damaging the historic character of the building.

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## Chapter 3. The Adaptation Planning Process

The Community Resiliency Initiative has produced a variety of resources that provide guidance on how to approach the adaptation planning process. These resources outline a flexible planning framework that allows communities to design and implement an adaptation strategy suited to their unique interests, needs, and resources. This chapter approaches adaptation planning for historic resources via the steps elucidated in the general adaptation components guide.

There are two general ways that communities might engage in adaptation planning for historic resources. First, communities may choose to develop a comprehensive sea level rise adaptation plan for their entire jurisdiction. In these communities, historic properties will be just one of the types of resources for which adaptive action is being considered. These communities will likely seek to discover how adapting historic resources to the effects of sea level rise fits within their overall adaptation planning framework. Alternatively, communities may choose to focus on protecting historic resources as their main adaptation planning activity. These communities will likely require guidance specifically related to adapting historic resources. This chapter discusses both how to engage in a standalone planning process specifically for the adaptation of historic resources and how to integrate considerations of historic properties into a comprehensive adaptation planning process.

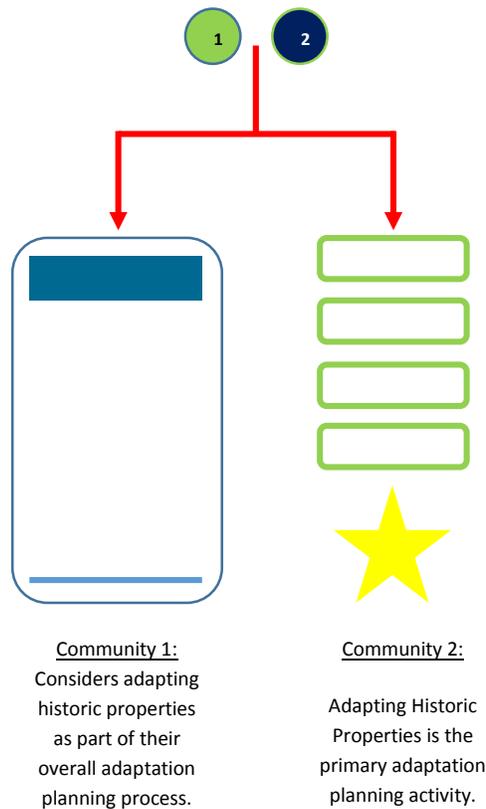


Figure 3: Community Types

# Components of an Adaptation Plan

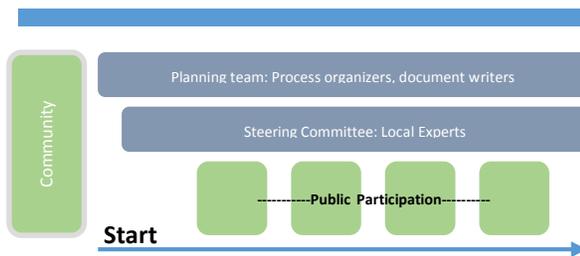
Figure 4: Adaptation Plan and Actors Overview



## Sea-Level Rise Adaptation Plans

### Main and Supporting Components

1. Context
  - 1.1. Assemble a Steering Committee
  - 1.2. Identify Opportunities for Community Participation
  - 1.3. Set Guiding Principles + Motivations
  - 1.4. Describe the Planning Context
2. Vulnerability Assessment
  - 2.1. Conduct an Exposure Analysis
  - 2.2. Conduct an Impact Analysis
  - 2.3. Assess Adaptive Capacities
3. Adaptation Strategies
  - 3.1. Assign Focus Areas
  - 3.2. Identified Adaptation Strategies
  - 3.3. Prioritize Adaptive Needs
4. Implementation Strategies
  - 4.1. Survey Funding Options
  - 4.2. Integrate into Existing Plans
  - 4.3. Create a Schedule of Activities
  - 4.4. Monitor and Evaluate



There are four essential components included in the adaptation planning process: Context, Vulnerability Assessment, Adaptation Strategies, and Implementation Strategies (see Figure 4). Carrying out the four components will likely be led by a planning team, or group of event organizers and document writers. A steering committee comprised of local experts may assist the planning team, and public participation may be incorporated at multiple points. Within each of the four main components are a number of supporting tasks (*i.e.*, subcomponents) that will assist with adaptation planning. It is important to note that these components are not intended to be approached linearly, and communities are encouraged and likely to take many different planning approaches to meet their individual adaptation needs.

**1. Context.** For the first part of their adaptation planning process, communities (via a planning team) are encouraged to consider factors typical of all planning exercises, focusing particularly on how each factor relates to sea level rise adaptation. This 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. It is important to note that these principles are not the same as the prioritized needs identified during the Adaptation Strategies Analysis phase.

**Context** refers to the preparatory activities taken by the planning team and the community to increase their understanding of the relevant planning issue and to unite and fortify their efforts to address the issue.

**1.1 Assemble a Steering Committee.** To write a sea level rise adaptation plan that reflects the expertise and interests of the community’s most informed residents, a steering committee should be assembled. This steering committee will have to ability to guide all ensuing activities in the planning process. It is the planning team, however, who will be the principal vulnerability assessors and plan writers.

**1.2 Identify Opportunities for Community Participation.** The planning team and steering committee are encouraged to identify opportunities for community participation. Stakeholder engagement may serve to educate people about the plan and inform aspects of the Vulnerability Assessment, Adaptation Strategies, and Implementation Strategies components.

**1.3 Set Guiding Principles and Motivations.** By deciding on guiding principles and motivations, the community can establish its compass for navigating through the following components. Exact principles and motivations will be unique to each community and will reflect that community's unique needs, interests, and access to resources. These guiding principles and motivations may be consulted to assist with decision-making activities in the second, third, and fourth components of the adaptation planning process.

**1.4 Describe the Planning Context.** Describing the planning context offers communities the opportunity to analyze previous adaptation planning efforts, information gaps related to adaptation planning, and available human capital (such as coastal scientists and land-use planners). This will also enable the community to determine the outside resources that are needed to conduct the desired planning effort. Essentially, this subcomponent provides communities the chance to assess the scope of work of and the resources necessary for the adaptation planning process.

**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 the concept of risk when measuring hazard impacts.

The **Vulnerability Assessment** draws from the Risk Assessment framework described in the Code of Federal Regulations (Title 44 CFR 201.6 (c)(2)), which measures the hazard exposures a community is likely to experience, and the sensitivities – *e.g.*, populations and land uses – that may be exposed to the identified hazards.

**2.1 Conduct an Exposure Analysis.** An exposure analysis utilizes a sea level rise projection to identify where the impacts of sea level rise are likely to occur, assuming a chosen time horizon and sea level rise scenario (*i.e.*, the amount of sea level rise). The areas identified as being vulnerable to sea level rise-related impacts will be affected by which computer model is used (*e.g.*, SLAMM, SLOSH, ADCIRC etc.) to produce the projection. Thus, an exposure analysis can help depict the areas in the community which are likely to be susceptible to the chosen sea level rise scenario over the chosen time horizon.

**2.2 Conduct an Impact Analysis.** Conducting an impact analysis will help the community identify the potential negative economic and physical impacts of the sea level rise projection created during the Exposure Analysis on the assets and other entities located in areas that the Analysis identifies as being at risk.

**2.3 Assess Adaptive Capacities.** Communities are encouraged to measure two forms of capacity: system-wide and asset-specific. System-wide capacity refers to the degree to which the community is equipped to adapt to sea level rise through policies, structures, finances, and human capital that can potentially assist

or that are already assisting in adaptation to potential changes. Asset-specific capacity refers to the characteristics of an individual asset that allow it to accommodate or adjust to the effects of sea level rise.

**3. Adaptation Strategies.** Adaptation Strategies represent the third component in the adaptation planning process and are in effect a set of responses to the findings from the Vulnerability Assessment. Adaptation strategies are often classified according to their status as Protection, Accommodation, and/or Retreat (PAR) strategies. There are also a set of supporting activities that assist the development of the strategies themselves, which are described in this component. This component also identifies how adaptation strategies can be prioritized for each focus area, then applied through PAR and No Regrets interventions.

**Adaptation Strategies** refers to the toolkit of responses from which communities can choose in order to adapt to sea level rise as well as to the steps taken to decide which adaptation strategies are the best fit based on the characteristics of individual communities.

**3.1 Assign Focus Areas.** With the assistance of the steering committee and community stakeholders, the planning team may assign focus areas. Communities may choose to prioritize which areas are to receive more attention and resource allocation based on the results of the Vulnerability Analysis and Analysis of Adaptive Capacity.

**3.2 Identify Adaptation Strategies.** These are the “bricks and mortar” of the adaptation process -*i.e.*, what is actually proposed to be done in each adaptation focus area and asset. These strategies do not need to be physical. They can conform to Protection, Accommodation, or Managed Retreat as official policies.

**3.3. Prioritize Adaptation Needs.** The community may develop a method, using cost-benefit analysis or other priority ranking system, to decide which adaptation strategies will confer the greatest benefit in relation to their cost (both monetary and otherwise) for each individual focus area.

**4. Implementation Strategies.** After a set of adaptation strategies has been developed and analyzed, communities then prepare for supporting activities that will facilitate the success of the chosen adaptation activities. This includes locating, preparing for, and applying for potential funding opportunities, creating a schedule of adaptation actions for the future, and addressing monitoring and evaluation needs.

**Implementation Strategies** encourage communities to look into available funding for adaptation activities, assign tasks to particular groups and/or individuals, and create mechanisms to evaluate how successfully chosen adaptation plan strategies are being implemented.

**4.1 Survey Funding Options.** Communities’ adaptation efforts will likely benefit from a systematic review of known funding sources in addition to inquiry into new funding opportunities that may facilitate successful implementation of chosen adaptation strategies.

**4.2 Integrate into Existing Plans.** To facilitate the integration of components of the sea level rise adaptation plan into other plans, the planning team is encouraged to identify all relevant documents, assess these documents for potential inclusion points, and (if applicable) initiate collaboration with the responsible party to encourage the incorporation of applicable sea level rise objectives and actions when these documents are next updated.

**4.3 Create a Schedule of Adaptation Activities and Actors.** Creating a schedule of adaptation activities and actors will provide an impetus for chosen adaptation actions to be completed on time by the appropriate

personnel. Program different types of adaptation activities according to their prioritized need (see subcomponent 3.2 above), and, in pairing with funding opportunities, help generate a concise and easy-to-follow plan.

**4.4 Monitor and Evaluate.** Monitoring and evaluation extends throughout the horizon of the adaptation plan's implementation, which could extend decades. The ability to communicate the guiding goals of the plan across generations of implementing actors is essential. This is done through a Monitoring and Evaluation plan that uses consistent language, such as referring to indicators (*e.g.*, acceptable levels of a certain pollutant) that can be tracked throughout the implementation horizon and rated by different implementing actors.

## Context

During the “Context” component, communities lay the foundation for the adaptation planning process. Table 1 displays considerations relevant to adaptation planning for historic resources.

*Table 1: Summary of contextual elements that are part of adaptation planning for historic properties*

| <b>ADAPTATION PLANNING COMPONENT</b> | <b>ADAPTATION PLANNING SUBCOMPONENT</b>            | <b>NOVEL ELEMENTS OF ADAPTION PLANNING FOR HISTORIC RESOURCES</b>  |
|--------------------------------------|--|--|
| Context                              | Assemble a Steering Committee                      | Include historic preservation professionals on the steering committee or as part of a focus group. Professionals might include local historians preservation architects, engineers, policy-makers, non-profits and organizations, Main Street Program coordinators, etc.               |
|                                      | Identify Opportunities for Community Participation | Identify when and how community discussions will specifically identify the needs of historic properties. Assure the inclusion of historic preservation professionals, property owners, and all stakeholders interested in preserving historic properties and districts in discussions. |
|                                      | Set Guiding Principles + Motivations               | Include goals specific to adapting historic resources and maintaining historic significance.   |
|                                      | Describe the Planning Context                      | Part of describing the planning context is gathering relevant data, which can include creating an inventory and map of current historic and cultural resources in the planning area.   |

## Assemble a Steering Committee

The first step in the adaptation planning process for historic resources consists of the planning team assembling a steering committee. The steering committee is responsible for providing guidance, going through the various components of the adaptation process, and possibly contributing to written portions of any planning documents produced. Communities who are undergoing a comprehensive adaptation planning process might consider how to ensure that the interests of historic preservationists are represented. These communities might opt to include people with historic preservation expertise on their main planning team and/or to form a focus group dedicated to historic preservation.

When creating a steering committee (or focus group), it is important for the planning team to consider all of the stakeholders who should be involved. Involving a wide variety of personnel can help ensure a diversity of expertise in addition to assisting with integrating implementation into existing planning frameworks. The planning team should consider who to involve that may have the knowledge and resources needed to work through the different steps of the adaptation planning process.

Some of the people that may be considered for involvement include:

- Hazard mitigation planners, including local hazard mitigation planners, Florida Division of Emergency Management staff, and FEMA staff;
  - State, regional, and local agency partners and other organizations involved in climate adaptation planning efforts;
  - Local planning and community development departments;
  - Local historic preservation planners;
  - The Florida Division of Historic Resources (including the State Historic Preservation Officer);
  - Members of the local historic preservation council/ review board;
  - Members of any local historic neighborhood associations;
  - Preservation architects and other preservation professionals;
  - Members of State, regional, and local historical societies or preservation non-profits;
  - Business and development organizations for historic commercial districts, “Main Street” Programs, and Waterfronts Florida Programs;
  - Professional and amateur archaeologists (including archaeology departments of nearby universities and colleges);
  - Federal agencies such as the National Park Service; and,
  - Relevant Native American tribal representatives, such as the Tribal Historic Preservation Officer (THPO) if there are potential tribal historic resources in the planning area.
-

## Identify Opportunities for Community Participation

Public involvement in the adaptation planning process is extremely important, as it helps to ensure that actions taken throughout the process are in agreement with the desires of the community while simultaneously giving the community a sense of ownership over the plan. Inviting the public to participate will also provide the planning team the opportunity to educate the community on the adaptation process and to obtain important local input.

During this component, the planning team lays the foundation for how the community will be engaged throughout the entire planning process. The team should identify ways to target the involvement of the general public as well as of specific groups, including historic preservation professionals, historic property owners, and anyone with a special stake in preserving historic properties who may not already be a contributing member of the steering committee. The team should also recognize that they will need to be flexible and responsive to the unique needs of the community by acknowledging that additional participation beyond what is initially planned may become necessary.

Community engagement can occur at a variety of stages that may include, but are not limited to, identifying goals and principles, inventorying historic and cultural properties, conducting vulnerability analyses, assigning focus areas and establishing preservation priorities, evaluating alternative adaptation strategies, and implementation. There are many different ways to engage the community throughout various stages of the process. Surveys, questionnaires, public meetings, workshops, online feedback forms, and other methods may all be applicable. The Community Resiliency Initiative has produced a guidance document, *Educational Techniques to Facilitate Involvement*, which details one collaborative planning process design, framing and messaging, and ideas for different potential methods of community engagement during adaptation planning.

### **The Importance of Consultation**

Consultation with historic preservation professionals can be extremely helpful to efforts to maintain historic integrity, apply the Secretary of the Interior's guidelines, or navigate the legal framework governing work undertaken on historical properties. If Section 106 (36 CFR § 800) or Chapter 267 (§267.061(2), Fla. Stat., (2014)) applies, the Florida Division of Historic Resources will be brought into the consultation process automatically (see pages 10-11). If there is a local preservation ordinance, local government representatives and local historic preservation experts may also be brought into the process. However, if none of these apply, the historic property owner and planning team can still opt to consult with the Division of Historic Resources or with other historic preservation professionals such as architects, architectural historians, historians, historical engineers, archaeologists, and others with experience in working with historic properties. The Division of Historic Resources in particular is a great resource for consultation, as their Office of Compliance and Review provides technical assistance to project managers undertaking development projects that impact historic and archaeological properties. The Division typically provides assistance with complying with Federal and State laws but Division staff can provide guidance even if the Section 106 or Chapter 267 processes are not triggered.

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## Set Guiding Principles and Motivations

It is important for the planning team to determine the community's major historic adaptation planning goals. The team may want to consider listing goals and associated objectives specific to adaptation planning and historic resources. Goal statements do not propose specific adaptation actions. Instead, they discuss the overall improvements the community wishes to see<sup>21</sup>. Establishing goals can provide the planning team with direction later in the planning process when attempting to establish which adaptation strategies are optimal for an area or for an individual historic resource. The planning team may also want to determine more specific objectives related to each of these goals that can help shape these goals are implemented. One example of a goal and some associated objectives provided by FEMA for general mitigation:

Goal: "Enhance the ability of vulnerable historic properties and cultural resources to withstand the impact of hazards while maintaining their integrity.

- Objective 1: Assess appropriate methods to retrofit historic properties and protect cultural resources.
- Objective 2: Promote the use of existing incentive programs such as Federal and State income tax credits and preservation easements.
- Objective 3: Disseminate best management practices for protecting Historic properties and cultural resources"<sup>22</sup>.

Setting goals can also help ensure that actions taken during adaptation planning for historic resources do not interfere or conflict with other goals set during previous planning processes. Establishing historic resource adaptation goals allows the planning team to compare them to existing plans and policy documents, especially those related to historic preservation, to ensure this set of goals does not interfere with other priorities<sup>23</sup>. If conflicts are encountered, they can be addressed earlier in the planning process rather than later and ensure that common and consistent goals are developed.

The development of goals and objectives can be undertaken by the steering team, a focus group designated by the steering team, or as a community participatory process. If goals and objectives are defined by the team, it important to bring these goals to the public to see if they faithfully represent community values. During an outreach meeting, the public may be able to help the planning team further refine the goals and objectives and reach consensus<sup>24</sup>. If strong disagreement arises about the goals and objectives at the public meeting regarding how historic properties should be treated during adaptation planning, the planning team may wish to work with an alternative dispute resolution specialist or neutral arbitrator who can help shape the goals and objectives in order to achieve consensus<sup>25</sup>.

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## Describe the Planning Context

During this component, communities work to:

- 1) Evaluate local capacity and further refine the composition of the planning team/steering committee;
  - o Beyond local capacity for the general adaptation planning process, consider capacity in the community as it relates specifically to historic preservation. For example, evaluate the capacity of local architects and engineers to rehabilitate historic properties.
- 2) Gather relevant data, such as topographical, hydrological, infrastructure, parcel, and demographic maps;
  - o Collect data on historic properties in the planning area.
- 3) Research previous and ongoing adaptation studies conducted in or around the community.
- 4) Create an inventory of all available resources (technical, financial, organizational, etc.) to conduct the adaptation planning effort;
  - o Identify grant funding for preservation/adaptation planning, identify partnerships (*e.g.*, have hazard mitigation and preservation professionals worked together before?), identify technical abilities (*e.g.*, GIS license), preservation organizations, etc.
- 5) Identify necessary resources that are not immediately available (*i.e.*, who/what do is needed that is not currently available?).

Whether the adaptation planning process for historic resources is part of a more comprehensive adaptation planning process or a standalone process, a large part of setting the planning context will include identifying and inventorying existing historic and cultural resources. A historic and cultural resource inventory may already exist in the community. This is important for the planning team to contact any local offices dedicated to historic preservation or community character (*e.g.*, Main Street and Waterfronts Florida Programs), in addition to the Florida Division of Historic Resources, as they begin. If no baseline inventory currently exists, the involvement of historic preservation agencies and organizations is important in the creation of a new historic resource inventory.

In deciding which properties to include in the local historic resource inventory, there are many sources of information. First, if funding is limited, the following hierarchy from higher to lower priority might be considered:

- First: Historic resources that are listed or determined eligible for listing in the National Register;
  - Second: Historic resources that are locally designated or identified as significant in a local plan or survey report; and,
  - Last: All resources older than fifty years and those resources that may have obtained significance in less than 50 years<sup>26</sup>.
-

The format of the historic resource inventory may vary. The appropriate format depends on available local capacity. Overall, if possible, it is useful if the historic inventory may be viewed and analyzed in a Geographic Information System (GIS) format<sup>2</sup> or at least mapped on paper, as this will be useful during the vulnerability assessment impact analysis to determine the exposure of individual historic properties to sea level rise. Access to the inventory in GIS form will allow communities to use this information for other purposes, such as having it available for general planning, for tourism marketing, and for emergency management functions for assisting in post-disaster recovery.

When developing a GIS layer mapping historic resources, more than the location may be entered into the database. Contextual information may be integrated in conjunction with a GIS spatial layer<sup>3</sup> that will be helpful when evaluating different adaptation strategies. This database of contextual information may also function as a standalone spreadsheet, outside of GIS software. Disaster Planning for Florida's Historic Resources, prepared by 1000 Friends of Florida, recommends that the inventory contain at least the following ten items for each resource:

- 1) Geographic location
- 2) Type of resource
- 3) Name
- 4) Tax identification number
- 5) Street address
- 6) Condition of resource
- 7) 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, the application should discuss these distinguishing characteristics that the register determines as important.)
- 8) Owner
- 9) Individual(s) with maintenance responsibility (This, along with the owner, is important because it can help determine which types of mitigation resources and recovery assistance may be available)
- 10) Date of construction<sup>27</sup>

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<sup>2</sup> GIS refers of digital mapping software, such as ESRI's ArcGIS, WEAVE, Global Mapper, etc. An historic structure inventory would consist of a "spatial data layer" of information about structures' location and other characteristics displayed on top of a general community map. For a larger list of GIS software, both free and proprietary, visit this link: [http://en.wikipedia.org/wiki/List\\_of\\_geographic\\_information\\_systems\\_software](http://en.wikipedia.org/wiki/List_of_geographic_information_systems_software)

<sup>3</sup> Context information, either numeric (such as square feet), or text (such as "birthplace of Dave Barry"), becomes part of a spreadsheet, or ".dbf" file that is attached to features displayed on the map. Upon selecting the item, such as a point, its collection of contextual information becomes available.

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In publication 386-6, [Integrating Historic Property and Cultural Resource Considerations into Hazard Mitigation Planning](#) (2005), FEMA recommends, at minimum, including the following items that are not included above:

- 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<sup>28</sup>.

During implementation, the spreadsheet can be expanded and elaborated upon to include all pertinent adaptation information (e.g., potential sea level rise impacts, proposed adaptation activity, project cost, time table, etc.) associated with all the historic properties listed. The planning team may also want to consider creating a photo library of historic properties as part of the inventory for reference and project planning purposes, as individual properties and areas change overtime and photos provide visual, historical reference<sup>29</sup>.

There are many potential sources of information available to help complete the historic resource inventory. Historic resources that are listed on the National Register can be found on the [NPS National Register of Historic Places Database](#). The Florida Division of Historic Resources can assist community representatives in identifying historic properties and provide guidance on any survey work that has already completed. The Division of Historic Resources maintains the Florida Master Site File, which contains a list of some properties that may be eligible for listing on the Historic Register. The Florida Master Site File (FMSF) is a partial inventory of potential historic resources that have been surveyed across Florida; however, not all properties included in the Florida Master Site File are necessarily significant and there may be significant resources not included<sup>30</sup>.

In addition to State and Federal partners involved in historic preservation, local and regional preservation partners, such as historic neighborhood associations, historic preservation councils, historical societies and non-profits, and preservation professionals such as preservation architects may have access to previously conducted surveys of historic properties and other resources. In addition, local or regional planners may have information on historic properties that have been surveyed, especially if the community is a Certified Local Government<sup>31</sup>. Another potential resource is the local property appraiser's office, which may be able to provide some of the minimum suggested information, such as the parcel tax ID number, street address, current owner(s), type of building/ structure, and possibly the date of construction<sup>32</sup>. If the property appraiser does have dates of construction, they may be able to generate a list or map of potential historic resources based on if properties are older than fifty years<sup>33</sup>. In addition to the aforementioned resources, conducting outreach to the general public on identifying historic resources can also be extremely beneficial. Community members may be able to contribute information on local historic resources that they value that may not be included in traditional written source materials. Involving the public at this stage is also a great way to first introduce the local community to the planning process as it relates to the community's historic resources.

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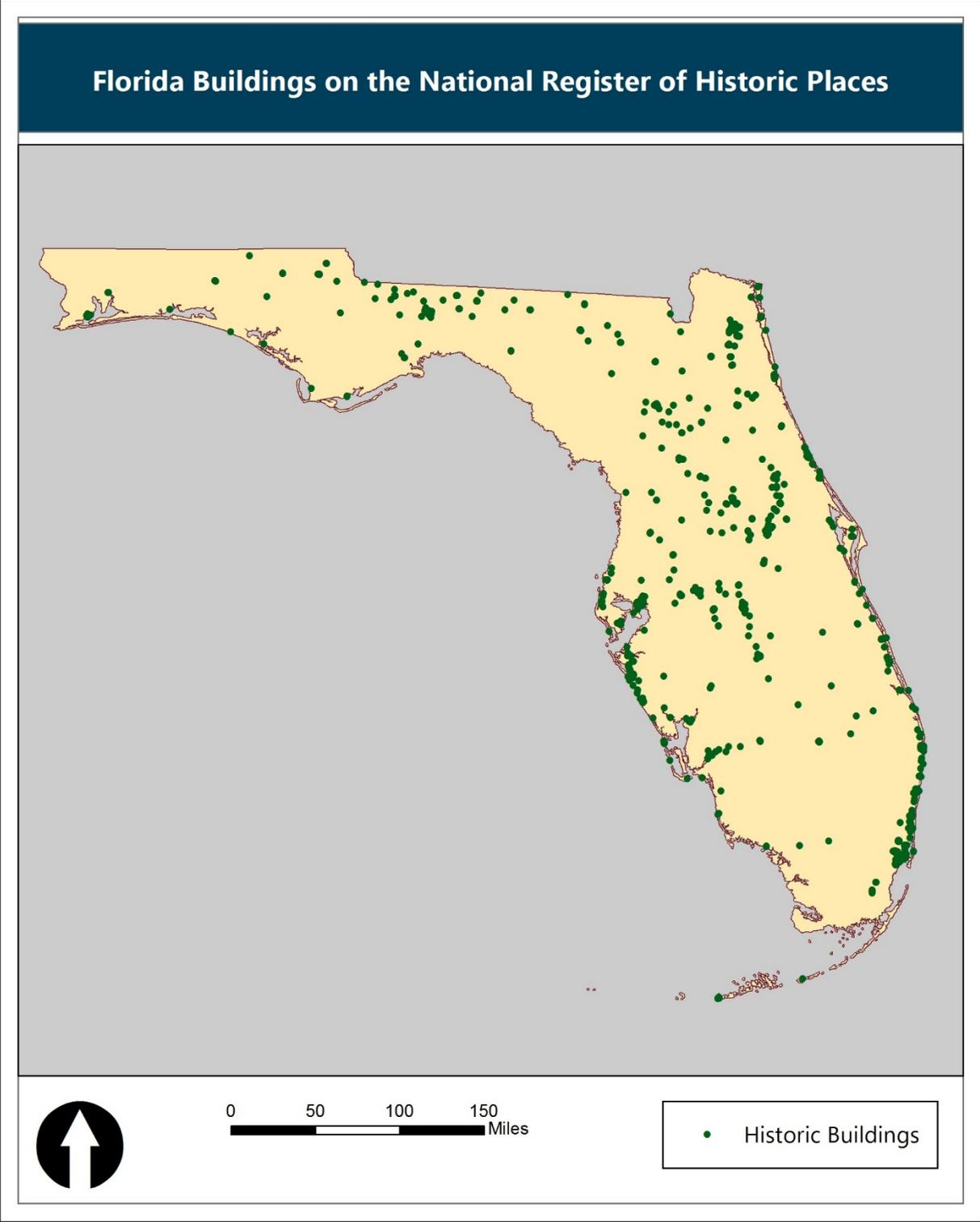


Figure 5: Map of historic buildings in Florida on the National Register of Historic Places<sup>4</sup>

<sup>4</sup> Florida data derived from the National Register of Historic Places Public Dataset at [http://www.nps.gov/nr/research/data\\_downloads.htm](http://www.nps.gov/nr/research/data_downloads.htm). Note: Map only includes historic properties on the National Register.

## Vulnerability Analysis

Vulnerability is constituted by “the characteristics and circumstances of a community, system or asset that make it susceptible to the damaging effects of a hazard”<sup>34</sup>. Characterizing vulnerability can be completed through the evaluation of exposure, sensitivity (impact effects), and adaptive capacity. The vulnerability assessment consists of measuring the impact of sea level rise by identifying historic properties that may be exposed to sea level rise through an exposure analysis, identifying the adverse impacts that historic properties might experience, and developing an understanding of community-wide and resource-specific adaptive capacity. Table 2 summarizes unique considerations of the adaptation planning process for historic resources.

*Table 2 Summary of new “Vulnerability Assessment” elements that are part of adaptation planning for historic properties*

| <b>ADAPTATION PLANNING COMPONENT</b> | <b>ADAPTATION PLANNING SUBCOMPONENT</b> | <b>NOVEL ELEMENTS OF ADAPTION PLANNING FOR HISTORIC RESOURCES</b>  |
|--------------------------------------|---|--|
| Vulnerability Assessment             | Conduct an Exposure Analysis            | Overlay the exposure map with the map of the historic properties inventory. Determine which historic properties are in the area exposed to the chosen sea level rise scenario.   |
|                                      | Conduct an Impact Analysis              | Evaluate the economic value of historic properties at risk in the sea level rise scenario, including potential direct damage costs and the potential loss of functional economic potential.  |
|                                      | Assess Adaptive Capacities              | Determine the ability of the community to adapt vulnerable historic resources and the innate ability of these vulnerable historic resources to accommodate potential sea level rise. This might include identifying local historic preservation regulations, planning capabilities, technical capabilities, fiscal capacity, and existing flood mitigation infrastructure. |

## Exposure Analysis

There are a variety of methods that can be used to undertake an exposure analysis. Methods for projecting sea level rise can range from extrapolating a straight line into the future based upon historically recorded sea level heights from the nearest NOAA tide gauge station to predicting a curve of accelerating sea level heights based upon Global Climate Model projections.

This part of the planning process will include deciding on a sea level rise projection and planning time horizon. One major consideration a community undertaking an adaptation planning process for historic resources might want to consider is what planning and vulnerability assessments might already be occurring in its region; these would have likely been discovered. If a unified sea level rise projection for the planning area already exists, communities may want to consider utilizing this same projection. If no such projection is already available, the planning team may choose to familiarize themselves with the existing resources that depict sea level rise in relation to the coast that are freely available online (see table 3 “online sea level rise visualizers”). With this information, they may elect to utilize a projection from a visualizer website or to execute its own exposure analysis (see table 2, “Add-ins for GIS and other calculators”).

Once the community understands the potential level of exposure of sea level rise it might face, the determination should be made of which historic properties are located in the exposed area projected by the chosen sea level rise scenario. This will involve a comparison of the GIS/paper map layer of the community’s historic resource inventory with the exposure layer from the exposure analysis. From this new map, the community can identify exactly which historic properties might be vulnerable to the impacts of sea level rise, when they might be vulnerable (horizon year), and their frequency of exposure (*e.g.*, daily tidal event versus annual events).

Example exposure analyses for historic properties in Florida can be located in Appendix 2.

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Table 3: Exposure Analysis Tools

| <b>Online Sea-Level Rise Visualizers</b>  |   |
|---|---|
| <b>FDOT Sea Level Scenario Sketch Planning Tool</b>                                   | <a href="http://sls.geoplan.ufl.edu/">http://sls.geoplan.ufl.edu/</a>   |
| <b>CanVis, Digital Coast: Sea-Level Rise and Coastal Flooding Impacts Viewer</b>      | <a href="http://www.coast.noaa.gov/digitalcoast/tools/canvis">http://www.coast.noaa.gov/digitalcoast/tools/canvis</a>                         |
| <b>NOAA Sea-Level Rise and Coastal Impacts Viewer</b>                                 | <a href="http://coast.noaa.gov/digitalcoast/tools/slr">http://coast.noaa.gov/digitalcoast/tools/slr</a>                                       |
| <b>Climate Central Surging Seas Viewer</b>  | <a href="http://sealevel.climatecentral.org/">http://sealevel.climatecentral.org/</a>   |
| <b>Databases of Resources</b>   |   |
| <b>Adaptation Database for Planning Tool (ADAPT)</b>                                  | <a href="http://www.icleiusa.org/tools/adapt">http://www.icleiusa.org/tools/adapt</a>   |
| <b>Climate Adaptation Knowledge Exchange (CAKE)</b>                                   | <a href="http://www.cakex.org/">http://www.cakex.org/</a>   |
| <b>Georgetown Climate Center</b>  | <a href="http://www.georgetownclimate.org/">http://www.georgetownclimate.org/</a>   |
| <b>Add-ins for GIS Programs or other Calculators</b>                                  |   |
| <b>HAZUS-MH</b>   | <a href="https://www.fema.gov/hazus">https://www.fema.gov/hazus</a>   |
| <b>SimCLIM</b>  | <a href="http://www.climsystems.com/simclim/">http://www.climsystems.com/simclim/</a>   |
| <b>Sea Levels Affecting Marshes Model (SLAMM)</b>                                     | <a href="http://www.slamview.org/slamview2/">http://www.slamview.org/slamview2/</a>   |
| <b>Community Viz</b>  | <a href="http://placeways.com/communityviz/productinfo.html">http://placeways.com/communityviz/productinfo.html</a>                           |
| <b>NatureServe Vista</b>  | <a href="http://www.natureserve.org/conservation-tools/natureserve-vista">http://www.natureserve.org/conservation-tools/natureserve-vista</a> |
| <b>Open-Source Nonpoint Source Pollution and Erosion Comparison Tool (OpenNSPECT)</b> | <a href="http://coast.noaa.gov/digitalcoast/tools/opennspect">http://coast.noaa.gov/digitalcoast/tools/opennspect</a>                         |
| <b>Land Use Portfolio Model (by U.S.G.S.)</b>   | <a href="http://geography.wr.usgs.gov/science/lupm.html">http://geography.wr.usgs.gov/science/lupm.html</a>                                   |
| <b>Integrated Valuation of Environmental Services and Tradeoffs (INVEST)</b>          | <a href="http://www.naturalcapitalproject.org/INVEST.html">http://www.naturalcapitalproject.org/INVEST.html</a>                               |
| <b>U.S.A.C.E. Sea-Level Change Calculator</b>   | <a href="http://www.corpsclimate.us/ccaceslcurves.cfm">http://www.corpsclimate.us/ccaceslcurves.cfm</a>                                       |
| <b>Coastal Adaptation to Sea-Level Rise Tool (COAST)</b>                              | <a href="https://www.blumarblegeo.com/products/COAST.php">https://www.blumarblegeo.com/products/COAST.php</a>                                 |
| <b>Other Assessment Tools</b>   |   |
| <b>The Social Vulnerability Index (SoVI)</b>  | <a href="http://webra.cas.sc.edu/hvri/products/sovi.aspx">http://webra.cas.sc.edu/hvri/products/sovi.aspx</a>                                 |
| <b>NatureServe Climate Change Vulnerability Index (CCVI)</b>                          | <a href="https://connect.natureserve.org/science/climate-change/ccvi">https://connect.natureserve.org/science/climate-change/ccvi</a>         |
| <b>Community-based Risk Screening Tool (CRiSTAL)</b>                                  | <a href="https://www.iisd.org/cristaltool/">https://www.iisd.org/cristaltool/</a>   |

## Impact Analysis

The impact analysis allows a community to characterize the level of economic impairment that it might experience as a result of sea level rise-related impacts. While non-economic factors such as sense of place and community value also play a large role in assessing impact, these are covered in the “Assigning Focus Areas” step. The goal of the impact analysis is to determine which historic properties and cultural resources would result in the most financial damage to the community in the event they were damaged or destroyed.

The impact analysis can be done in both qualitative and quantitative ways. For example, one way to evaluate economic impacts is through the qualitative analysis of sensitivity. Some of the economic impacts of sea level rise that a community may want to consider include:

- Direct damage costs
- Loss of functional economic potential for generating revenue
  - Lost income for historic property owners
  - Potential losses in tourism dollars
  - Potential losses in potential tax dollars collected
  - Potential losses in jobs

A community might choose to qualitatively assess impacts by assigning ordinal ranking values of “high,” “medium,” and “low” to factors such as those outlined above. For example, the exposure analysis might show that a historic hotel on the coastline is going to experience a significant amount of exposure to flooding within 30 years, according to the community’s chosen sea level rise scenario. The hotel might be a major tourism destination whose exposure would result in high tourism dollar losses, high losses in income for property owners, and potentially high direct damage costs. When examining the impact analysis, certain factors related to adaptive capacity (explained below) will play a role in how sensitive a resource is considered to be. Because of this, it is important to recognize that these two components are interrelated.

If the community wants slightly more precision in estimates, it may decide to conduct estimate loss evaluations, which help to determine the replacement value of historic properties should they be inundated either occasionally or permanently with flood waters. An estimate loss evaluation may consider the potential structural loss to a historic property, loss of contents, and costs associated with loss of function. FEMA provides many resources on estimating losses; they can be found in [FEMA 386-6: Integrating Historic Property and Cultural Resource Considerations Into Hazard Mitigation Planning](#) (see worksheet #5 in Appendix C) and [FEMA 386-2: Understanding Your Risks: Identifying Hazards and Estimating Losses](#). It is important to note that standardized loss estimation tables or damage curves specific to historic properties and that these tables should only be used as a broad planning tool for estimation.

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## Adaptive Capacity

A community may want to further characterize its vulnerability by evaluating its adaptive capacity and the adaptive capacity of its resources that will be exposed to sea level rise. Adaptive capacity is the ability of an asset or community to accommodate or adjust to an impact. The planning team is encouraged to develop a framework to evaluate the capacity of the community and its historic properties to respond to sea level rise and its impacts. This may include an assessment of:

- 1) Regulatory and planning capabilities (*e.g.*, coastal management regulations, and laws impacting historic preservation);
- 2) Administrative and technical capabilities (*e.g.*, the number of sea level rise experts, planners, engineers, historic preservation architects, historic preservation professionals);
- 3) Fiscal capacity (*e.g.*, grants, insurance, tax incentives); and,
- 4) Infrastructure and environment (*e.g.*, flood and erosion control structures, natural features that mitigate flooding, design advantages and disadvantages of historic properties)<sup>35</sup>.

The first three of the above points involve the capacity of the community to adjust to sea level rise. Other chapters and sections of this paper detail various aspects of regulatory and planning capabilities (chapter 2), administrative and technical capabilities (context component), and fiscal capacity (appendix 1). The last point above, infrastructure and environment, relates to the capacity of a community to accommodate sea level rise. These features can be influential when conducting the impact analysis.

Evaluating adaptive capacity may involve evaluating the design (dis)advantages and disadvantages of both the individual historic property and its surrounding environment. Some historic properties might have attributes that make them more able to cope with projected sea level rise (design advantages). Conversely, other historic properties might have attributes that make them less able to cope with projected sea level rise (design disadvantages). An example of this might be the design of an individual building; *e.g.*, a historic building that is already elevated might not suffer much, if any, damage from sea level rise. Another example of a design advantage that could lessen the impact of sea level rise might be the existence of flood mitigation strategies near a historic resources not modeled by the exposure analysis; for instance, an existing seawall built to a high enough level that it will also serve to protect the historic property from the projected sea level rise scenario. Other considerations besides previous flood mitigation might also include the building materials or the maintenance status of the historic building (*i.e.*, has it been well maintained?).

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## Adaptation Strategies

Communities may use the results of their vulnerability assessment to create a plan to implement adaptation actions to reduce their vulnerability to sea level rise-related impacts. Table 4 summarizes the unique considerations of this component for adaptation planning for historic resources.

Table 4 Summary of new “Adaptation Strategy” elements that are part of adaptation planning for historic properties

| <b>ADAPTATION PLANNING COMPONENT</b> | <b>ADAPTATION PLANNING SUBCOMPONENT</b> | <b>NOVEL ELEMENTS OF ADAPTION PLANNING FOR HISTORIC RESOURCES</b>   |
|--------------------------------------|---|---|
| Adaptation Strategies                | Assign Focus Areas                      | Determine the community value of vulnerable historic properties and combine this information with the results of the vulnerability assessment. Prioritize which historic properties, or areas containing historic properties, will be the focus of adaptation planning. |
|                                      | Identify Adaptation Strategies          | Identify adaptation strategies categorized by protection, accommodation, or retreat. Consider strategies that can be implemented at different scales ( <i>i.e.</i> , onsite or offsite).  |
|                                      | Prioritize Adaptation Needs             | Use a STAPLEE (see page 33) or similar analysis to determine which adaptation strategy to use per focus area. One major consideration will be the impact of potential adaptation strategies on historic integrity.  |

### Assign Focus Areas

After conducting a vulnerability assessment, the community should decide which properties or areas are to be protected from sea level rise inundation. The results of the vulnerability assessment may appear overwhelming, especially if there are a large number of vulnerable historic properties in the planning team’s designated hazard zones. Although every historic property in a community’s inventory is valuable, it is unlikely that the community has the ability and resources to immediately provide each historic property with an equal amount of attention with regards to sea level rise adaptation<sup>36</sup>. Because of this, it is likely that the planning team will want to evaluate properties to assign focus areas and thereby establish preservation priorities. Focus areas may be assigned on both an individual historic property level (*i.e.*, listing the prioritized properties) or through mapping of clusters of prioritized areas that have many historic properties located in them.

“We can’t save everything; we have to set priorities. We live in a time when things are going to change.”  
- Dan Scheidt, National Park Service<sup>37</sup>

Assigning focus areas will require consideration of each historic property's level of exposure to sea level rise, the adaptive capacity of each historic property (design advantages/ disadvantages), and the potential for losses of community value. The exposure analysis will allow the recognition of the varying levels of exposure that different historic properties may experience. Some historic properties may experience more inundation (*i.e.*, 1 foot versus 3 feet) during the chosen planning horizon, may experience inundation sooner, or may experience inundation more frequently (daily versus monthly). The community may wish to consider prioritizing properties that will experience the most inundation, those that will experience inundation sooner, or those that will be impacted the most frequently, with the highest calculated economic impairment, and with the lowest adaptive capacity.

### *Evaluating Community Value*

Evaluation of community value includes consideration of the economic impacts assessed in the impact analysis along with other aspects of historic properties that make them more or less valuable to a community. Aspects that influence total community value of a historic property may include, but are not limited to, historic designation (national register, local landmark, etc.), geographic context of significance, level of significance, degree of historic integrity, level of public sentiment towards the historic property, and how the historic property contributes to sense of place (including its relation to other historic properties). The planning team may wish to create a spreadsheet that includes the various aspects of historic properties that contribute to community value and, if possible, find a method of ranking them. For example, the community might assign an ordinal value of "high," "medium," or "low" to the level of public sentiment towards a resource.

Determining the community's valuation of different historic properties and assigning focus areas will require public participation. At this point, it will likely be beneficial to hold a series of public meetings to present the results of the vulnerability analysis and to begin prioritizing the historic properties or areas the community on which efforts and resources will be focused. Through different participatory methods (*e.g.*, visual definition surveys, questionnaires, or online feedback), public sentiment towards different historic resources and other aspects of community value can be discussed. The community can also contribute to the decision-making process when assigning focus areas. Communities may want to reflect upon the community goals set in the beginning of the process when assigning focus areas. Additionally, different communities may put more weight on some considerations than others. For instance, some communities may put more value on potential losses of economic revenue versus potential impacts on sense of place. The relative importance of each of these considerations may be discovered naturally through the participatory process of assigning focus areas, or a community may decide to formalize what aspects of total community value are most important for assigning focus areas.

FEMA's 2005 State and Local Mitigation Planning How-To Guide, [Integrating Historic Property and Cultural Resource Considerations Into Hazard Mitigation Planning](#) (FEMA 386-6) provides more assistance on assigning community value.



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## Identify Adaptation Strategies

The planning team should now have a list of vulnerable properties/areas and assigned focus areas that demonstrate the preservation hierarchy. The next step is to brainstorm potential adaptation strategies for each focus area (whether it be a prioritized area or an individual historic property). Adaptation strategies will fall under one of three categories:

Protection: Protection strategies work to prevent the landward migration of tidally influenced water by protecting areas against “inundation, tidal flooding, effects of waves on infrastructure, shore erosion, salinity intrusion, and the loss of natural resources”<sup>37</sup>. Protection strategies decrease vulnerability while allowing structures to remain unaltered. Protection strategies may be suitable for structures that are location-dependent and cannot be changed significantly. Protection strategies are sub-divided into hard adaptation strategies and soft adaptation strategies.

Accommodation: Accommodation strategies do not act as a barrier but instead alter structural design elements to both protect the structure and allow the structure to stay in place while permitting inundation. Accommodation strategies may be suitable for location-dependent structures that can be changed to accommodate sea level rise-related impacts without compromising the use.

Retreat: Retreat is a strategy that involves the relocation of structures in high risk areas to other areas with lower risk.

The next chapter, Chapter 4, Strategies for Adaptation, provides detailed information on example adaptation strategies for each of these strategic categories and discusses the implications of using these strategies for historic resources.

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## Prioritize Adaptive Needs

At this point in the planning process, communities decide which adaptation strategies to utilize for each focus area, whether those focus areas consist of individual historic properties or an area containing many historic properties. There are many ways to evaluate adaptation strategy alternatives. One method of evaluation is to apply the “STAPLEE” criteria analysis. This analysis considers the social, technical, administrative, political, legal, economic, and environmental implications of each adaptation action. The following page contains an example STAPLEE criteria worksheet, taken from FEMA’s how-to guide [Integrating Historic Property and Cultural Resource Considerations Into Hazard Mitigation Planning](#).

On the STAPLEE worksheet, relevant considerations are listed under each of the categories, one of which is unique to historic properties. This category is the Environmental “Adverse Effects of Historic Properties and Cultural Resources.” As noted in Chapter 2, the decision-making context for historic properties must incorporate unique considerations that are not applicable to non-historic properties. When evaluating alternative adaptation strategies, communities may want to consider the implications of different adaptation strategies on the historic integrity and significance of the historic property/properties. Communities may prefer to identify which adaptation strategy/strategies are most appropriate based on their potential impacts on historic integrity, significance, and context. Every historic property is unique and will have different aspects of integrity and different features that make up its historic integrity. Communities should not be surprised to find that an adaptation strategy may have limited impacts on the historic integrity of one historic property but have drastic impacts on the historic integrity of another historic property. Chapter 4 includes a discussion on different adaptation strategies and some of the broader implications of using these strategies on historic properties.

When evaluating alternative adaptation strategies, the planning team should consider how community engagement and public participation can inform this process. Community members can play a major role in identifying which adaptation strategies best fit with the community’s values and vision. Community chosen, publicly supported adaptation strategies often enjoy much smoother implementation proceedings. In addition to wider community involvement, the owners of historic properties must be heavily engaged in the alternatives analysis. If owners are unwilling to make changes directly to their historic property, then adaptation strategies that require direct owner action may be ineffective. Communities might therefore consider how larger-scale adaptation strategies may help to protect those historic properties.

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| STAPLEE Criteria (Considerations) |   | Alternative Actions |    |    |    |    |    |    |    |    |     |
|-----------------------------------|---|---------------------|----|----|----|----|----|----|----|----|-----|
|                                   |   | 1.                  | 2. | 3. | 4. | 5. | 6. | 7. | 8. | 9. | 10. |
| E<br>(Environmental)              | Adverse Effects to Historic Properties and Cultural Resources |                     |    |    |    |    |    |    |    |    |     |
|                                   | Consistent With Federal Laws                                  |                     |    |    |    |    |    |    |    |    |     |
|                                   | Consistent with Community Environmental Goals                 |                     |    |    |    |    |    |    |    |    |     |
|                                   | Effect on HAZMAT/ Waste Sites                                 |                     |    |    |    |    |    |    |    |    |     |
|                                   | Effect on Endangered Species                                  |                     |    |    |    |    |    |    |    |    |     |
| E<br>(Economic)                   | Effect on Land/ Water   |                     |    |    |    |    |    |    |    |    |     |
|                                   | Outside Funding Required                                      |                     |    |    |    |    |    |    |    |    |     |
|                                   | Contributes to Economic Goals                                 |                     |    |    |    |    |    |    |    |    |     |
| L<br>(Legal)                      | Favorable Benefit-Cost Ratio                                  |                     |    |    |    |    |    |    |    |    |     |
|                                   | Potential Legal Challenge                                     |                     |    |    |    |    |    |    |    |    |     |
|                                   | Existing Local Authority                                      |                     |    |    |    |    |    |    |    |    |     |
| P<br>(Political)                  | State Authority   |                     |    |    |    |    |    |    |    |    |     |
|                                   | Public Support  |                     |    |    |    |    |    |    |    |    |     |
|                                   | Local Champion  |                     |    |    |    |    |    |    |    |    |     |
| A<br>(Administrative)             | Political Support   |                     |    |    |    |    |    |    |    |    |     |
|                                   | Maintenance/ Operations                                       |                     |    |    |    |    |    |    |    |    |     |
|                                   | Funding Allocated   |                     |    |    |    |    |    |    |    |    |     |
| T<br>(Technical)                  | Staffing  |                     |    |    |    |    |    |    |    |    |     |
|                                   | Secondary Impacts   |                     |    |    |    |    |    |    |    |    |     |
|                                   | Long-Term Solution  |                     |    |    |    |    |    |    |    |    |     |
| S<br>(Social)                     | Technical Feasibility   |                     |    |    |    |    |    |    |    |    |     |
|                                   | Effect on Segment of Population                               |                     |    |    |    |    |    |    |    |    |     |
|                                   | Community Acceptance  |                     |    |    |    |    |    |    |    |    |     |

Figure 6: STAPLEE Criteria Evaluation Worksheet

In their guidebook, [Integrating Historic Property and Cultural Resource Considerations Into Hazard Mitigation Planning](#), FEMA discusses how to apply the STAPLEE evaluation criteria to historic properties. This is a copy of their STAPLEE sheet (worksheet #7). Communities fill in +/- for each column, allowing communities to draw comparisons between different adaptation strategies.<sup>38</sup>

## Implementation

Implementation consists of putting plans into action. Table 5 describes the elements of the implementation component during adaptation planning for historic resources.

*Table 5: Summary of new “Implementation” elements that are part of adaptation planning for historic properties*

| <b>ADAPTATION PLANNING COMPONENT</b> | <b>ADAPTATION PLANNING SUBCOMPONENT</b> | <b>ADAPTING HISTORIC RESOURCES</b>   |
|--------------------------------------|---|--|
| Implementation Strategies            | Survey Funding Options                  | In addition to resilience and hazard mitigation grants, there may be extra funding options applicable to historic preservation that can be used to adapt these properties.   |
|                                      | Integrate into Existing Plans           | Pass a resolution and/or incorporate aspects of adaptation planning for historic properties in the comprehensive plan. Identify plans in the community that address historic preservation and consider incorporating aspects of adaptation planning in these plans. Consider which plans will assist with implementation of chosen strategies. |
|                                      | Create a Schedule of Activities         | Determine who is responsible for each action and when the action might occur. Include considerations of the role of the historic property owner if the building is privately owned.  |
|                                      | Monitor and Evaluate                    | Monitor the implementation process in addition to reassessing vulnerability in future years. Keep historic resource inventory up-to-date if changes are made to properties.  |

### Survey Funding Options

Communities will likely benefit from the identification of funding mechanisms for implementing chosen adaptation strategies. Funding may be from internal sources (*e.g.*, the owner of the historic property) or from external funding from non-profits, private organizations, and local, State, and Federal government sources. Funding may already exist (*e.g.*, unallocated funding or available grant funding), or new funding mechanisms might be created to fund adaptation projects.

The Community Resiliency Initiative released a list of Adaptation Funding Opportunities, which can be found [here](#)<sup>5</sup>. Outside of this list, communities might consider if and how to utilize funding for historic preservation for implementing adaptation strategies for historic properties. Appendix 1 provides information on some historic preservation grants that communities might consider.

### *Integrate into Existing Plans and Create a Schedule of Activities*

A survey of funding often reveals the regulatory documents and plans that contain the power to direct funding allocations; this subcomponent, therefore, is a means of connecting the right strategy to the right plan. During this process, the planning team will assess ways in which adaptation goals and chosen strategies can be incorporated into plans and policy mechanisms with regulatory power. The goals decided upon by the community along with other underlying messages of the adaptation process can be formalized by a resolution or incorporated into the comprehensive plan, including the historic preservation element, to give more standing to the implementation of strategies and to help leverage future funding.

The funding mechanism being utilized will likely be a large determinant of which type of plan into which chosen adaptation strategies will be incorporated. Regardless of the type of plan, the planning team will need to have some idea of a schedule of activities for implementation of each strategy. The schedule of activities should be flexible and should assign responsibility of implementation to the party or parties who have the capacity to ensure successful implementation. If activities require property owners to take action, their role should be clearly defined and definitively agreed to and understood by the owners. It may sometimes be the case that the funding option chosen or adaptation strategy itself does not lend itself to be incorporated into a formally adopted planning document- for example, an owner deciding to elevate their historic building. When this is the case, communities will need to determine how to best facilitate the implementation process.

### *Monitor and Evaluate*

The last consideration a planning team is encouraged to include is how monitoring and evaluation of implemented adaptation strategies will be undertaken and how to monitor future adaptation needs. The team is encouraged to incorporate a “monitoring and evaluation” component to any plan or project, as appropriate, to help ensure that adaptation strategies continue to serve their intended purpose. The team may also want to consider if they should reconvene on a recurring basis to reevaluate vulnerability as conditions change.

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<sup>5</sup> Community Resiliency Initiative: Adaptation Funding Opportunities: <http://www.floridajobs.org/docs/default-source/2015-community-development/community-planning/crdp/adaptationfundingopportunities.pdf?sfvrsn=2>

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## Chapter 4. Strategies for Adaptation

This chapter serves to elaborate on the “Identify Adaptation Strategies” and “Prioritize Adaptive Needs” components of adaptation planning. It describes potential adaptation strategies by providing general information about each strategy, covers some of the advantages and disadvantages of each strategy, discusses the implications of using adaptation strategies to protect historic resources, and provides an example and/or diagram of the above. The sections regarding the advantages and disadvantages of adaptation strategies and the discussion of consequent implications for historic resources may assist with prioritizing adaptive needs when conducting an alternatives analysis.

Strategies are divided into three categories: protection, accommodation, and retreat. At the beginning of the section describing detailing each strategy, or category of strategies, a green textbox describes the scales of implementation and applicable historic properties for which the adaptation strategy may be used. There are two scales of implementation: “On-site” and “Large-scale.” On-site strategies are strategies that are smaller in scale and are generally applied to individual historic resources. Large-scale strategies, by contrast, are generally implemented on large areas (as opposed to individual historic resources). Large-scale strategies can be used to adapt entire historic districts or large areas that contain historic properties in addition to other important infrastructure. It is important to note that on-site strategies can be implemented at a wider scale, but must be applied to each historic property individually.

The green textbox also includes the list of applicable historic properties for which a given adaptation strategy may be used. Historic properties are grouped according into five categories: buildings, structures, objects, sites, and districts. Each strategy is linked to the categories for which it could be used. Inclusion of a category for a given strategy does not guarantee the appropriateness of the strategy for *all* properties within the category; communities are encouraged to approach strategies on a property-by-property basis. For instance, both fences and lighthouses are categorized as historic structures. Some adaptation strategies may be applicable to a historic lighthouse that are not applicable to a historic fence. In this case, “structure” will still be listed as an applicable resource even though the strategy may not be applicable to every historic property that can be categorized as a historic structure. In addition, it is also important to remember the individualistic nature of choosing an adaptation strategy for a particular property. While a strategy may be technically applicable, there are many factors that may make a particular adaptation strategy not appropriate for a particular historic resource. Some of these factors are examined in the sections discussing the implications of using an adaptation strategy on historic resources.

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## Protection

### Hard Adaptation Strategies

**Scale of Implementation:** On-Site and Large Scale

**Applicable Historic Properties:** Buildings, Structures, Objects, Sites, Districts

Hard adaptation strategies are also commonly referred to as “armoring” and may include strategies that are implemented both onshore and offshore. Examples of hard adaptation strategies include floodwalls, levees, dikes, barriers, groins, breakwaters, seawalls, and revetments. Floodwalls and levees are hard adaptation strategies that can be applied at both the on-site level and at a larger scale. Dikes, barriers, groins, breakwaters, seawalls, and revetments are usually applied at a larger scale to protect multiple properties, both historic and non-historic. Currently, most regulations require that armoring be designed to withstand, at minimum, a 100-year flood event, based on historic flood conditions. The design of any of the following hard adaptation strategies can consider future vulnerability from potential future sea level rise as well as current vulnerability due to flooding.

Floodwalls are generally constructed using concrete, masonry, or a combination of both. On-site floodwalls are generally constructed to be at or under four feet tall. While floodwalls can be built at a larger scale, they are most often built to protect small lots and tight spaces from floodwaters.

Levees are embankments of compacted soil that fix the shoreline in its current place and protect an area against floodwaters<sup>39</sup>. On-site levees are generally constructed to be at or under six feet tall.

Dikes are raised linear embankments built along the shore that are made from compacted earthen fill; they work to protect areas from inundation, particularly under extreme conditions. Dikes usually have a flatter gradient on the seaward side to dissipate wave energy and a steeper gradient on the landward side to reduce land requirements.

Groins are built perpendicular to the shore at a slightly oblique angle and are constructed of riprap (*i.e.*, loose stone) or other materials. They are used to dissipate wave energy, trap sediment along an intertidal area, and reduce seaward transport of sediment. Prevention of the transport of sediment often results in erosion on one side of the groin and accretion of sediment (beach widening) on the other side.

Breakwaters are rigid robust structures built parallel to the shore that are intended to dissipate wave energy in order to reduce erosion and damage from storms.

Seawalls are vertical linear structures made of rock or concrete and are built parallel to the shore. They are designed to fix the shoreline in its place, dissipate wave energy, and protect against erosion and flooding.

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Revetments are covers or facings that are made from concrete, timber, riprap, gabions, or other materials; they are applied to sloped surfaces to provide protection against erosion and severe wave action.

Barriers are large dams, gates, or locks (or a series thereof) that can manage tidal flow into and out of a bay or inlet. The barrier is fixed in place, manages the flow of water, and can be temporarily deployed to head off extreme flooding of storm surge.

#### Implications of Applying Hard Adaptation Strategies to Historic Properties

Hard adaptation strategies may threaten four aspects of integrity: design, setting, feeling, and association. The success of implementing hard adaptation strategies to protect historic properties while creating limited impacts on their historic integrity is dependent upon the distance from the historic resource (on-site versus further away), the size of the armoring structure, and the historical context of the resource. Adaptation strategies applied to the coast to protect larger areas may not have much impact on integrity if historic properties are not directly located on the coastline, especially in comparison to adaptation strategies that require on-site design changes to the historic property. If a historic property is on the coastline, hard adaptation strategies may impact its integrity of setting, feeling, and association. This may occur when the historical context of a property involves the visibility of the coast from the property or the relationship of the property to the coast (*e.g.*, coastal access).

Adaptation strategies applied on-site have the ability to potentially impact all four aspects of integrity. It can be difficult to build floodwalls, levees, or implement other strategies in a way that does not disrupt the design of, feeling of, setting of, or association with the historic property or district. Communities are encouraged to design armoring schemes that are architecturally and aesthetically pleasing and that blend well with the historic resource. For example, floodwalls can become attractive parts of a landscape if appropriate materials are used in an accommodating landscape. There are also trade-offs resulting from choosing the size of the armoring, as smaller floodwalls and levees may be more visually appealing and more easily integrated into the surrounding landscape but will provide less protection than larger floodwalls or levees, especially if the chosen size offers historic properties no real protection from water overtopping the armoring infrastructure. The chosen height of the hard armoring adaptation infrastructure needs to balance protection of resources with maintenance of their historic integrity.

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## Case Study

### Using a New Seawall to Protect a Historic District and Historic Seawall in St. Augustine

St. Augustine has seven designated historic districts encompassing 159 city blocks, all sited at low-lying elevations. One of these districts, the St. Augustine Town Plan, has been protected by a seawall since the Spanish built the first one between 1596 and 1602. This seawall has been replaced numerous times, the first in 1842 and most recently between 2012 and 2014.

The most recent addition involved a great deal of consideration of the best way to incorporate the 19<sup>th</sup> century historic seawall, which is considered a contributing element of the St. Augustine Town Plan historic district. The most recent decision to “replace” the historic seawall came after signs of deterioration



*This photo shows what remains of the historic seawall, to the left, and the new taller seawall, to the right, with the two seawalls separated by a walking path.<sup>42</sup>*

and inability of the seawall to protect the local historic district were noticed in the 1990s and early 2000s. In 1999, Hurricane Floyd resulted in a crest of water overtopping the seawall south of the Bridge of Lions and the consequent flooding of the Avenida Menendez roadway.

Following this occurrence, an engineering study was commissioned and completed in 2000. The city also began to discuss how to best address the failing historic seawall. Throughout the 2000s, further damage to the historic seawall was evidenced by the effects of tropical storms and hurricanes- Tropical Storm Gabrielle and Tropical Storm Faye caused parts of the wall to collapse, while Hurricanes Frances and Jeanne inflicted tens of thousands of dollars in damages to the wall. It was also noted that high tides were regularly overtopping the seawall south of the Bridge of Lions, which led to the flooding of many historic properties. Continued destruction throughout the 2000s led to the city initiating a process to plan for the replacement of the historic seawall<sup>40</sup>.

During this planning process, the City created many opportunities for public participation and worked heavily with the historic preservation community, including the City archaeologist and State Historic Preservation Officer (SHPO) to develop a plan to both preserve the historic seawall and build a new, higher seawall. After much deliberation, a final decision was made to build a new, higher seawall, measuring 9.1 feet, along the Matanzas River to protect both the area and the historic seawall. The historic seawall was protected by encapsulating it by infill, but was also highlighted as part of the landscape by the construction of a pedestrian path between the new and older seawalls and by leaving the top of the old seawall exposed to serve as a bench along the pedestrian path. The height of the new sea wall will not necessarily help with future sea level rise, as the new seawall is projected to hold back current category 1 storm surges and high tides. However, while the project did not take into consideration the impacts of future sea levels, it still serves as an example of how hard adaptation strategies can be used to protect historic districts and properties<sup>41</sup>.

### Hard Adaptation Strategies Advantages

- Many armoring techniques have been used for centuries. They are familiar and behave relatively predictably.
- Hard adaptation strategies can be used in combination with other strategies. For instance, groins may be paired with beach renourishment.
- Most strategies are useful against everyday coastal flooding and storm surge.
- Certain strategies, such as floodwalls, can use architectural design techniques to become attractive parts of the landscape.
- Buildings can be occupied during construction of these techniques.
- Many of these strategies keep floodwaters completely separate from properties and therefore protected properties will not be directly damaged by flooding, assuming the implemented hard adaptation strategy is adequate.

### Hard Adaptation Strategies Disadvantages

- Hard adaptation strategies are short term solutions in the context of long term sea level rise
  - Local zoning codes and other laws may restrict the use, size, and location of hard adaptation strategies.
  - Many hard armoring techniques have many environmental consequences, including the interruption of natural shoreline process such as sediment transport, no provision of habitat for wildlife, loss of the intertidal zone, water quality degradation caused by removal of the shoreline's ability to filter excess nutrients from runoff, and prevention of natural shoreline migration<sup>42</sup>.
  - Armoring strategies create a transfer of risk by increasing erosion and impacting drainage nearby, thus increasing the risk of flooding.
  - Hard adaptation strategies can only be engineered to accommodate a certain level of sea level rise and storm surge size. An unusually large storm event may rupture or overtop hard coastal armoring. When this occurs, the armoring provides no protection at all.
  - Hard adaptation strategies have high initial costs, are costly to maintain, and require regular monitoring. Floodwalls and some other strategies may be cost-prohibitive.
  - Installing hard adaptation strategies on an individual property may not be used to bring a substantially improved or substantially damaged structure into compliance with a community's floodplain ordinance or law. Likewise, they cannot be used to bring a building with a first floor elevation below base flood elevation into compliance with the National Flood Insurance Program.
  - Levees and floodwalls need openings that will provide access to roads or, if on an individual lot, driveways. These openings need closures which are installed over the openings during flooding events. Adequate advance warning of flooding and human intervention is needed in most cases.
  - When used at a large scale, hard adaptation strategies can give people a false sense of security. This may lead to more development in vulnerable areas.
  - Many of these strategies, such as levees, require a large amount of land, a requirement which may increase the difficulty of implementing this strategy on individual parcels, as adequate land may not be available.
  - Hard armoring strategies can also lead to a changed relationship with the coast, as the community may have reduced access and reduced views. This may make it difficult to obtain public consensus.
-

## Soft Adaptation Strategies

### Beach Renourishment

**Scale of Implementation:** Large Scale

**Applicable Historic Properties:** Buildings, Structures, Objects, Sites, Districts

Beach renourishment involves the placement of sand from offshore and/or onshore donor sources on coastlines to maintain and restore eroding beaches. Sand is placed along the shore to establish a beach width and shoreline position that will dissipate wave energy and enhance the value of beaches<sup>43</sup> because wider and shallower beaches are better at diminishing wave energy than steep and narrow beaches. However, beach renourishment does not stop erosion. Beach renourishment merely adds sediment that will help mitigate erosion and is usually done on a continual basis to maintain desired beach width. To determine both the volume of sand needed and the necessary frequency of renourishment, ongoing monitoring and significant engineering studies to determine the rate and extent of shoreline erosion must be undertaken.



*Figure 7: A coastline before and after beach renourishment<sup>47</sup>*

### **Beach Renourishment Advantages**

- Beach renourishment enhances beaches and is useful for recreation, tourism, and aesthetic purposes.
- Beach renourishment can make use of sand from navigation-based dredging projects that may have otherwise been discarded.
- Nearby areas that are not directly renourished may experience some benefits due to sediment redistribution.

### **Beach Renourishment Disadvantages**

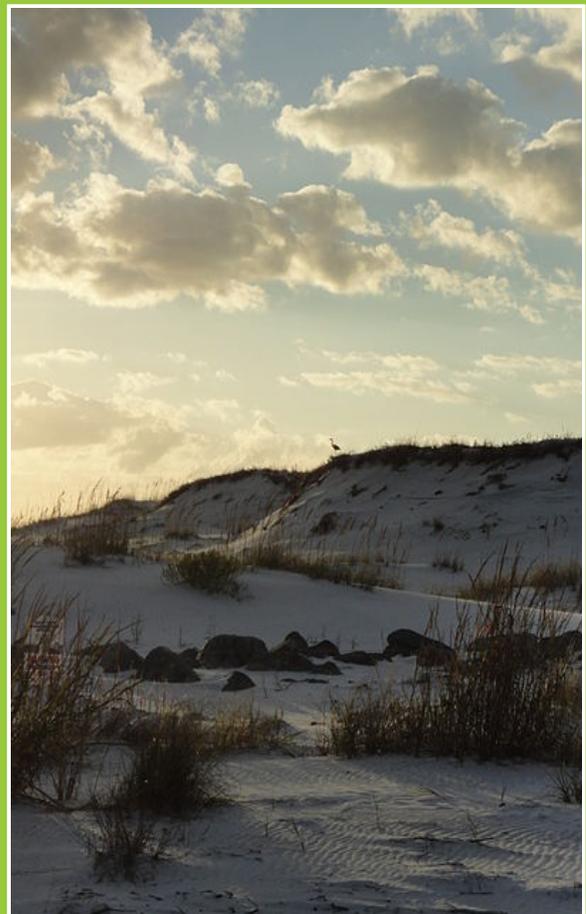
- According to NOAA, beach renourishment projects have serious environmental impacts on beach renourishment sites, at borrow sites, and in nearby areas. “Potential negative effects include: disturbance of species’ feeding patterns; disturbance of species' nesting and breeding habitats; elevated turbidity levels; changes in near shore bathymetry and associated changes in wave action; burial of intertidal and bottom plants and animals and their habitats in the surf zone; and, increased sedimentation in areas seaward of the surf zone as the fill material redistributes to a more stable profile”<sup>45</sup>.
  - Beach renourishment requires compatible sediment. A source of suitable sand may be difficult and will likely require research to find.
  - There are many economic considerations, such as the cost and availability of sand, the location of available sand, cost of equipment, frequency of renourishment, the cost of land required to accommodate renourishment, and the impacts on tourism due to closed beaches during the project period.
  - Project longevity can be uncertain. Some previously completed renourishment projects have produced long term benefits, while other renourishment sites have quickly eroded back to their pre-nourishment profile. Effort needs to be made to understand the processes that impact the erosion of each beach<sup>46</sup>.
  - Because large amounts of public funding are used for renourishment projects, public access to the renourished area should be maintained.
  - Beach renourishment may give a false sense of security and incentivize development in coastal high hazard areas.
-

## Dune Building and Rehabilitation

**Scale of Implementation:** Large Scale

**Applicable Historic Properties:** Buildings, Structures, Objects, Sites, Districts

Dunes are wind-formed sand deposits located in the zone landward of normal high tides that typically occur naturally along wide, sandy coastlines. Dunes provide an effective measure of protection against flooding and coastal erosion by dissipating energy from wave action, storm surge, and extreme high tides. Dunes are also dynamic and constantly moving as they have the ability to adjust to changes in wind action, wave action, and sea level rise. Dune rehabilitation and artificial dune building are two soft adaptation strategies that seek to capitalize on the benefits of this soft armor strategy. Artificial dune building involves the placement and shaping of dredged sediment from donor sources into dunes. Restoration of dunes can also involve adding sediment in addition to dune stabilization. Dune stabilization can be done through vegetative planting that depends on the roots of plants to stabilize the dunes or through the placement of sand fencing.



*Figure 8: A Great Blue Heron on the dunes at Destin beach, Florida. The dunes serve as both habitat and protection of the coastline.<sup>50</sup>*

### Dune Building/ Rehabilitation Advantages

- Dune building and rehabilitation enhances beaches, especially for recreational, tourism, and aesthetic purposes.
- Dune creation and protection has positive environmental impacts, including an increase in habitat.
- Dunes provide an effective defense against flooding and erosion and can serve as a store of sediment.
- Dune building can make beneficial reuse of sand from navigation-based dredging projects that may have otherwise been discarded.

### Dune Building/ Rehabilitation Disadvantages

- Dune creation requires compatible sediment. Finding a source of suitable sand may be difficult and require research to find.
  - There are many relevant economic considerations: cost and availability of sand, location of available sand, cost of equipment, the frequency of renourishment or dune rehabilitation, and the cost of land required to accommodate dune building<sup>48</sup>.
  - Tall dunes may lead to a loss of views and direct access to coastal areas.
  - Dunes are not static; they are dynamic and evolving and therefore require long-term management and protection.
  - Bathymetry near the shoreline may make dunes not suitable for an area.
  - Dunes require a large amount of land.
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## Living Shorelines

**Scale of Implementation:** Large Scale, On-Site

**Applicable Historic Properties:** Buildings, Structures, Objects, Sites, Districts

A living shoreline is a natural bank stabilization technique that seeks to reduce erosion and flooding by creating natural shorelines. According to the Florida Department of Environmental Protection,

“Living shorelines utilize natural habitat elements for erosion control through careful site evaluation and strategic placement of habitat components along the upland-water interface. Living shorelines serve to reduce erosion through the implementation of a natural salt marsh comprised of deeply-rooted, fast-growing plants which provide shallow water habitat for marine species, attenuate and reduce wave energy, increase sediment acquisition, improve water quality, reduce pollution via wetland filtration and moderate the effects of storms and floods”<sup>49</sup>.

Most living shoreline projects involve treatments that aim to minimize erosion by stabilizing the slope of the shoreline, often through trapping and retaining sediment and/or dissipating wave energy. In addition, the creation of tidal wetlands helps moderate flooding by changing runoff peaks and discharge flows<sup>50</sup>. Living shoreline projects will vary from site to site due to of site-specific conditions, so proper site analysis is extremely important. NOAA lists the following shoreline treatments, divided by habitat zone, as living shoreline treatments:

- Upland Buffer/ Bankface Zones
- Sand fill and placement of clean dredge material
- Tree and grass roots placement and stabilization
- Coastal Wetland and Beach Strand Zone
- Marsh grasses
- Mangroves
- Natural fiber logs
- Natural fiber matting
- Rock footers
- Low crested segmented rock sills
- Living breakwaters
- Rubble and recycled concrete breakwaters
- Sediment-filled geotextile material tubes
- Filter fabric
- Subtidal Water Zone
- Seagrass beds
- Native reef-building oysters
- Small concrete oyster balls<sup>51</sup>

In the State of Florida, living shorelines are generally encouraged as a flood and erosion control measure. The Florida Department of Environmental Protection “seeks to encourage and assist local coastal property owners, both residential and commercial, to embrace living shorelines as an alternative to hardened shorelines”<sup>52</sup>.

### Living Shoreline Advantages

- Creates space for recreational use, such as fishing areas, bird watching areas, canoeing and kayaking areas, and areas for artistic focuses such as painting and photography. Also provides attractive natural appearance.
- Improves or creates marina habitat, spawning areas, and aquatic productivity<sup>53</sup>.
- Provides ecological services, such as improving groundwater flow and sequestering carbon<sup>54</sup>.
- Improves water quality improvement and clarity by filtering and trapping sediments and pollutants, increasing dissolved oxygen levels and reducing nutrient levels<sup>55</sup>.
- Maintains natural coastal processes and shoreline dynamics<sup>56</sup>.
- Affordable construction costs. Living shoreline techniques are cost-effective relative to static man-made hard adaptation structures.
- Provides land-to-water access for property owners.
- If wetlands are not subjected to coastal squeeze and sea level rise is not too rapid, wetlands are able to adapt naturally to sea level rise without further intervention or investment.

### Living Shoreline Disadvantages

- Living shorelines are better suited for areas that are located in low-erosion settings<sup>57</sup>.
  - In places where shorelines are heavily developed or waves are too intense, living shorelines may not be feasible.
  - Designs must be very site-specific.
  - There are regulatory barriers to implementing living shorelines. The permitting process for filling wetland areas is often an impediment. Land owners must deal with layers of regulatory review through the State, the U.S. Army Corps of Engineers, and possibly through a municipality<sup>58</sup>.
  - Living shorelines have high land requirements and often take up more space than many linear armoring strategies because they need to have space to migrate landward to naturally adapt to sea level rise.
  - There may be a lack of public awareness on the benefits of living shorelines and wetlands and their ability to increase protection from flood and erosion.
-

## Case Study

### Protecting Turtle Mound from Erosion through Implementing Living Shoreline Techniques

Turtle Mound, a National Register historic site, is located on the northern portion of Canaveral National Seashore, is about 35 feet tall, and covers approximately 2 acres of land. The mound was built by the Timucuan people over 1,000 years ago from oyster shells, discarded bones, broken pottery, and other refuse<sup>59</sup>. Sea level rise, storm surges, boat wakes, and subsequent erosion have had severe negative impacts on the mound already<sup>60</sup>.

To protect the mound from erosive forces, in 2011 the National Park Service and scientists at the University of Central Florida began a project to manage Turtle Mound through the implementation of living shoreline techniques. In 2011, 200 meters of the shoreline were stabilized using 1,140 oyster shell mats, 622 *S. alterniflora* (saltmarsh cordgrass) transplants, and 450 mangrove seedlings<sup>61</sup>. As to date, the stabilization has proven successful. Before restoration, sediment was being lost at a rate of 1 cm or more per month. In the past year, sediment accretion increased by 0.96 cm. Recent estimates of sea level rise in Canaveral National Shoreline show an increase of about 0.24 cm per year. Thus, the site is accumulating sediment faster than the current local sea level is rising. Additionally and happily, the species planted as part of the living shorelines are flourishing. Through continued monitoring, project researchers have found that mean percent coverage of *S. alterniflora* and mangrove species increased from less than 3 percent before the project to over 40 percent and 50 percent, respectively, since the project's completion. Similarly, no oysters were present in the intertidal zone before the restoration project was undertaken; currently, the average density is 80 oysters per square meter.

In addition, the University of Central Florida team has also been involved in other living shoreline projects to protect other shell midden shoreline sites and locations of historic importance along the east coast of Florida. The team has completed living shoreline projects near two other shell midden shorelines (Castle Windy Trail and Hong Kong Island) and have completed a living shoreline project to protect the shoreline near the historic Eldora House. They are also currently working on living shoreline projects to protect Seminole Rest, Garver Island, and Fort Mose Historic State Park<sup>62</sup>.



*A photo of the team constructing the living shoreline in 2011 and photo of the living shoreline in 2013, 2 years after completion.*

### Implications of Applying Soft Adaptation Strategies to Historic Properties

In comparison to hard adaptation strategies, accommodation strategies, and managed retreat, soft adaptation strategies are generally less likely to impact the integrity of historic resources. Overall, soft adaptation strategies, with the exception of new dune creation, work to enhance and restore the natural historic environment, which likely will not alter the historic setting. However, there may be specific instances where a resource's historic setting and feeling is connected to a historically armored coast. An example of this might be a historic fort or lighthouse located directly on the coastline surrounded by historic hard armoring. Implementing a soft adaptation strategy would change the space around these types of historic resources and change their relationship with the historic armoring, thus resulting in a loss of integrity (setting/feeling) in these specific instances. Building artificial dunes may also have the potential to alter historic relationships to the coast through the blocking of waterfront views and the deterioration of accessibility to the coastline. In most cases, however, soft adaptation strategies work to restore the historic natural environment and may actually improve the historic feeling of a resource.

## Accommodation

### Elevation

**Scale of Implementation:** On-Site

**Applicable Historic Properties:** Buildings, Structures, Objects, Districts

Elevation usually consists of raising the lowest floor of a building or structure above the current base-flood elevation (BFE), which is the vertical elevation of the 100 year flood event. For sea level rise adaptation efforts, determination of the appropriate elevation of buildings or structures will necessitate utilization of the appropriate sea level rise projection, which is likely to exceed the current base-flood elevation.

There are two types of structural elevation to consider:

- 1) Lifting the entire building or structure and placing it on a new elevated foundation with columns, piers, posts, or raised foundation walls (*e.g.*, leaving an open crawl space).
- 2) Leave the exterior of the building or structure the same and raising the interior floor of the building or structure above base-flood elevation. This can only be used for certain properties where the existing design structure lends itself to such a modification. Structures for which this may be appropriate include older stone buildings with high ceilings and elevated window sills, historic commercial buildings with high ceilings, and masonry buildings with slab-on-grade foundations<sup>63</sup>.

The methods available for elevation of a structure depend on the structure's construction type (*e.g.*, stick built or masonry), foundation type (*e.g.*, slab or pier), and flooring conditions. For the first elevation method, the steps are the same for all building types. According to FEMA, during this method "a cradle of steel beams is inserted under the structure; [hydraulic] jacks are used to raise both beams and [the] structure to the desired [vertical] height; a new elevated foundation for the house is constructed; and the structure is lowered back onto the new foundation and [structurally] reconnected." The new or extended foundation may be built from continuous walls or separate piers, posts, columns, or piles. A second method often involves removing the structure's roof and raising the living space by raising the floor (and likely extending the walls) or abandoning the lower floor and moving living space onto an existing or newly constructed upper floor<sup>64</sup>.

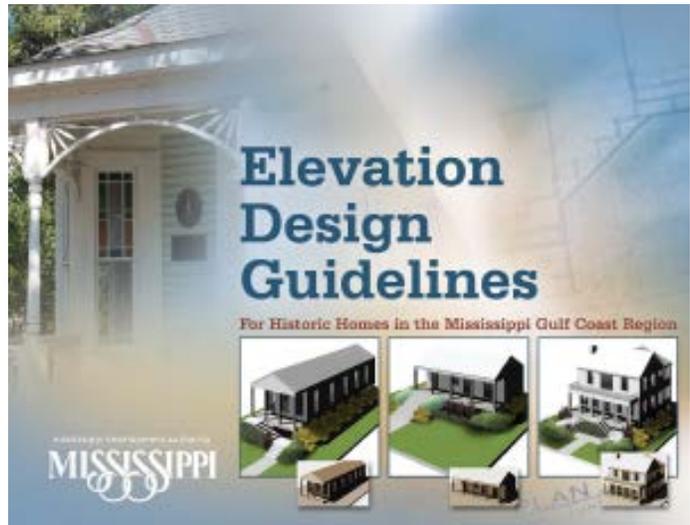
More detail on the different elevation techniques and how they apply to the different construction types, foundation types, and flooding conditions can be found in FEMA's guidance document, ["Homeowner's Guide to Retrofitting: Six Ways to Protect Your Home from Flooding."](#)

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## Case Study

### Mississippi Development Authority Develops Guidance for Historic Property Elevation Projects

Hurricane Katrina caused devastating losses to historic properties in coastal Mississippi. Many buildings were severely damaged and were subsequently demolished. With so many historic properties destroyed during Katrina and its aftermath, the protection of historic resources and their historic significance became important to rebuilding efforts and efforts to mitigate the effects of future storms



One major part of the rebuilding process in Hancock, Harrison, Jackson, and Pearl River Counties in Mississippi was the Mississippi Development Authority's (MDA) two funding

programs made possible through a Community Development Block Grant from the U.S. Department of Housing and Urban Development (HUD): the Homeowner Elevation Grant Program and the Small Rental Assistance Program. The Homeowner Elevation Grant Program allowed homeowners with homes damaged by Hurricane Katrina to apply to MDA for up to \$30,000 in grant assistance to defray the costs to elevate their single-family residences.

The desire of many homeowners of historic properties to apply for this funding led to the development by the Mississippi Development Authority of a programmatic agreement. This agreement was signed by State, local, and tribal stakeholders, including many historic preservation officials (such as the State Historic Preservation Officer or SHPO). This programmatic agreement established a process for homeowner applicants of historic properties that involved both the SHPO and local historic preservation councils, ensured that staffing was available where needed, and ensured that variances could be obtained to allow lower elevation heights for historic buildings.

In addition to the programmatic agreement, the Mississippi Development Authority provided guidance on historic preservation to homeowners of historic properties. This guidance included a grant applicant guide, a historic preservation commission guide, and an elevation design guidelines book. The design guidelines book worked towards MDA's goal of achieving two very different public policy goals involving historic properties: risk reduction and the "protection and enhancement of existing historic buildings and districts." This guidebook includes a description of the elevation design process and requirements; guidance on elevation design including site design guidelines, architectural design guidelines, and foundation design guidelines; and a section on other available resources and publications.

To see the guidebook, which has a great deal of guidance that applies to historic buildings outside of coastal Mississippi, [click here](#)<sup>65</sup>.

### Implications of Elevating Historic Properties

There are two major concerns surrounding the elevation of historic properties- the change of the properties' appearance (design/materials) and the resulting change in its scale (setting/feeling). Elevation has the potential to affect many aspects of historic integrity by changing those essential features of historic significance. Change in appearance is one possible concern associated with elevation. The addition of new foundation or an extension of the existing foundation may make some people nervous to choose elevation as an adaptation option as they may picture the new addition to be unsightly pilings or other unattractive foundations. The change in appearance threatens integrity through changing the historic design and materials. It is important to note that elevation does not have to result in an unattractive, time-period inappropriate façade. The new pilings of foundation walls can be covered by an architecturally pleasing façade with design and materials that are consistent with the historic property's aesthetics. In addition, it is possible to incorporate outside landscaping to camouflage the elevating features.

Another concern is how elevation impacts the scale and setting of the historic property. Elevating a property can potentially disrupt its relationship with the surrounding environment. For example, elevating one historic building may disrupt its relationship to both the road and to surrounding buildings; the integrity of the latter relationship may be especially important if these surrounding buildings are also historic. To attempt to decrease the potential negative impacts of elevation on historic integrity, efforts can be made to replicate and approximate the original scale and setting of a property. This may be accomplished through careful consideration of the appropriate elevation method. For example, it may be better to leave the exterior of the historic building intact and to instead elevate the building's interior floors. Another potential option is to elevate all properties surrounding the historic building, both historic and non-historic, to similar heights. This may be an especially appropriate strategy in a historic district, as elevating all of the historic properties may protect them from flood damage while maintaining their relationship to each other.

The appropriate height of elevation is another important consideration. It may be more practical to elevate historic properties to a more modest extent than is possible, even though a higher elevation height may provide the most protection. The appropriate elevation height will balance the desirability of retaining historic integrity with the need to take adaptive actions to mitigate the effects of sea level rise-induced flooding. Even if a less intrusive elevation height is chosen, the vulnerability of the historic property to the effects of sea level rise can be reduced through the implementation of additional adaptation strategies.

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### Elevation Advantages

- Can bring a building or structure into compliance with floodplain regulations and reduce flood insurance premiums if the property is brought up to at least the base flood elevation<sup>66</sup>.
- A number of qualified contractors have experience and knowledge elevating structures throughout the State of Florida.
- Depending on what new foundation is used and the height of the elevation, the area under the elevated building may provide space for storage or parking.
- Elevated properties are a vivid reminder of flooding risk and there is a possibility for greater awareness of sea level rise.
- Elevation is effective at reducing flood risk to buildings and their contents.
- Elevation removes the need to move vulnerable contents to areas above water level (excepting those items stored in the area below the elevated structure).
- Elevation does not require the additional land that many protection measures require.
- Limited environmental implications.

### Elevation Disadvantages

- Elevation may cause a home to become top heavy and more susceptible to other hazards, such as high winds. A design professional will need to determine if the elevated home can withstand all horizontal and vertical forces.
  - Costs can be substantial, depending on the size of the building, the building design, and the amount of elevation<sup>67</sup>.
  - There may be decreased accessibility to the building, especially by those with restricted mobility.
  - Buildings should not be occupied during a flood.
  - “Unless special measures are taken, elevation is not be appropriate in areas with high-velocity flows, waves, fast-moving ice or debris flow, or erosion”<sup>68</sup>. It may also be infeasible for certain buildings due to their construction or location.
  - Elevation may lead to poor community aesthetics. This is especially true when there is a mix of elevated and non-elevated buildings adjacent to each other.
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## Wet Floodproofing

**Scale of Implementation:** On-Site

**Applicable Historic Properties:** Buildings, Structures, Districts

Wet floodproofing a property makes uninhabited portions of the property resistant to flood damage and allows floodwater to enter the building or structure. Allowing temporary flooding of the building or structure's interior reduces the danger of buoyancy from hydrostatic uplift forces and counteracts hydrostatic pressure on walls, surfaces, and supports of a building or structure by equalizing interior and exterior water levels during a flood<sup>69</sup>.

Wet floodproofing of a structure using flood-resistant materials to construct the portion of the structure below the projected flood level; retrofitting existing structures may necessitate the removal of non-flood-resistant materials and replacement thereof with flood-resistant materials.

According to FEMA, building materials are considered flood-resistant if they can withstand direct contact with floodwaters for at least 72 hours without significant damage (damage that requires more than a low cost, cosmetic repair)<sup>70</sup>. Some historic properties are already constructed from materials that are relatively flood-resistant. For these properties, removal of modern finishing and materials that are less resistant to flood damage and restoring properties to their original configuration may be an option. Guidance on flood-resistant materials can be found in [FEMA's technical Bulletin 2-93](#). In addition to replacing building materials so they are flood-resistant, it is important when wet floodproofing a structure to incorporate into the structure strategic openings through which water can flow. Additionally, it is important to remember that valuable personal items, utilities, and equipment have to be relocated above the expected flood level.

Wet floodproofing is practical in only a limited number of situations and only for those portions of structures that are not used for living space, such as basements, enclosures such as walkout-on-grade basements, crawlspaces, or attached garages. Wet floodproofing is not feasible for most slab-on-grade homes because the living space in these homes is at or very near ground level. To determine if wet floodproofing is an option for a structure, consideration must be made both of expected flood conditions and the structure's design and construction<sup>71</sup>.

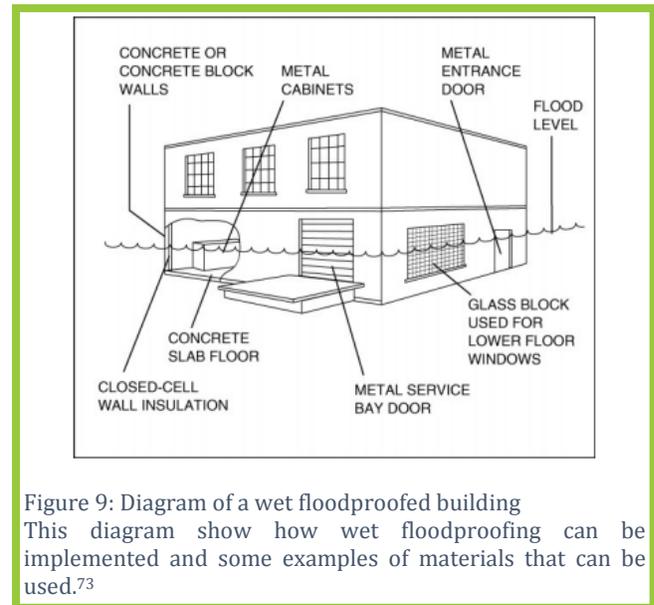


Figure 9: Diagram of a wet floodproofed building  
This diagram show how wet floodproofing can be implemented and some examples of materials that can be used.<sup>73</sup>

### Implications of Wet Floodproofing Historic Buildings

When wet floodproofing a historic property is a feasible adaptation action, the integrity of the structure may be threatened by potential changes in the design of, and materials integrated into, the property, loss of evidence of workmanship, and resulting changes in historic feeling. Depending on how wet floodproofing is implemented, threats to integrity may or may not be realized. Wet floodproofing may not be an acceptable option for buildings whose integrity is dependent upon the materials used in their construction, as wet floodproofing will often involve the replacement of building materials. However, the materials used in wet floodproofing may already be present in some historic properties due to previous flood mitigation efforts. If new materials must be used, special consideration should be given to the selection of flood-resistant materials than fit within the historic structure's existing character. There are a wide variety of materials listed by both FEMA and the U.S. Army Corps of Engineers as flood-resistant. Specialists in historic building architecture or the State/Tribal Historic Preservation Officer (SHPO/THPO) may be able to help identify the best materials for the individual property being considered for wet floodproofing.

### Wet Floodproofing Advantages

- Generally less expensive than many dry floodproofing methods. A wide range of water-resistant materials are available at a reasonable cost.
- Limited environmental implications.
- Wet floodproofing does not require additional land.
- The loads on walls and floors are less for wet floodproofed buildings than dry floodproofed buildings as there is reduced risk of structural collapse as hydrostatic pressures can equalize<sup>72</sup>.

### Wet Floodproofing Disadvantages

- Wet floodproofing does not remove the threat of damage posed by high-velocity flood flow and wave action.
  - During a flood and possibly for some time afterwards, buildings should remain uninhabited.
  - Human intervention and advanced warning time is required to move any valuable items that are kept below projected flood levels.
  - Floodwaters that enter the home can be contaminated by sewage, chemicals, and other materials. Standing water and excess moisture may cause excessive mold growth. Extensive cleanup may be necessary post-flood.
  - Wet floodproofing limits the use of the floodable area of the property.
  - “Pumping floodwaters out of a wet floodproofed basement too soon after a flood may lead to structural damage”<sup>73</sup>.
  - Periodic maintenance may be required.
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## Dry Floodproofing

**Scale of Implementation:** On-Site

**Applicable Historic Properties:** Buildings, Structures, Districts

Dry floodproofing makes buildings and structures impermeable to floodwaters by sealing them against the entrance of floodwaters. Structures and buildings are floodproofed by using some combination of the following methods:

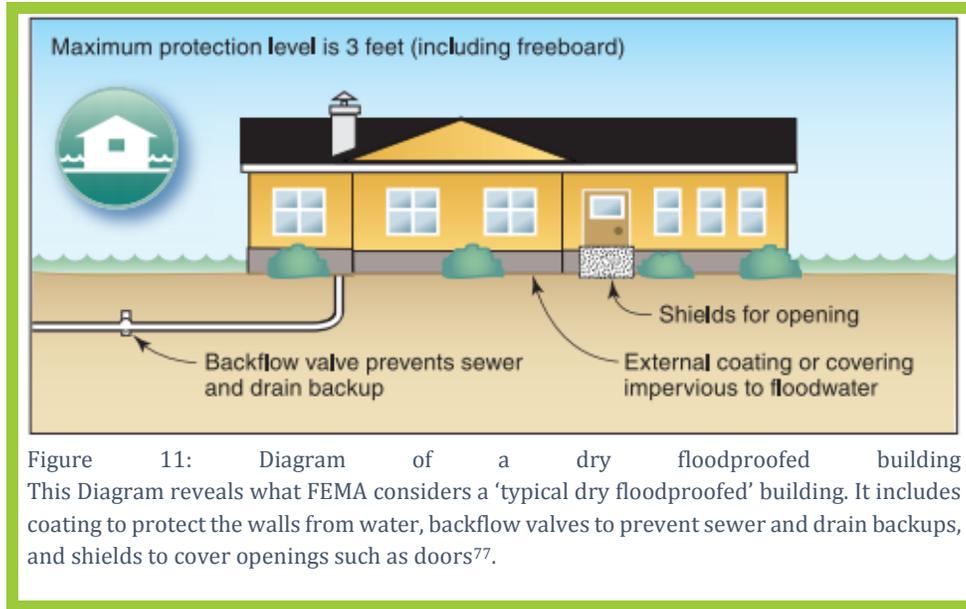
- Using waterproof coatings, sealants, or impermeable membranes to prevent seepage of water through walls;
- Installing watertight shields over openings such as doors and windows;
- Installing check valves (*i.e.*, backflow preventers) to prevent entrance of floodwater or sewage flows through utilities;
- Installing pumps to control interior water levels;
- Locating valuable and vulnerable equipment and contents above expected flood level;
- Reinforcing walls to withstand flood forces and impact forces from floating debris; and, Properly anchoring structures and buildings to resist flotation, collapse, and lateral movement <sup>74</sup>.



Figure 10: Photograph of a waterproof membrane along a wall's exterior surface.

The installation of this membrane is a relatively quick process that requires human intervention as it is installed prior to a flooding event. The membrane cannot remain in place indefinitely because it is unsightly and because the plastic will deteriorate with continued exposure to the sun.<sup>79</sup>

Whether dry floodproofing is an option for adaptation of a particular structure depends on the structure's construction and flood characteristics. Relevant property construction characteristics include the extent of a structure's ability to withstand the pressure exerted by floodwaters, its natural resistance to moisture damage, and the way in which its walls were constructed, which determines the ease with which the structure may be made watertight. Typical masonry and masonry veneer walls can often withstand pressure exerted by water up to three feet deep, are relatively resistant to moisture damage, and are easy to make watertight using sealants. Frame walls are more likely to fail at lower flood depths, are more difficult to make watertight, and are more vulnerable to damage from moisture. Dry floodproofing is also not recommended for buildings with basements, as saturated soils can damage basement walls and floors and cause them to fail<sup>76</sup>.



### Implications of Dry Floodproofing Historic Properties

Dry floodproofing is similar to wet floodproofing in that it can create threats to the historic integrity of historic properties through changes in these properties' design, materials, workmanship, and/or feeling. Design can be impacted by changes such as the installation of shields or anchoring. Threats to the integrity of materials are major, as some floodproofing strategies may adversely impact the materials used to build the historic building or structure (either because those historic materials are removed and replaced or outright changed). To reduce negative impacts to these properties' historic integrity, installation of materials consistent with the historic context and that do not change the historic design drastically or reduce the evidence of workmanship should be prioritized. For example, flood shields might be chosen that can be attached and detached without leaving evidence or that are consistent with flood shields used during the historical period.

## Case Study

### Flooding Accommodation Strategies on Darlington's Historic Main Street



Flooding had been a major problem for half a century in Darlington, Wisconsin, as repetitive flooding events along the Pecatonica River led to deteriorated structures, unhealthy conditions, and economic distress. After a flooding event in 1993, the community opted to implement mitigation strategies into Darlington's historic Main Street; however, emphasis was laid on retaining the Main Street's historic and community value. As part of Darlington's FEMA-approved Hazard Mitigation Plan, 19 commercial historic buildings in the downtown business district were retrofitted with mitigation techniques that maintained the district's historic character. Some of the techniques used included filling in basements, raising the first floor to the Base Flood Elevation (BFE), dry floodproofing the first floor to flood protection elevation (BFE plus two feet), raising utilities to Flood Protection Elevation, and constructing interior floodwalls.

Elevation through raising of the first floor of historic buildings was successful in Darlington because many of the historic buildings had high ceilings, thus allowing their first floor to be raised without raising the entire structure. This allowed for the preservation of the historic storefront of these buildings. According to the "Darlington Success Story" published on the Wisconsin Division of Emergency Management website, the "engineered solution was to build a vestibule area as you step into the front door, at street level. Steps lead up to the elevated first floor level, and a floodwall separates the vestibule level from the first floor...When flooding is imminent, a flooding shield slides into a frame at the top of the steps, creating a solid, sealed floodwall. The street level vestibule was constructed with materials that would not sustain flood damage, like ceramic tile or brick. Floodwaters are allowed to enter in the area in order to equalize the water pressure avoiding structural damages"<sup>78</sup>.

This engineering solution allows buildings to flood at street level, using wet floodproofing techniques to equalize water pressure inside and outside of these buildings to prevent damages. However, it also used dry floodproofing techniques such as a flood shields to prevent floodwater from entering the first floor of the buildings. Overall, the use of these flood mitigation techniques successfully maintained the historic storefronts and character of Darlington's Main Street, increased the buildings' protection from repetitive flooding damages, and had positive financial consequences for the City, including an increased property tax base.

### Dry Floodproofing Advantages

- Dry floodproofing may be less costly than other retrofitting methods
- Dry floodproofing does not have additional land requirements that may be needed for other adaptation methods, such as hard adaptation strategies.
- There are limited environmental consequences of dry floodproofing in comparison to many other adaptation methods.

### Dry Floodproofing Disadvantages

- Dry floodproofing often requires human intervention (*e.g.*, to install flood shields over openings). Thus, appropriate personnel and adequate installation time must be obtained
  - Flood characteristics can alter the ability of dry floodproofed properties to avoid damage. Properties should use a different adaptation option if they are expected to be exposed to floods that are longer than 24 hours, are over 3 feet in depth, are of high-velocity, or that involve the potential for wave action or floating debris.
  - If protective measures fail, flooding can cause the same or worse negative impacts on a dry floodproofed property than if there were no protection at all.
  - Dry floodproofing is not recommended for buildings and structures with frame walls or basements.
  - Dry floodproofing may not be used for bringing substantially improved or damaged properties into compliance with floodplain management ordinances or regulations. It may not reduce flood insurance premiums.
  - Buildings cannot be occupied during a flood event.
  - Ongoing maintenance is required.
  - Waterproofing materials and flood shields may not always be aesthetically pleasing<sup>79</sup>.
-

## Drainage Improvements

**Scale of Implementation:** On-Site and Large Scale

**Applicable Historic Properties:** Buildings, Structures, Objects, Sites, Districts

Drainage or stormwater management systems carry surface water to receiving bodies of water or storage facilities using natural or man-made conveyance systems. Modifications can be made to improve both conveyance and storage systems.

Conveyance systems may be modified through channel modifications, through increasing the capacity of storm sewers, or through the addition of stormwater detention or retention facilities. Channel modifications include reducing localized flooding (channelization), planting of vegetative swales, dredging, and increasing conveyance at stream crossings. Channelization is the straightening, deepening, or widening of a ditch, canal, or drainageway to increase the capacity of the system to move water. Vegetative swales are open channels that transport stormwater and naturally filter pollutants. Dredging excavates the bottom of a channel, thus removing built-up debris and sediments. Further, stream crossings (culverts and bridge openings) can often be undersized, which restricts water flow. Enlarging culverts and bridge openings can help to decrease the restriction of water flow. Storm sewers may be improved through the installation of new sewers, the enlargement of pipes, and the prevention of backflows. Many stormwater management systems are designed for 100-year floods and do not consider potential increases in vulnerability. As such, increasing their capacity can help with adaptation to the effects of rising sea levels. When designing storm sewers, consideration should be given to designing techniques to handle potential overflow (*e.g.*, through a swale, detention or retention pond, or other method) and to handle sewer backup (*e.g.*, through gates or valves) when the receiving body of water floods, especially in low-lying coastal and alluvial locations.

Storage improvements are another method of helping to control flooding. Improvements can be made to both regional reservoirs and on-site storage basins. Regional reservoirs to store floodwaters, including both wet and dry basins, can be expanded or created. On-site storage improvements likely will not diminish runoff from large flooding events, although they may reduce some flooding problems. One way to improve on-site water storage is through a reduction in the amount of nonporous materials, which will increase infiltration of water into the ground. This may be done through retrofitting driveways and parking lots with porous materials, such as bricks or other porous paving materials, and by implementing any of a variety of stormwater management techniques collectively referred to as [Low Impact Development \(LID\) technologies](#). LID includes practices aimed at increasing infiltration, such as the implementation of vegetative landscaping or rain gardens. Rain gardens allow approximately 30 percent more water to infiltrate into the ground than a conventional patch of lawn<sup>80</sup>. Another example of a drainage improvement might be to increase the grade of the ground immediately adjacent to a building to achieve positive drainage away from the building.

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### Implications of Improving Drainage near Historic Properties

Any threats to historic integrity caused by drainage improvements are likely to exist only in very unique cases. In comparison to some other adaptation strategies, most drainage and stormwater management improvements are able to be implemented in ways that do not have large negative impacts on historic integrity. Regional improvements to the drainage system likely have little impact on an individual historic property's historic integrity, as they can be distanced from the resource. Regional drainage improvements that are within close proximity to a historic resource can have negative impacts on the historical integrity of a resource if the presence or absence of certain features is important to the integrity of a resource. For example, the channelization of a stream nearby a historic resource may alter the setting and feeling of the historic resource if that stream was not historically channelized. On-site drainage improvements may also have negative impacts on historic integrity due to changes to the design, materials, setting, and feeling. As an example, changing the amount of porous materials to improve infiltration, such as through changing the materials used on a driveway or parking lot, can impact integrity through changes to the design and materials, although these are modest impacts.

#### **Drainage/ Stormwater Management Improvement Advantages**

- Vegetative swales filter pollutants using native vegetation and closely preserve natural hydrologic characteristics of drainage ways. They are often inexpensive to build and maintain.
- Because they are buried, storm sewers create more usable ground surface.
- Reservoirs can provide recreational benefits and/or an increased water supply.
- Drainage improvements can be combined with many other adaptation strategies.
- On-site storage improvements improve water quality at a local level. They also increase awareness of water quality and quantity. Rain gardens can enhance the beauty of yards, provide valuable habitat, protect streams and lakes from urban water pollutants, and increase the amount of water that filters into the ground, thus recharging local and regional aquifers<sup>81</sup>.

#### **Drainage/Stormwater Management Improvement Disadvantages**

- Drainage improvements will not be technically feasible for structures that are prone to experiencing deep flooding<sup>82</sup>.
  - Drainage improvements may be beneficial for one area but create problems, including flooding and erosion, in other areas.
  - There are cost and maintenance implications of drainage improvements. Some varieties are expensive and require frequent maintenance.
  - A drainage improvement project is built to a certain level of flood protection. If there is a larger flood event than expected, additional damage may occur to the property.
  - Some methods, such as channel straightening and dredging, can lead to increased or accelerated erosion.
  - Channelized streams rise and fall faster than natural ones. Dry weather can lead to low water levels that diminish water quality and degrade habitat<sup>83</sup>.
-

## Retreat

### Relocation

**Scale of Implementation:** On-Site

**Applicable Historic Properties:** Buildings, Structures

Managed retreat involves abandoning or relocating existing buildings and infrastructure to higher ground. Relocation offers the greatest security from flooding of all adaptation strategies<sup>84</sup>. Relocation can reduce the risk of damage to a historic structure from repeated flood events through the removal of the structure from a threatened area. The resource may be relocated elsewhere on the same lot if the lot contains sufficient land area above the height of the expected flood zone. However, it will oftentimes be necessary to move the resource to another site.

The process of relocation is complex and must be performed by professionals experienced in moving buildings and structures. To move a building or structure, it must be raised and then placed on a large wheeled vehicle (often a flatbed trailer), moved to a new site, and then lowered onto a new foundation. Some structures and buildings are easier to move than others. Generally, larger structures and buildings are more complicated and expensive to relocate than smaller structures and buildings. Buildings over a crawlspace or basement are also easier to relocate than slab-on-grade buildings. Masonry buildings, buildings with stone or brick veneer, and buildings with chimneys can require extensive bracing during relocation to prevent cracking or structural failure. Even so, properties of all sizes and types can be relocated, though some must be dismantled and rebuilt (especially if they are large)<sup>85</sup>.

## Implications of Moving Historical Resources through Managed Retreat

Relocation of historic properties threatens their integrity of location, setting, feeling, and association. There may also be threats to design, workmanship, and materials if unforeseen damage is sustained during the relocation process. Integrity of location will almost always be lost, except in very rare circumstances when a historic property may be moved to higher ground on the same property. Integrity of setting may be lost through the loss of site characteristics that contribute to historic significance. Some examples of this might include the loss of or damage to topographic features, vegetation, man-made features, and, relationships between the historic resource, other buildings, open space, and the transportation network.

“It’s something that is very much under discussion. I think we recognize on the one hand, that the context and setting in which a structure exists really is part of integrity. It’s critical to understanding it and interpreting it. That’s kind of the purist view, if you will. And then there’s the pragmatic view which says well, it may lose some of that integrity if you relocate it but it’s going to lose a lot more if it’s gone.”

- Daniel Odess, Ph.D., National Park Service<sup>90</sup>

Because in relocating a historic property there is always major potential to remove or damage those factors that contribute to the property’s historic significance, relocation must always involve a review process to ensure it is the most appropriate decision. When properties to be relocated are listed on the National Register of Historic Places, the review process is divided into two steps undertaken by the National Park Service. If proper procedures are not followed, the property will be automatically removed from the National Register when it is moved.

Even though relocation can present major threats to the preservation of a historic structure’s integrity, it can prevent food damage entirely and will not need to be repeated for a given structure. Relocation may therefore be an attractive adaptation strategy in some circumstances. Historic resources have been relocated successfully in the past, and resources may be relocated in a manner that maintains at least some of their integrity. When choosing a site on which to relocate a historic resource, then, the compatibility of potential sites with the maintenance of the resource’s integrity may be considered. Additionally, the relocation of multiple historic resources with similar historic contexts may provide the opportunity to relocate the resources in groups to new areas that are historically and aesthetically compatible. The faithful replication of a property’s historic context can be extremely difficult to achieve during relocation of the property. Despite the disadvantages, however, some communities may find it more advantageous to preserve (some of) its historic properties through relocation than to gradually lose each historic resource to demolition over an extended period of time.

Finally, it is important to consider the location from which historic properties are being relocated. Relocation of numerous buildings and structures out of a historic district can greatly compromise the character and integrity of the historic district. Every property in a National Register historical district that loses its designation reduces the integrity of the district. If enough integrity is lost, the district’s boundaries may need to be redrawn or the designation eliminated entirely<sup>87</sup>. When making decisions about which historic resources to relocate, it is important to consider each historic property’s relationship to its own setting as well as how moving the resource will impact the historic integrity of other resources.

## Case Study

### Historic Frank Lloyd Wright Home Relocated

The Bachman Wilson House was designed by American architect Frank Lloyd Wright and was built in 1954 in Somerset County, New Jersey, along the Millstone River. The house's design is a reflection of Wright's Usonian designs, which represent organic design principles and which were intended to provide all families with access to quality architecture.

The house had been flooded prior to the restoration work and there was strong indication that flooding on the property had been increasing in intensity and frequency, which led to the house experiencing significant damage. To address these issues, many mitigation options were considered. The owners ruled out certain options because they would have had severe detrimental effects on the house's historic integrity. For example, elevation was not considered to be an acceptable option because it went against Wright's vision. It was eventually decided that relocation was the best means of preserving the structure. To facilitate relocation, "the current owners conducted a multi-year search for a purchaser that could provide an appropriate setting and context for the historical building." This search led them to the Crystal Bridges Museum of American Art in Bentonville, Arkansas, which eventually purchased the home. The house was disassembled and reassembled to Frank Lloyd Wright's original specifications on Crystal Bridges' 120 acre grounds.



The Bachman Wilson House

The relocation of the Bachman Wilson House offers benefits other than the protection of the home from continued, repetitive flood damage. Relocation of the house on Crystal Bridges Museum property allows the property to be made available for scholarly study and other educational uses as well as for public exhibition. The Crystal Bridges Museum already focuses on architecture, and this will only be enhanced from the addition of the Bachman Wilson House<sup>88</sup>.

## Record and Let Go

**Scale of Implementation:** On-Site

**Applicable Historic Properties:** Buildings, Structures, Objects, Sites, Districts

Retreat can also include the idea of “abandonment” or “letting it go.” This is not the same as doing nothing. Rather, this involves allowing sea level rise to impact a historic property, with efforts focused on preserving its memory. This may include data recovery (*e.g.*, excavation of an archaeological site), creating a record of a historic property, and interpreting the change. Thus, a property may be damaged by flooding, but its memory is preserved in a comprehensive record or other form of documentation.

### Implications of Record and Let Go

“Record and let go” allows properties to experience the impacts of sea level rise, with an understanding and acceptance that damage or destruction to the properties may eventually occur. The potential threats to integrity resulting from choosing this option (as opposed to threats resulting from sea level rise) depend on the way in which the property is recorded and let go. Simple recordings, such as the taking of photographs and/or notes or the creation of a written “profile,” may not impact the property’s historic integrity.

Data recovery through excavation, by contrast, does threaten historic integrity, as excavation will change historic properties. Data recovery through excavation provides the opportunity to learn, interpret, and document historic and cultural meanings before a site is inundated and artifacts on the site are damaged or become inaccessible. If excavation is determined to be the most appropriate option, decisions must be made regarding the timing of this data recovery and how to retain the knowledge that is gained. The appropriateness of excavation depends on many factors, including ethical considerations and obligations. Each archaeological site is unique, and relevant ethical considerations and therefore management choices will vary from site to site. For example, considerations of the ownership of the archaeological site may be particularly important on Native American cultural or heritage sites, as Native American Tribes oftentimes have specific sets of rules regarding excavation or physical changes to sites relating to the particular characteristics of those sites. Generally, it is important to involve every potential stakeholder to ensure that the most appropriate decisions are made for each individual archaeological site. It will therefore be important to contact the appropriate State or Tribal Historic Preservation Officer (SHPO or THPO), who can help ensure that all laws related to archaeological excavations are followed and that all appropriate stakeholders are engaged.

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### **Retreat Advantages**

- Relocation offers the greatest security from future flooding of all adaptation strategies. It can be the best option when a property is subject to repeated flooding, severe or otherwise.
- Relocation techniques are well known and qualified contractors are readily available.
- Relocation allows a substantially improved or damaged building to be brought into compliance with a community's floodplain management ordinance or law. It also can eliminate the need for flood insurance or reduce annual premiums<sup>89</sup>.
- Retreat is a long-term solution that does not require the constant maintenance and costs associated with other, shorter-term, adaptation strategies.
- "Record and let go" can be inexpensive, depending on choices made.

### **Retreat Disadvantages**

- Relocation can be expensive, depending on choices made. There are costs associated with moving the resource, buying and preparing the new site (including building the new foundation, providing utilities, and permitting fees), and restoring the old site (including demolishing the old foundation, capping old utility lines, and removing old sewage management devices)<sup>90</sup>. If relocation is being used to protect multiple resources simultaneously, such as in the preservation of an entire historic district, it can be very expensive and thus cost prohibitive.
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## Chapter 5. Concluding Remarks

Adapting historic resources to sea level rise has to date not been a major component of public conversation surrounding hazard mitigation, increasing community resiliency, or historic preservation. However, this topic is extremely important to all of these fields, as many historic resources may find themselves in areas that are increasingly vulnerable to flooding in the future.

The balance between historic preservation and adaptation to changing conditions must be maintained. On one hand, it is important to protect a historic resource from flood damage in the most appropriate way so that the resource is not destroyed or damaged by repeated flooding events. On the other hand, preservation efforts should attempt to avoid and/or mitigate adverse impacts on a historic resource's integrity. Making informed, sensitive choices about appropriate adaptation strategies and how to implement them can reduce negative impacts on historic integrity. It is important here to remember the definition of historic preservation. Preservation is defined as "the act or process of applying measures necessary to sustain the existing form, integrity, and materials of an historic property"<sup>91</sup>. Carefully planned adaptation actions taken to protect a historic resource from potential damage may maintain the resource's existing form, integrity, and materials more satisfactorily than would be the case if that resource was left vulnerable to flood damage. Protecting a historic resource from sea level rise-induced flooding can make up an important aspect of its long-term preservation. In the end, if historic properties are to be preserved for future generations, decisions will need to be made about the most appropriate method to protect these properties from external threats.



Aerial View of Fort Clinch State Park, Fernandina Beach, Florida<sup>92</sup>



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## Appendix 1: Funding Sources

The Coastal Resiliency Initiative maintains a list of funding opportunities for adaptation planning on DEO's [website](#)<sup>6</sup>. However, this list does not include funding opportunities specifically for historic property adaptation planning. This need is addressed by this appendix, which provides a list of funding sources that may be applicable to adapting historic resources to sea level rise.

It is important to note that many funding sources require a plan that demonstrates how funding will be implemented. By developing a local historic resources adaptation plan using the methodology provided in this guidebook, communities will be able to demonstrate that: (1) the project for which funding is sought is feasible and effective; (2) since the local plan was developed with public input, the project has public support; (3) the project is appropriately needed and/or urgent, as evidenced by its prioritization during the planning process; and (4) the project can be implemented over a short period of time (*i.e.*, the project is shovel-ready), which is a requirement for many funding mechanisms. In addition to these four benefits, a local historic resources adaptation plan allows a community to create a long-term plan for applying for, securing, and closing out projects that require supplemental funding resources.

\*It is important to note that not every grant has blanket eligibility. Some grants are directed at public agencies while others are directed at non-profit organizations or private homeowners. Communities should contact grant providers directly to obtain more information about the eligibility of individual adaptation projects for particular grants.

### Division of Historic Resources: Special Category Grant

One of the major purposes of the Special Category Grant Program is to assist in the major restoration or rehabilitation of historic buildings and structures. Three types of projects covered by the Program that are closely related to sea level rise include the moving of a historic building or structure that is under threat of demolition or destruction due to natural causes (*e.g.*, sea level rise, coastal flooding), the rehabilitation of a historic property (*e.g.*, vertical elevation and stabilization of the foundation), and major archaeological investigations of a site or closely related sites. A community that has not had a historic site inventory completed and which has a medium to large number of historic properties might qualify for funding to conduct an inventory under this last type of project (*i.e.*, investigation of closely related sites). However, inventories are usually funded under the Florida Division of Historical Resources' Small Matching Grants program.

Eligible applicants include State agencies, universities, local governments and units of local governments, as well as non-profit organizations. Each type of applicant may have no more than one previously awarded Special Category Grant open at the time of application. This limitation on funding increases the importance of the adoption and implementation of a local adaptation plan for historical resources. By identifying and prioritizing adaptation projects, a community can strategically apply for these or similar Special Category

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<sup>6</sup> Community Resiliency Initiative website: <http://www.floridajobs.org/community-planning-and-development/programs/community-planning-table-of-contents/adaptation-planning>

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grants over an extended period of time and cumulatively adapt to the potential effects of sea level rise a number of properties on the community's mitigation prioritization list.

#### Division of Historic Resources: Small Matching Grants

The major purposes of the Florida Division of Historical Resources' Small Matching Grant Program are to assist in the identification, protection, and rehabilitation of historic and archaeological sites in Florida. Types of projects that qualify for funding include acquisition and development projects (*e.g.*, building rehabilitation, building stabilization, or planning for such activities) and protection activities (*e.g.*, surveying historic sites and preparing ordinances or preservation plans). This Program may be of interest to communities interested in developing a local adaptation plan for historical resources or developing a plan for the mitigation of sea level rise-related events on an individual historic property.

#### National Trust Preservation Funds

Grants from National Trust Preservation Funds (NTPF) are intended to encourage preservation at the local level by providing seed money for preservation projects. One of the of the Fund's priorities is building sustainable communities through funding of projects that demonstrate the role historic preservation plays in facilitating the development of economically, environmentally, and cultural sustainable communities. Currently, applications are reviewed three times annually for seed funding amounts ranging from \$1,000 to \$5,000. Potential uses of this funding may include the development of a local adaptation plan for historic resources, conducting a historic resources inventory to be used in development of a community's adaptation plan, and/or for public outreach purposes related to the development of "a shared vision" in a community's adaptation plan. It is important to note that there are several applicant and matching limitations listed on the NTPF's website, which suggests that this funding opportunity should be used as one component of a portfolio of potential funding streams rather than as a potential primary funding resource.

#### National Trust for Historic Preservation: Johanna-Favrot Fund for Historic Preservation

National Trust for Historic Preservation's (NTHP) Johanna-Favrot Fund is aimed at fostering an appreciation of the United States' diverse cultural heritage and to preserving and revitalizing the nation's communities. Favrot Fund grants are awarded for planning activities focused on preservation (*e.g.*, development of a local adaptation plan). Currently, applications are reviewed once a year for funding amounts ranging from \$2,500 to \$10,000. It is important to note that there are several applicant and matching limitations listed on the NTPF's website, which suggests this funding opportunity should be used as part of a portfolio of potential funding streams rather than as a potential primary funding resource.

#### National Trust for Historic Preservation: Cynthia Woods Mitchell Fund for Historic Interiors

NTHP's Cynthia Woods Mitchell Fund awards grants for planning activities focused on the preservation of historic interiors. Eligible activities include hiring consultants to create an interior restoration plan or conservation plan. Historic preservation projects eligible to be funded include the development of a restoration or conservation plan for projects focused on incorporating flood-resistant materials into areas

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of historic properties with features that are prone to flood damage (*i.e.*, wet floodproofing). Currently, applications are reviewed once a year for funding amounts ranging from \$2,500 to \$10,000. It is important to note that there are several applicant and matching limitations listed on the NTPF's website, which suggests this funding opportunity should be used as part of a portfolio of potential funding streams rather than as a potential primary funding resource.

#### Save America's Treasures Funding

The purpose of the Save America's Treasures Grant Program is to fund projects that protect the United States' endangered and irreplaceable cultural heritage. Grants are available for preservation and/or conservation work on nationally significant intellectual and cultural artifacts, historic structures, and historic sites. Although the Program has not been funded since 2011, it may be funded during future Federal funding cycles. A dollar-for-dollar, non-Federal match is required. The minimum grant request for collections projects is \$25,000 Federal share; the minimum grant request for historic property projects is \$125,000 Federal share. The maximum grant request for all projects is \$700,000 Federal share.

To be considered for funding, applications must demonstrate that the collection or historic property of interest is threatened or endangered and must document an urgent need for preservation and/or conservation. Eligible adaptation-related projects include elevation and floodproofing. Ineligible adaptation activities include acquisition, relocation, inventory creation, and reconstruction.

#### Preserve America Grant Program

The Preserve America Grant Program support planning, development, and implementation of innovative activities and programs in heritage tourism, such as surveying and documenting historic resources, interpreting historic sites, planning, marketing, and training. In order to qualify for funding under this Program, a community must have applied for the Preserve America Community designation. Grants are awarded on a full dollar-for-dollar (1:1) cost matching basis.

Projects related to adaptation planning that are eligible to be funded through the Program include project planning and documentation of a community's historic resources (*i.e.*, creating an inventory of historic resources). Many mitigation activities that require construction are ineligible to be funded through this Program; therefore, adaptation activities undertaken before and after mitigation and construction activities are best suited for these grant opportunities. For example, funds awarded through this Program can be used for educational, interpretative, marketing, and training purposes related to a particular historic property after adaptation strategies requiring construction have been implemented on that property.

Together with other funding resources in a community's portfolio, funding awarded through this Program can be used to implement a holistic approach to mitigation that allows structures to realize their full potential after mitigation strategies have been implemented.

#### Federal Investment/Rehabilitation Tax Credit

The Federal Investment/Rehabilitation Tax Credit Program provides tax incentives to encourage private sector rehabilitation of historic buildings. The Program is administered by the National Park Service and the

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Internal Revenue Service in partnership with State Historic Preservation Offices. The Program provides a 20 percent tax credit when certified historic properties are rehabilitated for income-producing purposes, including commercial, industrial, agricultural, rental, residential, or apartment use.

Adaptation planning-related activities for which this Program may be able to provide incentives include funding and cost-recuperation activities. Incentives provided through the Program are most appropriate for Certified historic structures that are prone to both the short- and long-term impacts of sea level rise, are currently in disrepair, and whose capacity for producing income is currently underutilized. One example of how the incentives offered through this Program may be used is as a mechanism to offset, through tax credits, the long-term repayment of construction loans used to implement mitigation strategies on and to rehabilitate qualifying properties. The major limitation associated with this Program is that owner-occupied residential properties do not qualify for the Federal Rehabilitation Tax Credit.

#### National Park Service Historic Preservation Fund Grants-in-Aid

The purpose of the Historic Preservation Fund (HPF) Grants-In-Aid Program is to issue Federal grant funds to encourage non-Federal investment in historic preservation. The Program is administered in Florida by the Florida Division of Historical Resources. At least 10 percent of the funds received by the State must be distributed to Certified Local Governments (CLGs) (those local governments whose preservation programs have been endorsed by the State and National Park Service (NPS) as meeting certain criteria). The Division of Historical Resources typically distributes these Federal funds through the Division's Special Category and Small Matching Grants Programs (see above); therefore, Certified Local Governments applying for these grant opportunities may receive prioritization of their projects.



## Appendix 2: Discussion of potential sea level rise impacts on Florida historic properties on the National Register

For this report, the Community Resiliency Initiative prepared an example exposure and impact analysis for Florida historic places listed on the National Register of Historic Properties. Data were obtained from the National Park service and the FDOT Geoplan Sketch Planning Tool websites<sup>7</sup>. GIS layers containing point and polygon information for historic buildings, structures, objects, districts, and sites were processed to determine overlap with sea level rise projection layers. The following maps and tables represent properties found to be within the inundation area of Mean Higher Higher Water (MHHW), as projected by a high (fast) rise scenario, at 2060 and 2100. Please note, these are *only* projections, and are not a substitute for a locally conducted exposure analysis. They are intended for educational purposes only.

Table 1: Sites, Objects, Districts, and Buildings affected by MHHW, 2060

| Historic Properties within the scope of 2100 MHHW, High Projection |                                 |  |  |
|--|---------------------------------|--|--|
| Type   | Name                            | Locational GUID  | Cultural Resource GUID                 |
| <b>Structures</b>  |                                 | <b>No results returned, based upon search criteria</b> |  |
|  | Horr, Capt. John Foley, House   | {71C6966D-C8E2-4DFB-8E14-926CE9FFFAE6}                 | {831B4DA1-FF09-467C-8439-2A6FD5EC92B1} |
| <b>Sites</b>   | Lincoln Road Mall               | {FC8FF64A-E113-4E04-87A6-37496ACD4B79}                 | {975FB816-C242-4C86-9E49-A695BC9DAE91} |
|  | African Cemetery at Higgs Beach | {9DDAD574-C80E-4CF2-B4A1-FE02A851625E}                 | {0B2F163B-5AE3-47E2-84DF-CFD05C7065CE} |
| <b>Objects</b>   |                                 | <b>No results returned, based upon search criteria</b> |  |

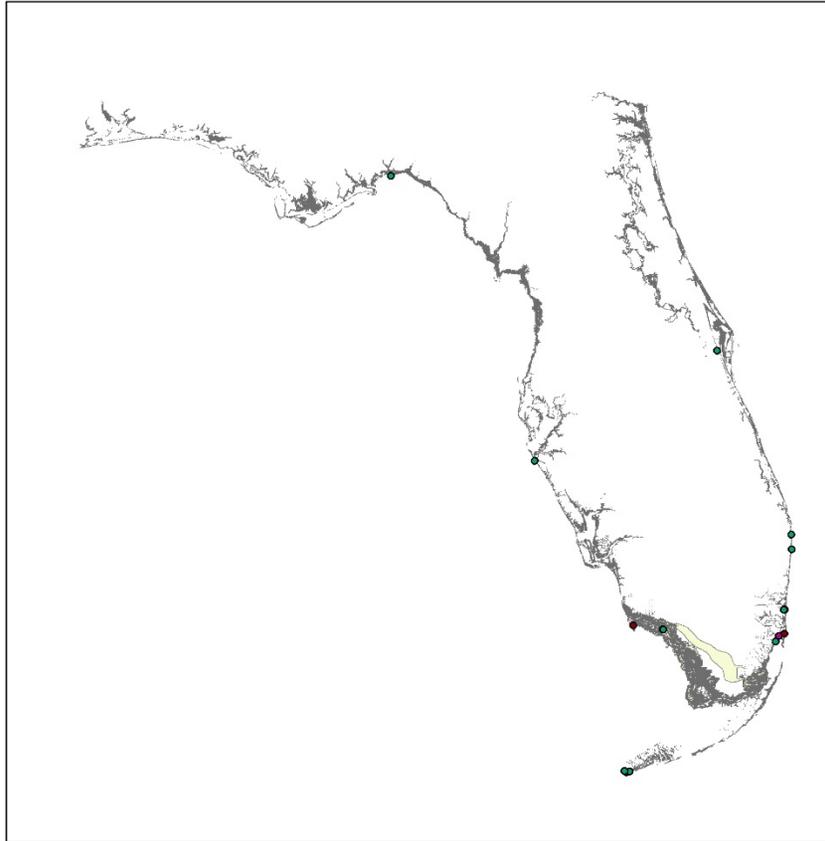
<sup>7</sup> [http://www.nps.gov/nr/research/data\\_downloads.htm](http://www.nps.gov/nr/research/data_downloads.htm)  
<http://sls.geoplan.ufl.edu/download-data/>



| <b>Districts</b> |   |  |  |
|------------------|---|--|--|
|                  | South River Drive Historic District                 | {0BA279FF-8E07-49BA-AA99-3F245628CAA5} | {47D72483-C2D6-4AA1-82B1-A66E210FF53A} |
|                  | St. Marks Lighthouse                                | {82B333AF-8059-43BB-AF40-ADF3AECE2242} | {F6DE74D4-A4C9-4708-B60C-3E6B01B00AE6} |
|                  | Ransom School "Pagoda"                              | {4434D264-609C-4A85-AE2C-898C40BED8ED} | {AE0B1461-54C2-42D2-9D0E-EABC0414E6A6} |
|                  | Martello Gallery-Key West Art and Historical Museum | {4D29EA50-E58D-4402-B6B5-EFDAA637D867} | {2189B370-1F15-4092-9086-2489DACB0C96} |
|                  | Vineta Hotel  | {2098F170-3F63-467A-86A8-760FD32DC098} | {CCEC1B7A-279C-4EE6-8AF6-FD3C3B5CB8DC} |
|                  | Young, Joseph Wesley, House                         | {E4F46BD1-94DE-4EE2-A1E3-FD0F5BF297C6} | {ED2D4FAD-A951-416E-93AB-0A7F578E7A97} |
|                  | Hollywood Woman's Club                              | {5C152DEA-2361-4BAC-94D5-90AB0DA96B4E} | {2F93B1C3-8983-4B38-9E90-B218298414A3} |
| <b>Buildings</b> | City Point Community Church                         | {CAE6B994-875C-4BA4-9119-D7FDACD982D2} | {0A1E195B-13EA-4126-B6D1-AEDBDB293939} |
|                  | Bank of Everglades Building                         | {D16DD096-50AE-4462-B67F-90AF0D26BE7C} | {57352674-FA59-434B-B41E-1DD36D47C6D3} |
|                  | Hammerstein House                                   | {FB62E758-E182-4322-963B-A01F8232A090} | {80E52C30-8553-4071-96F0-4EFE993ABB18} |
|                  | Jordan, Rufus P., House                             | {4DE67A6E-F3BB-4593-8205-EC4FC5215FA0} | {1904D72D-FECA-42BB-AEA5-24BAB0BF2BE4} |
|                  | Sloppy Joe's Bar                                    | {91562E4B-EBFE-4F16-BA22-202028964289} | {C650A444-3464-4BAA-AB8F-FA1A1D2673D2} |
|                  | Eastover  | {26743341-9F99-4E59-B798-EFB179358AA1} | {6402BE68-D961-4507-BA33-51CE6875796F} |
|                  | Old Collier County Courthouse                       | {A6F40C9F-67B2-4EFF-A40A-7A01C9430244} | {E223014D-7947-4366-9DFC-BE33627AE7AA} |



### Historic Places Affected by Sea-Level Rise, 2060



0 80 160 Miles

- Buildings in MHHW 2060
- Districts in MHHW 2060
- Sites in MHHW 2060
- Sea-Level Rise, MHHW 2060

Figure 1: Statewide locations of affected historic properties



Table 2: Structures, Sites, Objects, Districts, and Buildings affected by MHHW, 2100

### Historic Properties within the scope of 2100 MHHW, High Projection

| Type              | Name   | Locational GUID                        | Cultural Resource GUID                 |
|-------------------|--|--|--|
| <b>Structures</b> | Yulee Sugar Mill Ruins                                 | {17255D75-14E2-48EA-8197-37D0177912E2} | {DC05C20A-5579-4E57-93E0-1630555F09A4} |
|                   | Venetian Causeway                                      | {D85E1D05-AF57-4A96-89C7-7E206FCD25E3} | {ACDD83D4-FA89-49C4-8D61-ECF3419C8E4A} |
|                   | Venetian Causeway                                      | {93B1FC02-7999-49B4-8F74-45FE8B2EBEF7} | {ACDD83D4-FA89-49C4-8D61-ECF3419C8E4A} |
|                   | Anclote Key Lighthouse                                 | {13AA73BD-7B22-41D0-9E15-8C27BD8F3B99} | {4FBA5457-D71E-4C97-B24C-7CA55B2E6688} |
|                   | Bay City Walking Dredge                                | {7C3E7613-68B7-4CA2-8B94-005740B90C63} | {E48395D1-9082-4ACF-97E8-44A0E19344EC} |
|                   | Fort Gadsden Historic Memorial                         | {1D8AFA95-B961-4A6E-BA80-EA087FAE6B07} | {DBE667E0-5F4D-4ED2-B703-58A5B3246CD3} |
| <b>Sites</b>      | Horr, Capt. John Foley, House                          | {71C6966D-C8E2-4DFB-8E14-926CE9FFFAE6} | {831B4DA1-FF09-467C-8439-2A6FD5EC92B1} |
|                   | City Island Ball Park                                  | {E0BE75D8-CF0B-4E1F-ACBB-020B41CA3A32} | {742D1E98-8B28-4836-BB83-2AF386E0F24E} |
|                   | Three Chimneys Archaeological Site                     | {62D2A5DB-E780-4760-9EA2-99913E4141D8} | {7FBF6E07-D950-4A1A-85A9-0F17DFE10D06} |
|                   | Lincoln Road Mall                                      | {FC8FF64A-E113-4E04-87A6-37496ACD4B79} | {975FB816-C242-4C86-9E49-A695BC9DAE91} |
|                   | African Cemetery at Higgs Beach                        | {9DDAD574-C80E-4CF2-B4A1-FE02A851625E} | {0B2F163B-5AE3-47E2-84DF-CFD05C7065CE} |
| <b>Objects</b>    | Fulford by the Sea Entrance                            | {BFE1F416-E168-46E5-AF6B-EF27C9A4A07B} | {36E930C2-9C31-4142-AD04-8C7E37AD488E} |
| <b>Districts</b>  | South River Drive Historic District                    | {0BA279FF-8E07-49BA-AA99-3F245628CAA5} | {47D72483-C2D6-4AA1-82B1-A66E210FF53A} |
|                   | Bachelor--Brewer Model Home Estate                     | {D1ADE36F-A943-4CF1-BBC2-392089E5BE69} | {63455399-9F7D-42E9-8FD6-3FC66C347CE7} |
|                   | Via Mizner   | {45106EE1-3552-4500-88F9-7C5128522E21} | {1F2DE3B4-B99C-4B30-B1C0-CAA04D5F7BEF} |
|                   | Burrows, Waters and Elsa, Historic District            | {2683BA22-0A43-4C84-947A-EDAE094975B1} | {CB8671B4-F4F6-45EF-9303-43C230F9DC69} |
|                   | Captiva School and Chapel-by-the-Sea Historic District | {AC3C0003-34EA-4172-99AE-81D3A67F8640} | {F1D19445-F16C-4254-A6B8-F0633B344774} |
| <b>Building</b>   | Edmunds, John, Apartment House                         | {381BAF36-404D-46B8-9931-ADE9A2D397A7} | {CAD7A559-840B-4ECD-A96B-C388D3EF42F6} |
|                   | St. Marks Lighthouse                                   | {82B333AF-8059-43BB-AF40-ADF3AECE2242} | {F6DE74D4-A4C9-4708-B60C-3E6B01B00AE6} |
|                   | St. Mary's Episcopal Church and Rectory                | {1BE9E831-B125-4562-B102-4D677CCE8975} | {20605A26-4A43-4DAF-87F4-6178AD0F5FD0} |
|                   | Louisville and Nashville Depot                         | {75F548E8-AE99-4BA7-9B3D-2326BF64CE4D} | {849E8263-AD8E-49CE-9FE1-A04A59C7C59F} |



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| Warner, J. W., House                                | {27E07801-648F-426E-9C1F-1A6EC18C6945} | {D78D2DDF-45B9-49FB-8ABD-D295E61B1A92} |
| US Post Office                                      | {40D36DD1-7E73-4A53-A8EC-B8DA15D8A351} | {87F2ADAB-E496-4A6F-83B9-9E3951483743} |
| Kress, S.H., and Co. Building                       | {9B0CFA7B-F785-4E4B-B35A-DB7EEAA7270C} | {8AFE94AC-9DCB-4B14-8066-42CF7176CF06} |
| Reagin, L.D., House                                 | {DF3DC87A-038A-4F14-ABC3-C9BC70D590C2} | {E128986C-5C08-4F87-87F5-5B55B5652246} |
| Gulf Stream Hotel                                   | {658F9314-B818-446C-A7A0-5E421F599074} | {821BD0A8-38A6-43D9-95B1-7ADD8B9E59E6} |
| Casa De Muchas Flores                               | {BDD0BA0B-44C2-421B-ABAE-D959A3F968CB} | {DC22520C-9AF3-4B4C-9E84-635B3022B7F4} |
| DeCanizares, F.A., House                            | {9F0E8011-EFAF-4615-A196-B6988E8ACA8D} | {512291F5-55EF-4586-94D3-6059D1E670FA} |
| Frances-Carlton Apartments                          | {1D2EDFFE-9FE8-4232-A0C5-29E6FF947100} | {DADFBEB8-5208-4F58-9263-45389F1FE07E} |
| Fire Station No. 4                                  | {AEB1E4DC-E124-44A0-9DF5-FDC349C848B5} | {2ED12568-6E76-4E8D-8E35-B967A2A3611F} |
| Sarasota Times Building                             | {975213F4-B866-4438-A3AC-0745DA6E99F1} | {8EB63F24-B6F0-4C56-B674-736500623F5A} |
| El Vernona Apartments-Broadway Apartments           | {9376A6EB-8EEC-41B8-92D0-6084CE704002} | {0E7C9B17-0D3C-4B9C-81EC-6B287D3B9ED2} |
| St. Mary's Church                                   | {16F7E8EC-90F5-4F26-A31A-F26E8ED2E964} | {11843092-F37D-406A-BD41-65A9EDEF6D3E} |
| Dyal-Upchurch Building                              | {76B8CC09-390C-49CC-9B86-FAE503300AF7} | {50C569A5-E1FC-44DC-B5DB-A4C0842C8633} |
| Jackson, Dr. James M., Office                       | {DDB53C14-C6FD-44F1-B8B9-EB9C612232EA} | {1C2B37A3-DE80-44ED-B18D-DF7622ED024F} |
| New River Inn                                       | {FC06CBA9-2497-4435-A761-ADD1E7E78239} | {FD31D183-F29B-4A57-A202-431678AB1019} |
| Florida Pioneer Museum                              | {1423B133-E3A7-433F-AF0D-D9A5FBF0E453} | {090573E0-95C1-4F45-92EE-5922D8902F9C} |
| Ransom School "Pagoda"                              | {4434D264-609C-4A85-AE2C-898C40BED8ED} | {AE0B1461-54C2-42D2-9D0E-EABC0414E6A6} |
| Old Spanish Monastery                               | {D68DA274-C7F5-463C-8250-7BD812C918A0} | {840B7697-811F-4746-B7C0-1F5C99406382} |
| Miami Women's Club                                  | {408C1284-777F-4BAC-8E04-5344ACDE463C} | {88EC4220-DC50-404A-998E-0C08CC1170D9} |
| Beth Jacob Social Hall and Congregation             | {031E73E0-DA2E-4E83-8F6B-6C5BD7324488} | {C08628D0-4E9C-45AC-8521-C819AA783945} |
| Trinity Episcopal Cathedral                         | {9DB0BACF-D801-48C7-A6BA-272EAF2B462E} | {EEBD125C-7D6B-4CA0-9EFC-AD491D1AA0C0} |
| West Martello Tower                                 | {ABE9D9A6-0B93-4EAB-A210-1F219342DB89} | {E3D788EF-F8DF-4A27-AB56-5C7093BD4242} |
| Flagler, Henry Morrison, House; Whitehall           | {5EC828D2-F0A7-4080-8FDB-759B66906AF2} | {F4029E78-1525-4364-A4DB-AAB5BD4C695D} |
| Charlotte Harbor and Northern Railway Depot         | {75F849D9-D384-4414-B53F-681D51A6315A} | {2B1C9E79-B41C-43AC-AE82-AC18A669789D} |
| Boynton Woman's Club                                | {2661B93F-627F-46AA-8B47-3027ECE7DA4B} | {BB3816C4-B4DF-4BCA-A83F-B4875EE889B1} |
| Sanibel Lighthouse and Keeper's Quarters            | {CECB56C4-B036-42A3-8A19-3B1EA8BA9169} | {4A313534-A3A4-440B-94C5-8ABDC46574C0} |
| Palm Beach Daily News Building                      | {78BBC102-6A0F-44F4-B147-8111465D6414} | {D724C7FE-4165-4329-9209-2B919CCAC4E4} |
| Armory, The   | {22199B27-1538-4A9C-A0C0-17E0C0A0533A} | {BF8E8263-79C9-43BC-B93F-2E2D560E5914} |
| Martello Gallery-Key West Art and Historical Museum | {4D29EA50-E58D-4402-B6B5-EFDAA637D867} | {2189B370-1F15-4092-9086-2489DACB0C96} |
| Old Post Office and Customhouse                     | {3896437B-9E6F-4244-B948-4D07D87D2A44} | {B79FEF31-B1A6-43FD-B77C-F4BEE30E18B6} |

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| U.S. Coast Guard Headquarters, Key West Station | {F1DAA7C0-2D67-4D28-BDF6-49BC51EB8B1D} | {CBEB6E60-1E56-42E8-A53F-D574B1D916B7} |
| Stranahan House                                 | {C859E576-8473-4AFD-9F61-05F94915D579} | {35EDB75A-F582-4FF8-86AD-FA680300104A} |
| Llambias House                                  | {99615C4D-BC91-446D-93E8-84076A0B76DD} | {F05E839E-9777-4755-84D7-5043598DFB5C} |
| Vineta Hotel                                    | {2098F170-3F63-467A-86A8-760FD32DC098} | {CCEC1B7A-279C-4EE6-8AF6-FD3C3B5C88DC} |
| Freeman, A. C., House                           | {D096C7BE-004F-4B41-A71B-24D634327815} | {02EE3FAA-1498-44CE-AA16-81EE9476177A} |
| El Vernona Hotel--John Ringling Hotel           | {2EF81811-6D29-4B73-8015-127049531613} | {6A7EA5C4-7934-4E7B-9C9C-11CD66DDACE2} |
| Burns Realty Company--Karl Bickel House         | {565342A1-BD95-4579-BE80-F53530F8A2C5} | {7E458D6B-F4AB-41E0-B8EA-2A8FCD7A1907} |
| Abbey, The                                      | {B85B09C2-C9CC-4794-B103-647C657C4780} | {F6713AAA-C0B2-43BC-9C50-9CC159835C87} |
| Clune Building                                  | {A386F126-2381-4132-8475-27776B2BA498} | {B37B6B2C-E949-4FC9-AAAC-9F77377B6A35} |
| Curtiss, Glenn, House                           | {5FE1F823-2D3C-45C7-B254-701C08F804F0} | {COC6284F-60E1-4EB9-831E-1A7CFA6204BD} |
| US Post Office                                  | {D80E2F15-28A8-4DCF-8032-3E7AB8A9A36C} | {CF3937EF-09A5-46FA-B1F0-66BF40EC8F59} |
| Jewett-Thompson House                           | {34D3E9C5-9FE5-4998-9F5E-B088223714A5} | {9B00AC97-3EE3-4142-9E90-4EA96F973699} |
| Porches, The                                    | {33B00423-1E66-4BFF-A1D6-DF53B932F9B5} | {6A44A65F-8E67-4255-87D6-8A76EF244A7F} |
| Alderman House                                  | {F352B9E4-5FDF-43B1-BFC9-C8524364CDF6} | {8C34CD3C-FFEF-49AC-B246-9436D3920C16} |
| Atlantic Gas Station                            | {9F3A2124-A08A-4D92-9B1B-BA58B4A226A2} | {26F02461-13CC-44ED-9EBB-C3F218F7C8D3} |
| Algonquin Apartments                            | {E6C7232A-A199-4DA2-9351-1F178BC8EFD4} | {6AF4E0FC-6C01-4F95-B4CA-B2727DC93D0E} |
| Priscilla Apartments                            | {0BAD8D30-39BF-4989-817E-1C96E5A5FEE3} | {23EB972E-F1E5-4ED8-BADE-AC2796C791D1} |
| House at 59 Aegean Avenue                       | {D8746CEF-0E98-4CB6-93E3-656913E1C159} | {55911F1D-53C3-4EC2-BDB8-27EF2833FA69} |
| House at 124 Baltic Circle                      | {D56A7D67-E6DB-4A6D-BF8E-900A535380E3} | {9200721D-C315-470E-80F1-2BECA56383DD} |
| House at 132 Baltic Circle                      | {9CA08760-EF66-44E0-852D-B3D1E5A3E48D} | {4DFDB7C7-589A-47DC-B0EC-C2E599BC9B71} |
| Palace of Florence Apartments                   | {D7F24F3C-BF73-4800-ADE5-04C4A6D498E7} | {898586C1-2E21-4E09-9778-BDD17C85E57A} |
| Palmerin Hotel                                  | {205E241A-91D8-4467-9E22-C5EA33E94AFC} | {10325B5C-8B4D-40F7-8FB3-E2A2E6480EEE} |
| Bay Isle Commercial Building                    | {F706D2EA-D14A-4CA3-9169-F0FB89F97385} | {7BA8DB9D-6512-4DD9-B20F-49A789030E37} |
| House at 116 West Davis Boulevard               | {96ADBC65-F8CF-4FB2-B213-7925793FAE02} | {0AD653DA-A622-4B8A-BF44-01CDDF4154D7} |
| Dix House                                       | {7220184A-0F6A-42B8-AD2F-36A651B11B4A} | {72615893-7951-4C91-BF92-8BB67F157C29} |
| Young, Joseph Wesley, House                     | {E4F46BD1-94DE-4EE2-A1E3-FD0F5BF297C6} | {ED2D4FAD-A951-416E-93AB-0A7F578E7A97} |
| House at 36 Columbia Drive                      | {7911D8FC-E566-435B-B59D-33CDCA20F846} | {174A760B-1935-410A-A3FB-67F1CD24F5F5} |
| Spanish Apartments                              | {B5D55AAD-59C7-4576-9D2B-171819B8A313} | {7FDBEE9F-6A3E-45C5-8FD6-66FD8F883D24} |
| House at 100 West Davis Boulevard               | {B85A567C-ABDB-4BF4-8374-3234637FAC05} | {38E3BE22-105B-44F7-9B20-5E166F9755D1} |
| House at 36 Aegean Avenue                       | {60857FB0-D540-46C1-B089-E11F58FD8977} | {25E6CFDA-919C-4626-99E3-E05990DCC81F} |

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| Murphy--Burroughs House                 | {89E9DB6E-DC60-4CA5-9DAF-EF01A9E1F74D} | {735C0738-2218-46DB-BDEF-0F577B20B083} |
| Cap's Place                             | {6A2FC88A-F4B3-4C83-BA06-797A2E10F265} | {F41AB809-890C-46E9-8B2A-2BCB2AA034CA} |
| Punta Gorda Ice Plant                   | {06F8ED58-F5AD-4C86-9149-F51D03F254C1} | {E304D215-8FB2-4394-8FD8-5FFF11286221} |
| First National Bank of Punta Gorda, Old | {A1FCF125-7491-44B4-92F3-187EBBAA2F1A} | {BCFD9B78-F915-4FDD-B474-3EB0744B7BA3} |
| Punta Gorda Woman's Club                | {603E4622-A334-4AD2-8A6B-F5BA85504E72} | {C2650B01-EFC4-44B6-8CDF-84F6E87A7DF9} |
| Villa Bianca                            | {4E4941D8-884F-49B0-A15C-3E782D14DA96} | {54BE7199-0837-4C4D-8EF1-C4A7063A5757} |
| Smith, H. W., Building                  | {2B366329-98C9-405A-AA5E-7B00FF5A4505} | {AB2FD706-CCAA-437A-9E58-D9EB95CBFAAE} |
| Solla--Carcaba Cigar Factory            | {47E4EEEF-9588-4248-A392-42F269EC5E35} | {3D1D63ED-98F9-487B-89B4-03489258D7FE} |
| Out of Door School                      | {CBE84219-D66D-4BBE-849E-81144AE0318B} | {0C5B3DD8-F67F-44B8-8436-E5BBD688A224} |
| Hollywood Woman's Club                  | {5C152DEA-2361-4BAC-94D5-90AB0DA96B4E} | {2F93B1C3-8983-4B38-9E90-B218298414A3} |
| Boca Grande Community Center            | {93705C90-41D6-485E-A54F-E2637EEFCD6D} | {1D405881-5E7C-4E06-9760-CA8459E37BC2} |
| City Point Community Church             | {CAE6B994-875C-4BA4-9119-D7FDACD982D2} | {0A1E195B-13EA-4126-B6D1-AEDBDB293939} |
| Boca Grande Quarantine Station          | {6358B73D-6037-47BC-AB27-72BDAF99178C} | {CBBF5518-7C58-4AA2-A8B2-AE48F0FE2674} |
| Heitman, Gilmer, House                  | {B969CC7C-08F5-4840-9FE9-F58D53A1E246} | {1D181BA0-4AF6-44FF-A5E1-1429A79016FD} |
| Casa Del Mar                            | {3D031A35-ED75-41F6-A52E-C28CE51E8C07} | {898C8B9C-9F7E-46E7-8CDF-59296B147C3A} |
| Burns, William J., House                | {03804864-443D-4F9C-9491-DA93E8237632} | {393FC4F2-3E83-46C7-BA2B-EA846248B84A} |
| Mott Willis Store                       | {B8EDF5B5-BAA1-4655-9273-365BCC78A49A} | {F4344693-0842-4360-8E09-A440F6D648F4} |
| Schueler, George, House                 | {508A3ECA-FF54-4166-8FE3-DCD71312227B} | {37848E45-6096-4930-BEDA-12244445351B} |
| Bryan Building                          | {BF90A8C5-9CFB-496C-885B-7B7C59A7F273} | {BFCD2BCE-37E2-4125-9F58-DFF68DC86C6B} |
| House at 507 Jackson Drive              | {C48848AD-76BE-4EF1-A21C-2C11B85D5FAB} | {24622B03-D280-4549-BEAB-C9AFE55BCACE} |
| Grace Episcopal Church and Guild Hall   | {C5ED4173-D03E-4B16-96B1-5A2D552AC2C0} | {AD09CA73-D194-487B-83EC-40D7951A116F} |
| Link Trainer Building                   | {2D1E268F-4C16-4731-8318-2BD2AD457E45} | {D5759BC8-BF4A-4565-918E-F21742140297} |
| Crystal River Old City Hall             | {B7F84B4E-21AE-4878-84CC-D9A35D502CB5} | {A3A0339C-D751-4F65-9EC3-1C83E2A22EC5} |
| Jorgensen's General Store               | {9F182DCE-B53A-4AF9-A35F-90DC1C5A4B99} | {1E9F4547-9227-48B6-9943-D6BFD590A215} |
| Fort Myers Beach School                 | {9AD95176-41B0-49F3-AC51-069325F62686} | {CD7D5E86-F1A3-48CF-8C92-32C1B2ED3F72} |
| Sanibel Colored School                  | {FD4F3C9D-D16F-4485-8202-463D0F85031E} | {93ED54B0-15E0-4A54-ADA5-CA3E116FEE16} |
| Bank of Everglades Building             | {D16DD096-50AE-4462-B67F-90AF0D26BE7C} | {57352674-FA59-434B-B41E-1DD36D47C6D3} |
| El Jobean Post Office and General Store | {6A82B893-CE75-431D-BE79-B7DAEE600328} | {69B5317D-8CD0-413A-9217-1EBC8ECDDA94} |
| El Jobean Hotel                         | {2867EFB3-6553-426A-A067-8E61AA341403} | {B5B5E11D-63C1-4124-9B03-7E0B888E171}  |
| Monroe Station                          | {4D88B27F-5AFA-4D94-B062-AD2E40873B48} | {422F850F-8294-45AE-9BA0-863E88D5BC6B} |

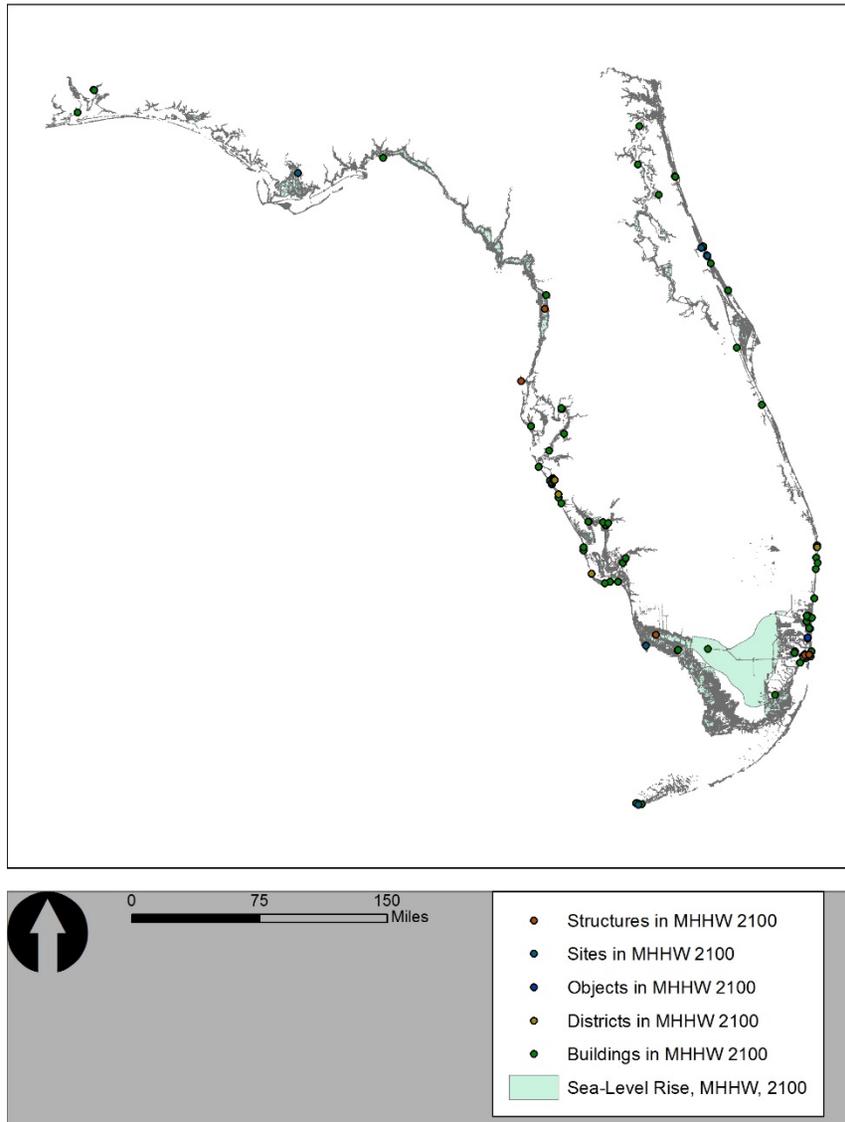


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| Dickman, A.P., House                            | {5F7E5E13-C6C9-402E-80C5-58871DD89458} | {8C26500C-E157-4013-9A85-5F79ACE66EF0} |
| Everglades Laundry                              | {8D07602B-D491-49BF-A879-BEB93928E8B0} | {4C27FCD3-0420-43C3-8A6F-999CF197C414} |
| Sanchez Homestead                               | {5EAFB7D7-0A4E-4673-A81F-DB1AF1BD95DE} | {13451AFD-239E-403A-95D8-F6253E7872B0} |
| Southwick--Harmon House                         | {6CCA77AB-5044-4C8D-886A-8ACA6940D5B7} | {568472CA-0A05-483D-A2B4-17B2506DBD28} |
| Moulton--Wells House                            | {7295F874-1EAB-4C6A-8EA6-1997574F06BE} | {0BDB79A4-792B-4815-BD8F-39633CBBF5FA} |
| Terra Ceia Village Improvement Association Hall | {8C003774-3481-4809-BDC1-92818D91A956} | {2FE4D67D-D85E-4A51-9AB7-F81486FCBCE8} |
| Palm Beach Town Hall                            | {215CF7E4-7F31-498B-A635-D68EB714C4F8} | {B1082214-0D2D-4031-BDAF-C3F69B994560} |
| Hammerstein House                               | {FB62E758-E182-4322-963B-A01F8232A090} | {80E52C30-8553-4071-96F0-4EFE993ABB18} |
| Jordan, Rufus P., House                         | {4DE67A6E-F3BB-4593-8205-EC4FC5215FA0} | {1904D72D-FECA-42BB-AEA5-24BAB0BF2BE4} |
| Williams House                                  | {694D6F99-AC72-4A0A-9D88-F46CB67892E7} | {7FCD80AB-AC52-463E-B354-804790C83852} |
| Cadillac Hotel                                  | {5E4FBC60-3F1B-4B98-9453-6FCBB5ABE5DF} | {BD7DDDFE-4C6D-481B-8D85-844A54ADC730} |
| King, Dr. Willard Van Orsdel, House             | {F6ED11E7-260A-4AD3-AC72-F5D3E5BB54E3} | {394DED30-823F-46F8-81C2-76CACC5A7C23} |
| Record Building                                 | {6CE28DFE-908F-4C4F-8A28-BDEFAE5B228C} | {D5AFCCB-2E15-4CB7-A16B-B886603D7021}  |
| Sloppy Joe's Bar                                | {91562E4B-EBFE-4F16-BA22-202028964289} | {C650A444-3464-4BAA-AB8F-FA1A1D2673D2} |
| Nielsen, Lucienne, House                        | {768988AF-6B93-4C8E-8E6D-1BA93A4E6665} | {F9CED87F-DC3B-4682-A100-C3897F2752B0} |
| Revere Quality Institute House                  | {220FEFE7-6DAA-408B-BCF3-EE07DC5BC2D5} | {A85FD28F-CE94-4600-AD6A-BC0DF06186D3} |
| Fontainebleau Hotel                             | {98C57D2D-A62E-46BC-94CC-4DC4FAE0A990} | {B112E8EF-D385-4DDD-8895-A8C11E2ECCD1} |
| Babcock, Clarence L., House                     | {C01F56BA-9FF0-43CE-A083-0CA20F226DD7} | {CD905228-7E18-4F01-948B-47643F799F3A} |
| Armistead, William Martin, House                | {9CB01526-DBDC-416C-9735-849811D7538B} | {DAEF7074-C4CB-4CBA-A564-475EBAC8221C} |
| First Baptist Church of Boca Grande             | {429B5D06-E5F7-46F5-B455-D038B533B371} | {C2483B78-7281-4D8B-9BF2-BD8DDC3E74D0} |
| Palm Beach Hotel                                | {3F500D7D-AEA1-4BA0-B6FA-017A4245057C} | {C4CC18B9-0083-459E-A90D-B3D5B3829304} |
| Eastover  | {26743341-9F99-4E59-B798-EFB179358AA1} | {6402BE68-D961-4507-BA33-51CE6875796F} |
| West Side Grade School, Old                     | {71240EFD-824C-4031-AA8E-2C0E0E830BC7} | {B83D769A-1C5B-4D42-BA60-CB67787CEE4C} |
| Nokomis Beach Pavilion                          | {E1853BBF-FAC4-42D8-8570-DA78A98CC09F} | {D4F291AE-8510-47F9-A51A-1C6234AEDC56} |
| Old Collier County Courthouse                   | {A6F40C9F-67B2-4EFF-A40A-7A01C9430244} | {E223014D-7947-4366-9DFC-BE33627AE7AA} |

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## Historic Places Affected by Sea-Level Rise, 2100

Figure 2: Florida historic properties affected by Sea-Level Rise, 2100





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## Notes

- <sup>1</sup> (U.S. Census Bureau, 2012)
- <sup>2</sup> Paragraph derived from: (Smith, Miller, Kelley, & Harbin, 1997)
- <sup>3</sup> (Stockholm Environment Institute and the Stockholm Resilience Centre, 2013)
- <sup>4</sup> (National Park Service, 1990, p. 7)
- <sup>5</sup> (National Park Service, 1990)
- <sup>6</sup> Definitions derived from: (National Park Service, n.d.)
- <sup>7</sup> (National Park Service, 1983)
- <sup>8</sup> (National Park Service, 1990)
- <sup>9</sup> (National Park Service, 1990)
- <sup>10</sup> (National Park Service, 1990)
- <sup>11</sup> (National Park Service, 1990)
- <sup>12</sup> (National Park Service, 1990)
- <sup>13</sup> (National Park Service, 1992a)
- <sup>14</sup> (National Park Service, 1992b)
- <sup>15</sup> Standards derived from: (National Park Service, 1992c)
- <sup>16</sup> (Advisory Council on Historic Preservation, 2010)
- <sup>17</sup> (Advisory Council on Historic Preservation, 2013)
- <sup>18</sup> (1000 Friends of Florida, 2006)
- <sup>19</sup> (Bureau of Archaeological Research, 2007)
- <sup>20</sup> (1000 Friends of Florida, 2008)
- <sup>21</sup> (FEMA, 2005)
- <sup>22</sup> (FEMA, 2005, pp. 3-4)
- <sup>23</sup> (FEMA, 2005)
- <sup>24</sup> (FEMA, 2005)
- <sup>25</sup> (FEMA, 2005)
- <sup>26</sup> (1000 Friends of Florida, 2006)
- <sup>27</sup> (1000 Friends of Florida, 2006)
- <sup>28</sup> (FEMA, 2005)
- <sup>29</sup> (1000 Friends of Florida, 2006)
- <sup>30</sup> (1000 Friends of Florida, 2006)
- <sup>31</sup> (FEMA, 2005)
- <sup>32</sup> (1000 Friends of Florida, 2006)
- <sup>33</sup> (1000 Friends of Florida, 2006)
- <sup>34</sup> (UNISDR, 2007)
- <sup>35</sup> (Russell & Griggs, 2012)
- <sup>36</sup> (FEMA, 2005)
- <sup>37</sup> (Intergovernmental Panel on Climate Change, n.d., p. 148)
- <sup>38</sup> (FEMA, 2005)
- <sup>39</sup> (FEMA, 2005; Tam, 2009)
- <sup>40</sup> Paragraph derived from: (Horowitz, 2013)
- <sup>41</sup> Paragraph derived from: (Horowitz, 2013)
- <sup>42</sup> Florida Department of Environmental Protection, 2013; The Arlington Group Planning + Architecture Inc. et al., 2013).
- <sup>43</sup> (Intergovernmental Panel on Climate Change, n.d.)
- <sup>44</sup> Image from: (USGS)
- <sup>45</sup> (NOAA, 2000, p. 4)
- <sup>46</sup> (NOAA, 2000)

- <sup>47</sup> Image from: (Simmons)
- <sup>48</sup> (The Arlington Group Planning + Architecture Inc. et al., 2013)
- <sup>49</sup> (Florida Department of Environmental Protection, 2013)
- <sup>50</sup> (Center for Coastal Resources Management, 2013a)
- <sup>51</sup> (NOAA, n.d. b)
- <sup>52</sup> (Florida Department of Environmental Protection, 2013)
- <sup>53</sup> (Center for Coastal Resources Management, 2013b)
- <sup>54</sup> (Center for Coastal Resources Management, 2013a; Ray-Culp, 2010)
- <sup>55</sup> (Center for Coastal Resources Management, 2013b; Center for Coastal Resources Management, 2013a)
- <sup>56</sup> (Sea Grant Mississippi- Alabama, 2014)
- <sup>57</sup> (Sea Grant Mississippi- Alabama, 2014)
- <sup>58</sup> (Georgetown Climate Center, 2013)
- <sup>59</sup> (Caffery & Escue, 2014)
- <sup>60</sup> (Caffery & Escue, 2014)
- <sup>61</sup> (Florida Native Plant Society, 2014)
- <sup>62</sup> Case study information derived from: (Melinda Donnelly personal communication, June 6, 2014). Image Courtesy of Linda Walters.
- <sup>63</sup> (FEMA, 2005; FEMA, 2008; FEMA, 2009)
- <sup>64</sup> Paragraph derived from (FEMA 2008; FEMA, 2009)
- <sup>65</sup> Case study derived from: (Mississippi Development Authority, 2008)
- <sup>66</sup> (FEMA, 2005)
- <sup>67</sup> (The Arlington Group Planning + Architecture Inc. et al., 2013)
- <sup>68</sup> (FEMA, 2009, pp. 3-18)
- <sup>69</sup> (FEMA, 2008)
- <sup>70</sup> (FEMA, 2011)
- <sup>71</sup> Paragraph derived from: (FEMA, 2009)
- <sup>72</sup> (FEMA, 2009).
- <sup>73</sup> Disadvantages derived from: (FEMA, 2009)
- <sup>74</sup> (FEMA, 2007; FEMA, 2008)
- <sup>75</sup> Image from: (FEMA, 2007)
- <sup>76</sup> (FEMA, 2008)
- <sup>77</sup> (FEMA, 2009)
- <sup>78</sup> Quote, images, and case study information derived from: (Wisconsin Division of Emergency Management, n.d.)
- <sup>79</sup> (FEMA, 2008)
- <sup>80</sup> (FEMA, 2005)
- <sup>81</sup> (FEMA, 2005)
- <sup>82</sup> (FEMA, 2007, pp. 3-12)
- <sup>83</sup> (FEMA, 2005)
- <sup>84</sup> (FEMA, 2009)
- <sup>85</sup> Paragraph derived from: (FEMA, 2008)
- <sup>86</sup> (National Park Service, 2014)
- <sup>87</sup> (Jennifer Farewell, 2010)
- <sup>88</sup> Case study information derived from: (Crystal Bridges Museum of American Art, 2014; Regatao, 2014). Photo from Nancy Wegard, NY Times.
- <sup>89</sup> (FEMA, 2009)
- <sup>90</sup> (FEMA, 2009)
- <sup>91</sup> (National Park Service, 1983)
- <sup>92</sup> Image from: (Florida Memory State Library and Archives of Florida, ca 1906)
-