

*Informing Plans for Managing Resources of  
Cape Lookout National Seashore under  
Projected Climate Change, Sea Level Rise, and  
Associated Impacts:*  
**Cultural Resource Management and Historic  
Preservation Experts Survey Results**

ISABELLE 9/18/03

GLORIA SEPT '85

ALEX AUG 3, 2004

DENNIS AUG 30, 1999

CPHELIA 9-15-05

MAY 6, 2005

GUSTAV 9/14/02

SANDY 10/28/12

FEB 7 '98

NOV 22 '06

APRIL 6 1993

NORIDA 11/1/09

Earl 09-02-10

EMILY AUG 30, 1993

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## Executive Summary

Anthropogenic climate change challenges cultural resource management and historic preservation globally. As our understanding of climate change impacts advances, conceptual frameworks, practical guidance, and actionable tools are needed to help decision-makers plan for and implement climate adaptation actions. Traditionally, decision-makers have been tasked with ensuring the persistence or survival of tangible (physical) cultural resources within a landscape. A range of adaptation actions have been suggested as options suitable for managing cultural resources that are vulnerable to climate change impacts, including relocating, elevating and releasing or “letting go” of cultural resources. Yet, there are few instances in which these adaptation actions have been implemented (Rockman et al., 2016). Moreover, there is a limited understanding of: how the actions could alter the integrity of cultural resources; how decision-makers will make prioritization decisions about which cultural resources to adapt first (given budget constraints that limit the ability to apply actions simultaneously across the landscape); and which actions do decision-makers feel are most appropriate given increasing vulnerability to climate change impacts.

This report is part of a series of studies being conducted with cultural resource stakeholders to enhance climate change adaptation planning. The specific stakeholder perspectives documented in this report represent “cultural resource and historic preservation experts.”

The **research objectives** were to:

- Enhance understanding of the barriers facing cultural resource management;
- Identify information and policy needs to overcome these barriers;
- Document the most important considerations for prioritizing adaptation actions; and,

- Explore the use of a geovisualization decision support tool for recommending adaptation actions.

We were particularly interested in the perspectives of experts located in the southeastern region of the United States, as the **study context** for the geovisualization decision support tool was **buildings located with two historic districts** (Portsmouth Village and Cape Lookout Village) at Cape Lookout National Park (CALO). As climate change impacts vary regionally, our intention was to include experts with some degree of familiarity with barrier islands and maritime history, as current policy directs managers to focus adaptation actions on the most vulnerable and most significant cultural resources (NPS 14-02). In the case of these buildings, we focus on vulnerability to flooding from sea level rise (SLR) and the significance of the area’s maritime history, which is considered to be of “fundamental” importance in CALO’s Foundation Document (NPS, 2012).

We collected the opinions of 39 cultural resource and historic preservation experts (49%) using an online survey questionnaire. Respondents included experts from federal (i.e., NPS) and state governments (i.e., State Historic Preservation Offices), as well as non-profit organizations (e.g., National Trust for Historic Preservation, tribal organizations), academia, and private architectural and engineering firms. The survey instrument included:

- A section of open-ended questions to collect perspectives on how SLR and stronger or more frequent storms challenge current historic preservation and cultural resource policy and practice, as well as recommended strategies and information or training needs for overcoming those policy and practice challenges.
- A section with closed-ended questions to capture the relative



importance of different strategies for prioritizing historically designated buildings for climate adaptation planning on a 30-year time horizon.

- A section with an interactive map of SLR visualizations and brief descriptions of specific historic buildings for use in evaluations of a building's vulnerability, significance, urgency for action, as well as in recommendations for adaptation and perceptions of the impact of that action on the cultural landscape.

Experts identified 226 policy and practice challenges, which we synthesized into 16 distinct subthemes and then classified into 3 main categories: (a) institutional barriers, (b) technical barriers, and (c) financial barriers. Our findings revealed that five **most salient barriers** (accounting for 61% of all identified barriers) were:

1. A lack of climate adaptation planning and implementation for cultural resources (institutional barrier);
2. A lack of institutional guidelines and procedures on how to carry out climate adaptation of already vulnerable cultural resources to climate change (institutional barrier);
3. A lack of funding for current cultural resource management and historic preservation practice and policy, as well as for planning and implementing climate adaptation strategies (financial barrier);
4. A lack of climate change knowledge, including a lack of information on climate change scenarios for various spatial scales and a lack of comprehensive climate change risk and vulnerability assessments for diverse cultural resource types (technical barrier); and
5. A lack of knowledge about historic integrity changes while planning for

and implementing different climate adaptation actions (technical barrier).

Experts identified 214 needs or strategies, which we synthesized into 8 main subthemes and then into 3 main categories: (a) institutional needs, (b) technical needs, and (c) financial needs. The three **most salient needs** for overcoming identified barriers (accounting for 66% of all identified needs) were:

1. Increasing climate change research to improve knowledge of regional climate models and climate change scenarios—including projecting impacts to cultural resources from SLR, storms and hurricanes and coastal flooding—and develop feasible climate adaptation strategies for cultural resources (technical need);
2. Enhancing collaborative partnerships among diverse multi-level actors from government agencies to private sector and engaging with local communities, as well as sharing their lessons learned and best practices (institutional need); and
3. Strengthening decision-makers and stakeholders' technical capacity for directing and overseeing climate change adaptation and disaster preparedness and recovery efforts, including use of proper materials and techniques, GIS mapping and modeling of coastal risks and vulnerability assessments, 3D imaging for documentation and inventorying, and emerging techniques for maintaining and repairing cultural resources.

The findings of this study also revealed that the five most important **considerations for**

### **prioritizing historically designated buildings**

during climate adaptation planning efforts were:

1. Being of national importance;
2. Being unique historic building of its type across the cultural landscape;
3. Having the highest scientific value;
4. Having a prominent role in the cultural landscape; and
5. Experiencing most immediate storm-related flooding and erosion impacts.

Findings from the application of the interactive **geovisualization decision support tool** highlight some **preliminary trends** (note: only 29 experts completed this section of the survey questionnaire and descriptive statistics reported should not be generalized, as the number of responses per historic building ranged from 4 to 12):

- The buildings were considered to be slightly to moderately important in terms of national heritage but moderately to very important for local communities.
- Perceptions of SLR vulnerability were typically highest for maritime buildings and lower for residential structures.
- Perceptions of increased SLR vulnerability was associated with heightened perceptions of certainty of SLR impact as well as priority levels for adaptation of those buildings (e.g., those that are vulnerable and certain to be impacted should be adaptation priorities).
- *Improving resilience* and *managing change* were among the most common adaptation strategies selected, and these actions, along with *leave things as they are*, were perceived to detract the least from the cultural landscape.

- A strategy of *document and release* was perceived to have the greatest (negative) impact on the cultural landscape.

Additionally, findings from the application of the tool illustrate some interesting **relationships between selection of climate adaptation strategies and respondents' occupational background, as well as their perceptions of spatial significance (i.e., national or local importance), vulnerability to SLR, and certainty of the impact from SLR**. These findings suggest the utility of the tool as a technique for site managers to access and consider expert opinion in climate adaptation planning for cultural resources. The following relationships between SLR vulnerability and SLR impact certainty with experts' selection of various adaptation strategies emerged:

- Perceptions of low vulnerability were related to recommending the strategy *leave things as they are*;
- Perceptions of moderate vulnerability were most commonly associated with recommending the strategies *manage change* and *improve resilience*;
- Perceptions of high vulnerability were most related to recommending *document and release* strategy to adaptation;
- When experts were not at all certain that historic buildings will be impacted by SLR, they were likely to choose climate adaptation strategies *leave things as they are* or *manage change*;
- When experts reported a fair amount of certainty in SLR impacts, they were most likely to select *improve resilience* strategy; and,
- When experts were very certain that impacts will occur, they were most likely to recommend *relocation* of

the building or *documenting and releasing* the building.

## **Recommendations**

Based on the above findings, we identified five thematic recommendations for enhancing climate adaptation planning and research endeavors.

1. Improve spatial and temporal evaluations within climate adaptation planning for cultural resources.
2. Apply measurement frameworks for assessing historical significance and use potential of historic buildings, and synthesize these into more holistic modeling efforts.
3. Mainstream cultural resource climate adaptation into sectoral policies.
4. Enhance communication and dissemination of best practices.
5. Improve interpretation of climate change-cultural resources nexus.

## Introduction

Anthropogenic climate change, one of the greatest challenges in the 21<sup>st</sup> century, has had noticeable impact on our natural and cultural resources globally. As these impacts occur, our ability to adjust to the new changes is jeopardized. Over the past decade, the National Park Service's (NPS) integration of climate change mitigation and adaptation discourse has become prevalent through policy initiatives, management practices, planning efforts, and other initiatives sponsored by the agency's NPS Climate Change Response Program office.

The focus on climate change impacts to natural resources, ecosystems and wildlife has traditionally been the central priorities within scholarly literature. Investigation of the climate change threats to cultural resources has lagged in this debate until recently (Fatorić and Seekamp, 2017a). In 2014, the NPS issued policy memorandum 14-02<sup>1</sup>, which highlights the critical need to better understand how cultural resources are being affected by climate change and how to successfully adapt these resources for future generations. Additionally, the NPS has initiated a range of preliminary climate change adaptation planning and implementation efforts, which are the central focus of the recent agency's Cultural Resources Climate Change Strategy (Rockman et al., 2016).

In a cultural resource management context<sup>2</sup>, climate change adaptation is a decision-making process used to safeguard the finite, tangible aspects of human existence for current and future generations. Cultural resources hold multiple and diverse values, such as research and discovery,

introspection, conserving cultural memories, and ancestral connections, which provide economic, socio-cultural and educational benefits. Additionally, cultural resources serve as a primary data source of human responses to environmental change. Although successful adaptation planning should involve both knowing what is significant to various stakeholders and how that significance is vulnerable to loss (Fatorić and Seekamp, 2017b, c), documentation of on-the-ground adaptation implantation efforts is limited (Rockman et al., 2016). Therefore, more information is needed to identify and understand what are the impeding factors or barriers to current climate adaptation process across parks, as well as identify strategies for overcoming those barriers.

Barriers are obstacles, constraints, or hurdles that impede climate adaptation or make adaptation impossible to achieve (Eisenack et al., 2014; IPCC, 2014). In climate change contexts, barriers arise due to characteristics of the individuals involved, the nature of the systems involved, and the larger social, political and ecological contexts within which the individuals and systems operate (Moser and Ekstrom, 2010). Barriers can prevent building adaptive capacity, hinder implementation of adaptation measures, slow down the uptake of adaptation in policy, lead to policy failure, constrain individual engagement or action, or prevent the uptake of new frameworks and tools to support adaptation (Biesbroek et al., 2013; IPCC, 2014). Barriers are often interdependent of each other, where barriers from different categories co-occur or reinforce each other (Eisenack et al., 2014). Understanding these interdependencies of barriers is central for explaining their occurrence and persistence, as well as determining how to overcome them (Eisenack et al., 2014). Decision-

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<sup>1</sup> For more information on NPS Policy Memorandum 14-02, see <https://www.nps.gov/policy/PolMemos/PM-14-02.htm>

<sup>2</sup> The NPS defines cultural resources as physical evidence or place of past human activity: site, object, landscape, building; or a site, building, landscape, object or natural feature of significance to a group of people traditionally associated with it. The NPS defines cultural landscape as a geographic area,

including both cultural and natural resources and the wildlife or domestic animals therein, associated with a historic event, activity, or person or exhibiting other cultural or aesthetic values. **This report focuses on buildings located within historic districts designated on the National Register of Historic Places and their associated cultural landscapes.**

makers need to understand what barriers are impeding cultural resource climate adaptation planning and implementation, how these barriers are experienced by diverse stakeholders and communities, and what are the needs or strategies that could be used to overcome such barriers. **The first objective of this study was to identify the most salient barriers facing cultural resource management and historic preservation for climate change adaptation from the perspective of regional experts, as well as to identify the most salient needs and strategies for overcoming these barriers.**

Increasing scarcity of financial resources and climate uncertainty has led to growing attention of prioritization processes for cultural resource preservation threatened by climate change (Fatorić and Seekamp, 2017b, c). Climate adaptation prioritization is a process that guides how a decision-maker chooses certain cultural resources (e.g., historic buildings, historic structure, archaeological site) over others to allocate limited funding for preservation (Fatorić and Seekamp, 2017c). In this sense, the NPS policy memorandum 14-02 highlights that it is critical that cultural resource preservation decisions under changing climate conditions prioritize those cultural resources that are the most vulnerable and most significant. Yet, multiple considerations can influence prioritization processes, including the certainty or uncertainty of the timing and extent of climate change impacts.

Additional challenges include the need to differentiate among significant resources listed on the National Register of Historic Places (NRHP) and understanding how different adaptation strategies not only reduce a resource's vulnerability but also minimize loss to its cultural integrity<sup>3</sup>. Fatorić and

Seekamp (2017c) made a first attempt by developing a transparent and robust measurement framework for assessing historical significance (including use potential) of designated buildings. This framework, when integrated with climate change vulnerability assessment data, can assist managers in making climate adaptation prioritization decisions. However, decision-makers should also consider stakeholders' perceptions of the most important considerations for prioritization, as differing perceptions might influence the viability or feasibility of any proposed adaptation actions. **The second objective of this study was to assess cultural resource and historic preservation experts' perceptions of the most important considerations in prioritizing climate change adaptation actions.**

In this study, we also respond to a call from the academic literature on climate change (e.g., Sheppard et al., 2011) to explore a climate adaptation decision support tool that enables multiple considerations. For example, scholars within the environmental history discipline point out that climate adaptation planning by federal agencies motivates thinking about "the long history of human management of the environment" (Carey et al., 2014, p.351). In particular, cultural resource adaptation to climate change should consider the significance of the cultural resources' history, as well as environmental vulnerability or resilience, when selecting the best adaptation strategy.

Further, the role of geovisualization is important to conceptualize climate impacts at a local scale (e.g., to view land cover change, such as SLR, over time on an interactive map). Imagery has been shown to influence climate change risk perceptions (Leiserowitz, 2006) and geovisualizations are capable of transforming complex, scientific data

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<sup>3</sup> According to the NPS, a cultural resource has integrity if it retains material attributes associated with its social values. The NRHP traditionally recognizes a property's integrity through seven aspects or qualities: location, design, setting, materials, workmanship, feeling, and association. These

definitions are found in the National Park Service (2002) document, NPS 28: Cultural Resource Management Guidelines, last accessed December 11, 2017 at [https://www.nps.gov/parkhistory/online\\_books/nps28/28contents.htm](https://www.nps.gov/parkhistory/online_books/nps28/28contents.htm).

into clear, understandable, and meaningful information (Sheppard et al., 2011). Therefore, **the third objective of this study was to explore how historical information and geovisualization of land cover change are related to cultural resource management and heritage preservation experts' perceptions of cultural resource significance and vulnerability, their recommendations of specific adaptation strategies for historic buildings, and their perceptions of how such adaptation strategies may alter the cultural landscape**<sup>4</sup>.

## Report Overview

This report documents the findings from a study conducted online survey research with cultural resource management and heritage preservation experts. A list of experts was provided by our NPS project collaborators and included individuals with known experience with climate adaptation planning and/or implementation for cultural resources (particularly within the southeast region of the United States) within the NPS, tribal organizations, state historic preservation offices, historic preservation organizations, private contractors, and academia. It is important to note that this type of strategic sampling limits the generalizability of our findings to the field of cultural resource management and historic preservation; rather, our study enables identification of: (a) salient barriers to climate adaptation within the field (and particularly within the southeast region), (b) recommended strategies to overcome those barriers, (c) perceptions about the relative importance of different prioritization considerations for climate adaptation, and (d) the utility of geovisualization for off-site decision support for park planning. The results from the geovisualization component of the study are much more highly contextualized: a

subset of historic buildings within CALO's two historic districts (Portsmouth Village and Cape Lookout Village). Moreover, the results from the geovisualization component of the study should not be generalized due to small sample size but are presented to demonstrate emerging patterns within experts' responses, as well as to discuss the utility of such decision support tools. The report begins with a brief description of CALO (to help the reader better understand the geovisualization component of the study). Then, details of the study design are provided before the findings are presented. The report concludes with recommendations for both the science and practice of future cultural resource management impacted by changing climatic conditions. We consider this study to be extremely timely given the increasing vulnerability of cultural resources to climate change along the U.S. coastline (Peek et al., 2015) and the difficulties facing federal and state agencies in funding the maintenance and preservation of cultural resources.

## Overview of CALO<sup>5</sup>

CALO is the southernmost area of North Carolina's Outer Banks region that is under federal management by the National Park Service (NPS) (Garriety-Blake & Sabella, 2009). Established in 1966, CALO was created "to preserve for public use and enjoyment an area in the state of North Carolina possessing outstanding natural and recreational values" (NPS, 2007, p. 21). CALO is 56 miles long, stretching from Ocracoke Inlet to Beaufort Inlet, covers an area of 532 square miles, and is located within Carteret County, NC (NPS, 2008; NPS, 2012). The barrier islands that comprise CALO border the Atlantic Ocean to the east and south, and Back Sound, Core Sound and Pamlico Sound to the north and west (Figure 1).

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<sup>4</sup> The NPS defines cultural landscape as a geographic area, including both cultural and natural resources and the wildlife or domestic animals therein, associated with a historic event, activity, or person or exhibiting other cultural or aesthetic values. The definition can be found in The Secretary of Interior's Standards for the Treatment of Historic Properties:

Guidelines for the Treatment of Historic Properties (1995), last accessed on December 11, 2017 at:

<https://www.nps.gov/tps/standards/four-treatments/landscape-guidelines/terminology.htm>

<sup>5</sup> The "Overview" narrative and map are presented in all reports affiliated with this series.



CALO is only accessible by ferry or private boat, and one of the park's most valued attributes is its "primarily undeveloped qualities in contrast to neighboring barrier islands" (NPS, 2012). Despite this undeveloped quality, the islands that comprise the park unit were once home to three distinct settlements (Portsmouth Village, Cape Lookout Village, and Diamond City). However, only two of the settlements (Portsmouth Village and Cape Lookout Village) had residents at the time of acquisition, as the last residents had left Diamond City by 1902 (precipitated by a destructive hurricane in 1899).

CALO is a constantly shifting landscape. Barrier islands are "highly ephemeral in nature," meaning that the banks naturally move with tides and storms (NPS, 2008, p. 47). CALO was used temporarily by pre-Columbian peoples for fishing encampments and was later inhabited continuously by maritime communities that were involved in whaling,

shipping and port activities, commercial fishing, and work for the Lifesaving Stations and Coast Guard (Garrity-Blake & Sabella, 2009). Over time, livelihoods were sustained by fishing, farming, and boat building, gradually transitioning to fishing and hunting camps and other second home vacation properties. Today, CALO is one of only a few uninhabited barrier island systems left in the world but the two historic districts (Portsmouth Village and Cape Lookout Village) listed on the NHRP contain the physical remnants of the cultural heritage of this place.

Portsmouth Village is located at the northernmost point of CALO. The landscape at Portsmouth Village is very open and flat with marshes, ponds, creeks, plains, forested areas, and beach. The buildings in Portsmouth Village are regularly exposed to storm-related flooding (hurricanes and nor'easter storms). The community at Portsmouth Village was historically associated with the shipping and lightering industry<sup>6</sup>, and was at one point the

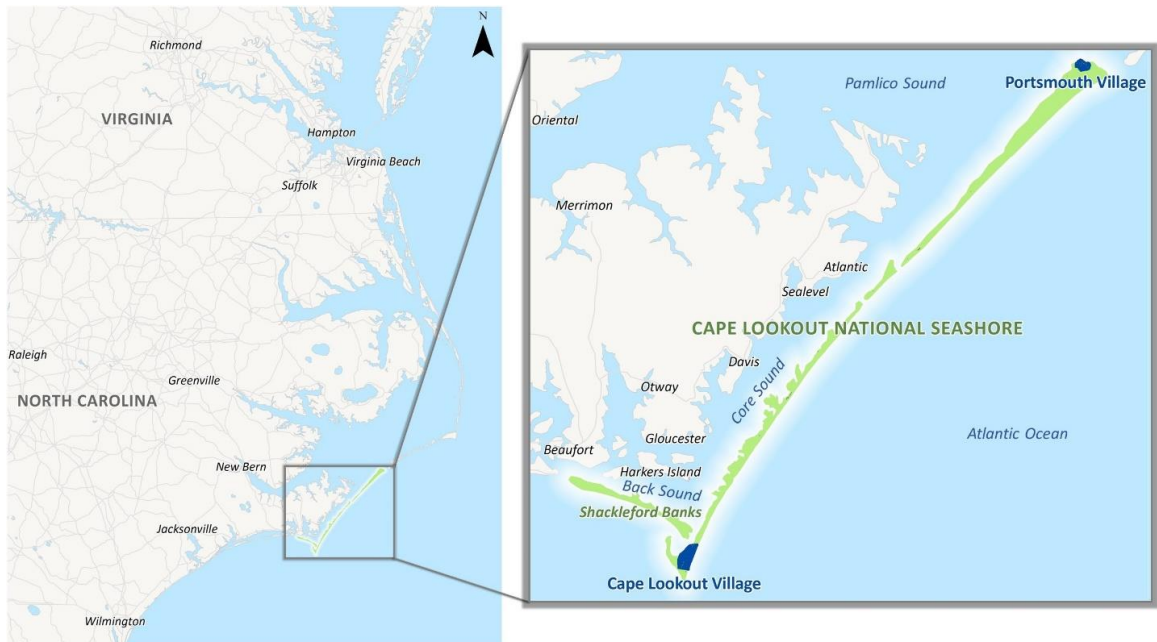


Figure 1. Map shows location of CALO in respect to North Carolina (left) and location of both historic districts (right; shaded in dark blue). Created by K. Bitsura-Meszaros, 2017.

<sup>6</sup> "Lightering" refers to the process of transferring cargo from large ocean-going vessels (which cannot enter port facilities) to a lighter barge (which can enter port).

largest town on the Outer Banks. As the local shipping industry dwindled, the establishment of a Lifesaving Station in 1894 sustained the village in some ways, but the 20<sup>th</sup> century brought mostly challenges to survival and resilience of the community. However, residents of Portsmouth in the early 20<sup>th</sup> century expressed fond memories of the village despite the “harsh environmental conditions of banks life” (Garrity-Blake & Sabella, 2009, p. 32).

Cape Lookout Village is located on the southernmost tip of CALO and once was characterized by rolling sand dunes; however, the landscape is now comprised of pine trees that were planted in the 1960s. Cape Lookout Village is highly susceptible to coastal erosion, particularly the buildings located on the sound side of the island. Cape Lookout Village, unlike Portsmouth Village, was not a fully established residential village. The settlement began with the establishment of the Cape Lookout Light Station and, subsequently in an area two miles south of the Lighthouse, the Live-Saving Station and Coast Guard Station. Residential development that followed served as temporary homes for men working for the Coast Guard and their visiting families (Garrity-Blake & Sabella, 2009) and seasonal fishing camps.

Historic accounts of both villages reveal stories of human resilience and relationships to the land and the sea. These communities were challenged with living in isolation as well as basic human survival in a very strenuous environment. Islanders who were subjected to the harsh conditions of the banks responded by adapting to and working with these conditions.

The NPS acquired the lands and buildings in 1966 and instituted either 25-year leases or life estates, all of which have since expired. The last permanent residents left Portsmouth Village in 1971 and Portsmouth Village (including 24 of the buildings) was listed on the NRHP in 1976. At the southern

end of CALO, The Cape Lookout Light Station Complex was listed on the NRHP in 1972, the Cape Lookout Coast Guard Station Complex in 1988, and these complexes along with 14 of the residential buildings (one of which is a former Life-Saving Station) were designated as a historic district in 2000.

Tourism and recreational values of the CALO are high with its attractive seashore widely used for activities such as camping, fishing and wildlife viewing. In 2016, visitors spent an estimated \$20.9 Million while visiting CALO. These expenditures supported a total of 322 jobs, \$7.45 million in labor income, \$12.25 million in value added, and \$22.9 million in economic output in local gateway economies surrounding CALO (Cullinane Thomas and Koontz, 2017). Additionally, CALO is valued as “a living laboratory” due to its educational resources where visitors can learn about the natural processes and history of coastal North Carolina (NPS, 2012).

The NPS is responsible for stewardship of the Park units and is tasked with protecting their resources and preserving the cultural values embedded within the resources. The historic districts and associated cultural landscapes CALO have been at the interface between a terrestrial and marine environment over the last two centuries, thus already exposed to a range of natural coastal hazards (Riggs and Ames, 2007). Over the last few decades, this vulnerability has been amplified by anthropogenic climate change. A recent assessment of CALO assets (i.e., historic buildings, historic structures and park infrastructure) by Western Carolina University examined exposure to 1 meter of sea level rise and found that all 289 assets are considered to be of “high” exposure to flooding and coastal erosion due to the overall low elevation of CALO and the extreme exposure of its park assets to storms and 1-meter of SLR. The assessment also suggested that these highly exposed park assets had a cumulative value of nearly \$880 million (Peek et al., 2015).

Given these climate change impacts, it is likely that more structural damage to diverse cultural resources at CALO will occur, perhaps even complete loss of some irreplaceable resources (Rockman et al., 2016). As suggested by the NPS (2012), the surviving coastal features and cultural landscapes provide observable lessons regarding the impact of changing climate which can inform future decisions regarding what is important to protect and the impacts of potential development on CALO's natural and cultural resources. Yet, having fixed buildings and resources existing on constantly fluctuating islands and estuaries calls for a flexible management approach. The NPS has recognized the need to better understand diverse stakeholder perspectives of resilience and adaptation as they begin to develop strategies to adapt the cultural resources to climate-related threats within the two historic districts. This report series documents stakeholders' (i.e., community members, partner organization members, visitors, and cultural resource management and historic preservation experts) perspectives on climate adaptation planning for cultural resources, and this report specifically focuses on the perspectives of cultural resource management and historic preservation experts.

## Research Methods

### Questionnaire Design and Recruitment

We designed and administrated an online questionnaire to cultural resource management and historic preservation experts using Qualtrics Survey Software following a modified approach of Dillman et al.'s (2009) Tailored Design Method. Experts were identified through a strategic sampling approach (also known as purposive sampling; Tongco, 2007) to recruit experts actively working in the field of cultural resource management and historic preservation across the southeast region of the U.S. A list of 85 experts was developed by the NPS Southeast Regional Office and Washington,

DC Office. This list included experts from federal (i.e., NPS) and state governments (i.e., State Historic Preservation Offices), as well as non-profit organizations (e.g., National Trust for Historic Preservation, tribal organizations), academia, and private architectural and engineering firms.

In mid-February (non-NPS sample) and mid-March 2017 (NPS sample), the experts were contacted by email informing they would be phoned during the same week to receive an invitation about the online questionnaire as well as be provided with instructions for completing the questionnaire (given the complexity of the geovisualization component of the survey). One week later, the expert received an email with online link and questionnaire instructions. Two email reminders were sent approximately after one and two weeks after the initial link was provided. Once the experts completed the questionnaire, they received no further reminders. In the beginning of April, a follow-up email was sent to those experts who only partially completed the questionnaire, and to non-respondents to once more encourage participation.

The online questionnaire comprised four sections:

1. 6 close-ended questions about professional background and work experience of the expert;
2. 4 open-ended questions about the cultural resource policy and practice challenges presented by SLR and stronger or more frequent storms in coastal environments, as well as the needs and strategies to overcome those challenges;
3. 20 Likert-scale questions about the importance of different considerations for prioritization of historically designated buildings for adaptation planning (Likert-scale questions used 5-point scale from 1=Not at all important, 2=Slightly important, 3=Somewhat important, 4=Very important, to 5=Extremely important); and
4. a section that asked experts to assess five

historic buildings and evaluate these buildings based on (a) historical significance and (b) an interactive visualization tool that illustrated moderate (A1B) and high (A1F1) SLR projections for 2025, 2050, 2075, and 2100 SLR vulnerability.

Individuals within our sample were randomly assigned to one of six survey questionnaire versions<sup>7</sup>. Each version contained five buildings (to reduce respondent burden). A total of 18 buildings were included in the study (14 in Portsmouth Village; 4 in Cape Lookout Village) that reflect a mix of federal maritime buildings and private residences; some buildings appeared in more than one version of the survey questionnaire. Survey respondents were presented with one building at a time. Respondents were provided with background information about a building (around 500 words), which included a summary of past protection/restoration efforts, historic use, descriptive text (illustrating building's features such as color, size, porches, etc.), and discussion of its present use (see Appendix A). Respondents were also prompted to open the interactive visualization

tool in a separate web browser so they could view the SLR projections for a particular building as they were responding to questionnaire items (example provided in Figure 2). Respondents were first asked, *how important is this building to (a) national heritage and (b) local communities*.

Their responses were collected via a five point Likert-type scale with options of: (1) *not at all important*, (2) *slightly important*, (3) *moderately important*, (4) *very important*, and (5) *extremely important*.

Next, respondents rated the vulnerability of each building to SLR, their perception of certainty of impact, and their assignment of a priority level for taking action. Vulnerability, certainty, and priority ratings reflect the respondents' own judgements and expertise, as well as their consideration of the information provided (building description and land cover change map). Building's vulnerability responses were collected via a five-point Likert-type scales with options of: (1) *very low vulnerability*, (2) *low vulnerability*, (3) *moderate vulnerability*, (4) *high vulnerability*, and (5) *very high*



Figure 2. Screenshot of Geovisualization Decision Support Tool.

<sup>7</sup> The versions were designed to explore if differences in perceptions could be found depending on the types of buildings within a version (e.g., only private residences, only

federal maritime buildings, and various mixes of building types); however, the valid sample of completed survey responses was too small to explore if such biases existed.

*vulnerability*. Certainty responses were measured on a four-point scale: (1) *not at all certain*, (2) *not very certain*, (3) *fairly certain*, (4) *very certain*. Prioritization was measured on a five-point Likert-type scale: (1) *very low priority*, (2) *low priority*, (3) *moderate priority*, (4) *high priority*, and (5) *very high priority*.

After reviewing the background information and interactive land use map and then reporting on building's importance, vulnerability, and prioritization, respondents were asked to select an adaptation strategy that would best meet the needs of the building. Respondents were provided with the following seven adaptation strategies<sup>8</sup> (asked to select one strategy for each building evaluated):

- Leave as they are (if vulnerability is low or if preservation treatments are too technically challenging or expensive, take no action and allow building to deteriorate as change occurs).
- Take offsite action (construct barriers like seawalls to deflect storm surge).
- Improve resilience (alter or modify buildings to withstand storm surge or flooding, including elevating buildings).
- Manage change (plant vegetation to reduce erosion or build boardwalks to access buildings).
- Relocate (actively relocate building to a less vulnerable location).
- Document and release (study and record the details of the buildings, and then allow them to deteriorate with storms and flooding).
- Interpret the change (talk with visitors or provide signs with information about how storms, flooding, erosion and SLR submerged or partially submerged a building that was once on dry land).

Lastly, respondents were asked how the selected adaptation strategy would influence the cultural landscape of the historic district. Respondents were asked to respond to this question on a five-point Likert-types scale, with response options of (-2) *substantially detract*, (-1) *slightly detract*, (0) *no change*, (1) *slightly enhance*, and (2) *substantially enhance*.

The experts had the opportunity to ask for clarifications (by phone or email) concerning the questions. The questionnaires were in-depth, lengthy, and the average response time by experts that completed the questionnaire in its entirety was 1 hour and 8 minutes.

## Response Rate and Data Analysis

Of the 85 experts sent the initial email request, 6 experts sent reply notifications that they did not feel qualified (lack of expertise or in-depth knowledge). After removing those who did not feel qualified, our new total sample size was 79. Of these 79 experts, 39 experts completed the questionnaire. Four respondents sent notifications that they did not have the time to complete the questionnaire, and one expert declined to complete it due to his disbelief in anthropogenic climate change. The response rate was 49%.

We analyzed the questionnaires in four steps. First, we analyzed the respondents background information using descriptive statistics and present a respondent profile in our results. We also utilized these data to explore trends in the findings from the geovisualization component of the survey questionnaire.

Second, to analyze the qualitative data from open-ended questions, we utilized content analysis (Webber, 1990). Data were downloaded as text into a Microsoft Excel spreadsheet and coded by one researcher; then the pattern of coding was

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<sup>8</sup> The adaptation strategies were informed by Melnick, R.Z., Burry-Trice, O., Maliny, V., 2015. A decision framework for managing cultural landscapes impacted by climate change: a

preliminary report. *George Wright Forum* 32 (1), 77–88.

corroborated and additional coding considerations suggested by a second researcher. This process led to further refinement of subthemes and relationships between subthemes. The coding process included first categorizing the main four themes of codes such as “policy challenge,” “practice challenge,” “strategies,” and “needs” according to the questionnaire question (i.e., descriptive coding), and then further elaborating into subthemes derived from the data (i.e., open coding). Another researcher cross-checked the main themes of codes to enhance analytical rigor and provided some refinement of codes. Then, we condensed content coded as either “policy challenge” or “practice challenge” into one main theme titled “barriers”. Similarly, we condensed content coded as “strategy” or “needs” into “needs.” Then, we classified both the “barriers” and “needs” themes as relating to one of three categories: “institutional,” “technical,” or “financial”. Additionally, we looked for relationships or interdependencies among the subthemes (i.e., axial coding). Once all open-ended responses were coded, we calculated frequencies of each subthemes to illustrate the range of experts’ perceptions. In our presentation of results, we report the number of references made by the participating experts for each subtheme with number of mentions (not number of respondents who mentioned) to illustrate how frequently the barrier or need was encountered, experienced or identified. These metrics should only be interpreted as measures of salience, not measures of importance. It is important to note that experts did not intuitively differentiate barriers or needs as institutional, technical, or financial; rather, the authors identified these categories within experts’ responses and were guided by the existing literature on climate change adaptation (e.g., Biesbroek et al., 2013; Moser and Ekstrom, 2010).

Third, the quantitative data from Likert-scale questions were entered the Microsoft Excel spreadsheet and descriptive statistical analysis (mean, standard deviation, minimum and

maximum) were carried out for each of the 20 questionnaire items.

Fourth, for the final section of the survey (i.e., the geovisualization component, which asked about national and local significance, SLR vulnerability and certainty, prioritization, selection of an adaptation strategy and impact of that strategy on the cultural landscape), data were imported into and analyzed using the Statistical Package for the Social Sciences (SPSS v. 24). A total of 29 usable responses were analyzed for this section as some respondents did not complete this portion of the questionnaire (this could be due to technological literacy or functionality of respondents’ computers to open the interactive mapping tool and view SLR projections). Descriptive statistics, including means, standard deviations, and percentages of responses were calculated to describe respondents’ assessments of the CALO buildings. Additionally, a series of Pearson chi-square tests were used to explore differences between groups (within the predictor variables) that differ statistically significantly from one another in regards to the dependent variable (selection of adaptation strategy). Specifically, we explored the relationships between selection of adaptation strategies and:

- Building group (residence, maritime, or community building);
- Respondents’ organizational affiliation (government, private, or nonprofit);
- Respondents’ total number of years working in cultural resource management;
- National importance ranking;
- Local importance ranking;
- SLR vulnerability ranking;
- Impact certainty ranking; and,
- Prioritization ranking.

## Results

In this section, we first provide a profile of the experts who responded the questionnaire. Then, we present the main findings which are organized



by perceived perspectives on: (a) barriers of current historic preservation and cultural resource management given climate change impacts; (b) interactions or interdependencies between identified barriers; c) needs to overcome barriers to cultural resource management and historic preservation threatened by climate change impacts<sup>9</sup>; (d) factors in prioritizing climate adaptation planning; and (e) respondents' perceptions of CALO building significance, vulnerability, priority, and appropriate adaptation (geovisualization component).

## **Respondent Profile**

Nearly one-half of the experts who responded to the survey questionnaire worked for the federal government (44%), followed by state government employees (20%), private contractors or consultants (15%), academics (10%), historic preservation organization employees (8%) and local government employees (3%). The average number of years of experience in their current profession was 9 years (range between 1 and 20 and more years), and the average number of years employed in the current work organization was 13 years (range 3–20 and more years).

About one-third of respondents (38%) had only one cultural resource management or historic preservation employment experience, while nearly another third (28%) had their current and one previous employment experience. About one in five respondents (21%) had during their period of employment a total of three positions within the cultural resource management or historic preservation fields, and a few experts had held four positions (8%) or five (5%) within the field.

Nearly two-thirds of respondents conducted the majority of their work within South Atlantic region (25%), Gulf Coast region (21%), the Mid-Atlantic region (10%), or North Atlantic region (8%). Some respondents reported that most of their work experiences was in other regions: Great Lakes and Central US regions (both 6%), Rocky Mountain and California (both 5%), Pacific Northwest and Caribbean regions (both 4%), internationally (3%), Pacific Islands (2%) and Southwest region (1%).

## **Barriers to Cultural Resource Management and Historic Preservation**

Respondents identified a large number of barriers (a total of 226 barriers were listed by study respondents). We synthesized the diversity of barriers into 16 distinct barrier subthemes and classified the 16 subthemes into 3 main categories of barriers, which organize our presentation of the subthemes: (a) institutional barriers, (b) technical barriers, and (c) financial barriers (Figure 3).

We found that the barriers, as well as the barriers and needs, appear to be interdependent in many cases; these interdependencies are noted using parenthetical references throughout our presentation of the barrier findings.

### ***Institutional Barriers***

#### **Lack of effective planning processes and implementation strategies**

Questionnaire responses revealed that the most salient barrier is a lack of effective planning processes and implementation strategies for climate adaptation of cultural resources (51 mentions). One respondent specifically noted lack of leadership at higher levels of government as a

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<sup>9</sup> The findings reported for the barriers, interdependencies, and needs (a-c) are also published in Fatoric, S., & Seekamp, E. (2017). Securing the future of cultural heritage by identifying barriers to and strategizing solutions for preservation under changing climate conditions. *Sustainability* 9(11), 2143,

DOI: 10.3390/su9112143. Given the nature of reporting frequencies, some of the same narrative occurs between this report and that publication.

barrier to adaptation planning and implementation. Climate adaptation planning and implementation appear to be a great challenge, which requires considerable research (technical need) on reducing the vulnerability of cultural resources through protection and manipulation of the broader landscape, together with exploring feasible climate adaptation options (technical need) that would not affect the significance or integrity of cultural resources (technical need).

Respondents specifically expressed concern regarding the relocation and elevation of historic buildings as adaptation strategies that have been traditionally implemented, opining that these two actions can adversely affect a resource's significance. Hence, they call for more research in this aspect (technical need) and to explore new ways of flexible management and preservation (institutional need).

### Lack of institutional guidelines and adequate procedures

A second salient barrier was the lack of institutional

guidelines and adequate procedures on how to carry out climate adaptation of already vulnerable cultural resources to climate change (26 mentions). Respondents expressed that there is an inescapable need for developing guidelines and strategies (institutional need) that help managers and decision-makers efficiently preserve cultural resources threatened by present and future climate change. Respondents often stated that current guidelines for cultural resource management and historic preservation do not transparently guide what to do given climate change impacts and that current guidelines are not integrated with other federal or state agencies' guidelines, standards, or legislation documents. Some respondents commented that barriers can result in lengthy decision procedures triggering inefficient decision-making for preservation and adaptation. Overcoming these barriers was noted as a critical (institutional) need for initiating climate adaptation planning, which was observed as a main barrier to current cultural resource management and historic preservation efforts.

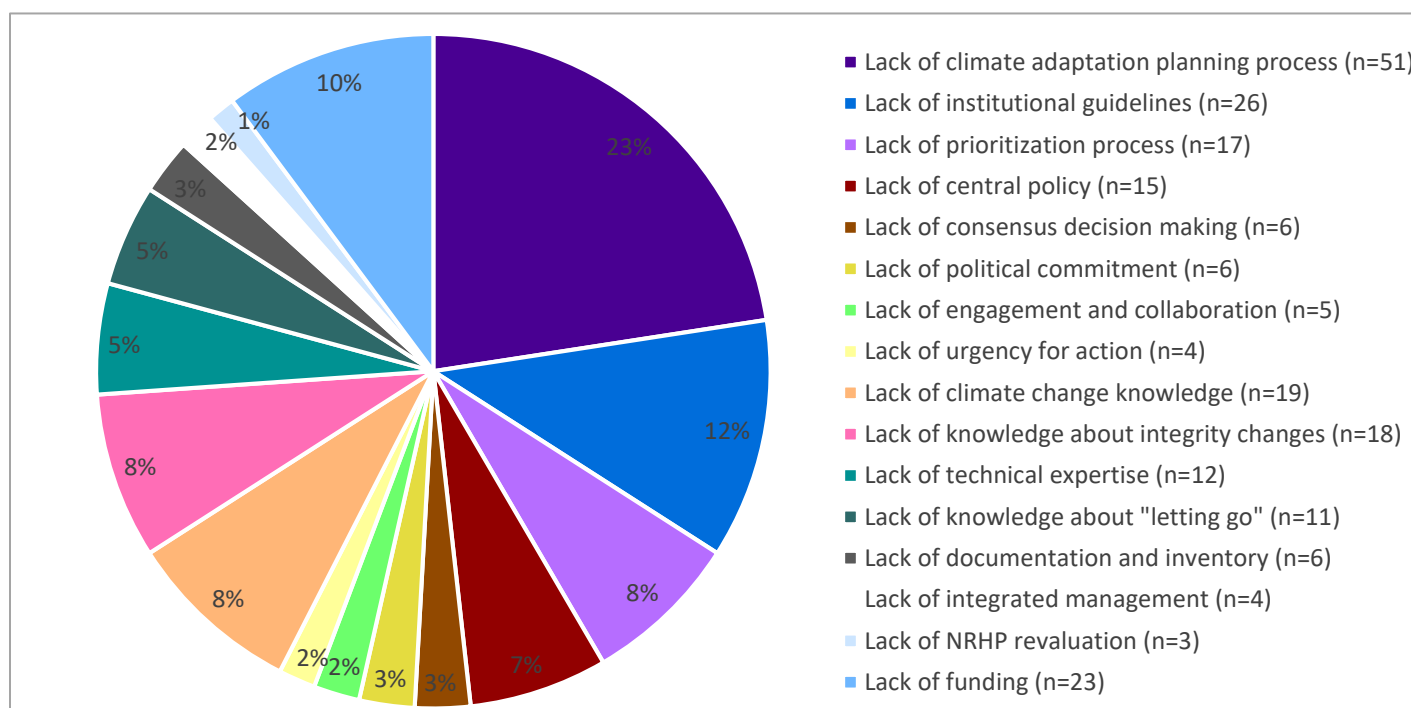


Figure 3. Percentage and number of mentions for institutional barriers (in blue colors), technical barriers (in green colors) and financial barrier (in orange color) to current cultural resource management and historic preservation given climate change impacts.

### **A lack of prioritization process for climate adaptation of cultural resources**

A lack of prioritization process for climate adaptation of cultural resources (17 mentions) was frequently mentioned by respondents. This barrier reflects the lack of methods or approaches to assess and prioritize funding allocations for implementing adaptation actions on specific cultural resources (technical need). In particular, a process for distinguishing the relative significance among cultural resources was noted as lacking, which is problematic given that some cultural landscapes have numerous cultural resources that have been listed on the NRHP. As such, respondents expressed that a transparent method for differentiating between significant cultural resources is needed (technical need), which is necessary prior to developing a prioritization process for adaptation planning and decision-making (institutional need).

### **Lack of central policy for guiding cultural resource management and historic preservation under climate change**

A lack of central policy for guiding cultural resource management and historic preservation under climate change (15 mentions) was identified as an institutional barrier to current efforts, which can also hinder proactive adaptation planning and implementation processes (institutional need). As previously mentioned, the NPS issued Policy Memorandum 14-02, which directs managers to prioritize the most significant and most vulnerable cultural resources. However, respondents indicated that little is known regarding how this policy memorandum has influenced the management decisions to date (technical need).

### **Lack of political commitment**

A lack of political commitment (6 mentions) caused by climate change skepticism and a lack of scientific/climate literacy—including the lack of political pressure on national and state government agencies to implement proactive adaptation actions—were mentioned as institutional barriers

for developing climate change policy, climate adaptation planning, and the implementation of adaptation strategies. Interestingly, only one respondent perceived that cultural resource management and historic preservation are not and may not be affected by the changing climate, believing the management can go through these changes simply using “business-as-usual” approach towards climate change risks.

### **Lack of consensus decision-making**

Impediments that arise from existing policy and associated regulations and laws were noted to be resulting from the lack of coordination or collaboration between government agencies and stakeholders (institutional need) who act upon the same territory where cultural resources are located (e.g., wildlife management, urban planning, emergency management). A few respondents specifically mentioned that a lack of consensus decision-making (6 mentions) among government agencies, stakeholders and communities, together with limited shared discourse between government and scientists, act as an institutional barrier to cultural resource management and historic preservation and climate adaptation.

### **Lack of engagement and collaboration**

Respondents noted that a lack of engagement and collaboration (5 mentions) between government agencies and various stakeholders (including the lack of sharing information about good practices and the lack of trusted relationships between communities and government agencies) impede effective practices for cultural resource management and historic preservation given climate change risks. These respondents perceived that this group of barriers often do not promote the necessary cross-disciplinary collaborations and co-production of knowledge for effective cultural resource management and historic preservation and adaptation (institutional and technical needs). It was stressed that these barriers can create adverse outcomes for cultural resource

management, including power imbalances and distribution of financial resources.

### **Lack of urgency for action**

A few respondents mentioned the lack of urgency for action (4 mentions), which reflects a lack of knowledge about climate change impacts on cultural resources and feasible adaptation strategies (technical barriers) and the limited procedures for documenting and inventorying cultural resources (technical need). It was noted that these barriers should not be considered as an excuse for current and future inaction.

### ***Technical Barriers***

#### **Lack of climate change knowledge**

The lack of climate change knowledge (19 mentions), including a lack of information on climate change scenarios for various spatial scales (technical need) and a lack of comprehensive climate change risk and vulnerability assessments for diverse cultural resource types (technical need), creates technical barriers to current management and preservation efforts. Interestingly, the respondents did not identify the barrier of climate change uncertainty per se, but instead draw on specific contexts where the knowledge needs pose barriers to current cultural resource management and historic preservation. Coupled with these knowledge barriers, respondents often expressed the lack of research on methods and approaches for assessing the significance of cultural resources (technical need) and a lack of transparent methods for assessing diverse values that cultural resources embodies (technical need), both of which are necessary for listing on the NRHP.

#### **Lack of knowledge about historic integrity changes**

Respondents documented a concern about the limited understanding of how adaptation can change the integrity of cultural resources (18 mentions). Currently, historic integrity is

determined based on an assessment of seven factors, which are the cultural resource's location, design, setting, materials, workmanship, feeling and association; yet, there is no systematic assessment that quantifies these aspects of integrity and experts noted that the current methodology for assessing a cultural resource's integrity needs to be revised and improved (technical need). Regardless of this short-coming, respondents explained that it is necessary to understand how any of the seven aspects of integrity may change from climate-related impacts or the application of adaptation actions. In fact, the concern was raised that once integrity is lost, it might be lost forever.

#### **Lack of technical expertise**

Respondents perceived that there was a lack of technical expertise (12 mentions) for efficiently and effectively cope with climate change impacts within the current cultural resource management and historic preservation field, including an unfamiliarity with existing adaptation practices and their technical feasibility. Technical know-how to adapt to climate change is primarily influenced by the lack of climate change knowledge, limited research on climate change impacts to cultural resources, and the lack of appropriate training in cultural resource adaptation (technical needs). Furthermore, while some information may exist, the lack of capacity to understand climate change data, together with a lack of training in climate adaptation planning tools and techniques, can impede informed decision-making for cultural resource management and historic preservation (technical needs).

#### **Lack of knowledge about "letting go"**

The lack of knowledge about "letting go" or the deliberate decision to allow for the loss of cultural resources (11 mentions) is another technical barrier to current cultural resource management and historic preservation in the face of climate change. This barrier considers the fact that due to climate change uncertainty and economic and political

constraints, not all cultural resources within a cultural landscape may be preserved or adapted for the enjoyment and benefits of future generations. For instance, a few respondents described that nature will take its course no matter what managers do, that decision-makers need to start acknowledging that some elements of cultural resources will not be fully maintained and can be lost, or that climate change already challenges long-term feasibility of cultural resource management and historic preservation.

### **Lack of documentation and inventory**

The lack of documentation and inventory of listed cultural resources (6 mentions) was perceived as barrier that impedes successful management and preservation. Respondents noted that this issue not only applies to a climate change context but also to other threats such as vandalism, trafficking, ageing and urban or rural development. Respondents pointed out that there are currently limited techniques for cultural resource surveying and lack of comprehensive documentation or digitalization of various cultural resources, especially for archaeological sites. Improved documentation and inventory methodologies (technical need) can enhance cultural resource management and historic preservation generally and with regard to adapting cultural resources to climate change impacts.

### **Lack of integrated cultural resource and natural resource management**

The lack of integrated cultural resource and natural resource management (4 mentions) was considered by a few respondents as a technical barrier to current cultural resource management and historic preservation efforts, particularly given climate change risks. Even though natural resources and cultural resources on the same landscape or within the same park unit are highly interdependent (and cultural landscapes encompass the natural resources and wildlife or domestic animals therein), they are usually

managed as distinct resources. Therefore, these respondents described that planning and decision-making is constrained by single-discipline research, which can hinder sustainable preservation and adaptation strategies, and technical skills are needed for integrated management approach (technical needs).

### **Lack of NRHP reevaluation**

The lack of NRHP reevaluation (3 mentions) highlights the importance of developing improved criteria for nominating potentially eligible cultural resources to the NRHP, specifically focusing on cultural resources that are at risk from being lost due to changing climate conditions. Additionally, this technical barrier shows interdependencies with financial (lack of funding) and technological (lack of knowledge about assessing historical integrity) barriers. Together, these barriers indicate the pressing need for a better understanding of the specific relationship between climate change impacts, criteria for listing on the NRHP, and strategies for adapting to climate change hazards (technical needs).

### ***Financial Barriers***

#### **Lack of funding**

Respondents perceived a lack of funding (23 mentions) to be considerable factor constraining current cultural resource management and historic preservation practice and policy, particularly related to planning and implementing climate adaptation strategies. Responses related to this financial barrier also indicated concern for potential funding cuts by the new U.S. administration within the National Flood Insurance Program, including its funding for updating flood maps across U.S. and eliminating the Federal Historic Preservation Tax Incentives program that encourages private sector investment in the rehabilitation and reuse of historic buildings. In considering the interdependencies between barriers, we found that this barrier drives most of the institutional and technical barriers in this study.

## Interdependencies of Identified Barriers

To better visualize the interrelationships between the barriers to current cultural resource management and historic preservation given climate change threats, we developed a concept map that illustrates how the barriers are dynamically interdependent and are not mutually exclusive (Figure 4).

The most frequently mentioned barriers by respondents (e.g., lack of climate adaptation planning and implementation, ineffective guidelines, lack of funding, and inadequate knowledge about cultural resources and climate change) are shown to be clearly interdependent. For instance, the lack of effective adaptation planning is closely intertwined with the lack of knowledge about climate change processes and the lack of technical expertise, as well as the lack of funding and the lack of guidelines for climate adaptation planning. Similarly, the lack of climate adaptation prioritization process highlights the lack of central policy development, the lack of consensus-based decision-making, the lack of guidelines, and the lack of funding, as well as the lack of knowledge about historic integrity changes and the lack of knowledge about climate change. The lack of engagement and collaboration appears to be intertwined with the lack of coordinated and integrated climate change planning initiatives by

management and historic preservation given climate change threats, we developed a concept map that illustrates how the barriers are dynamically interdependent and are not mutually exclusive (Figure 4).

other government agencies, and a lack of technical expertise. Another example is knowledge limitations (i.e., knowledge about climate change processes, integrity changes, and “letting-go”), which can be limiting factor for some other technical barriers, such as the lack of technical expertise or the lack of NRHP revaluation. Importantly, almost all technical barriers are interdependent with a lack of funding, such as insufficient financial support of federal and state funding for cultural resource management and historic preservation under changing climatic conditions. Funding barriers also drive most of the institutional barriers identified in this study.

## Needs for Overcoming Identified Barriers

Diverse needs were identified as critical to overcome barriers to current cultural resource management and historic preservation given climate change. The 214 needs identified by the

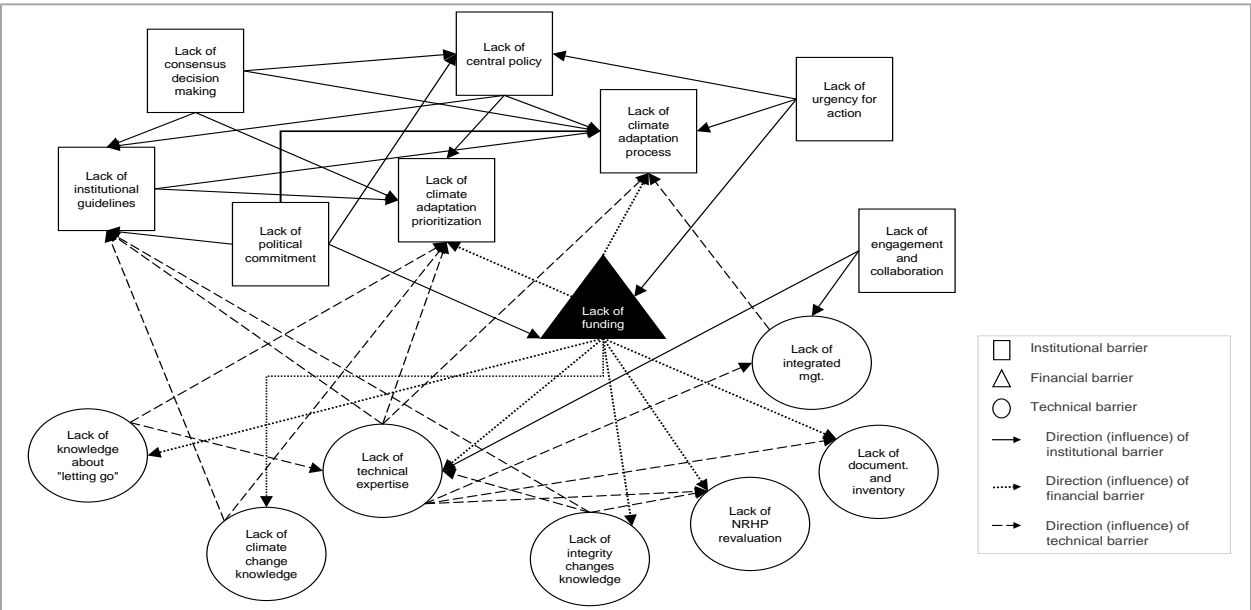


Figure 4. Conceptualization of barrier interdependencies for current cultural resource management and historic preservation under changing climate conditions.



experts who responded to the study were synthesized into 8 main subthemes (Figure 5). To demonstrate the links between barriers and needs, we display examples of verbatim responses provided by the participating experts in Table 1.

**Institutional Needs**

**Enhancing collaborative partnerships**

Enhancing collaborative partnerships among diverse multi-level actors from government agencies to private sector and engaging with local communities, as well as sharing their lessons learned and best practices, was a dominant need identified by study respondents (40 mentions). Respondents identified these institutional needs as crucial to advancing current cultural resource management and historic preservation practices, particularly for but not only limited to climate adaptation planning and implementation. Additionally, responses indicate that this need for enhancing partnerships is linked to the idea of sustainable development, community integration and participation in the cultural resource management, and multi-level co-production of knowledge. As such, respondents also commented that strengthening partnerships can help to reshape traditional decision-making rules of federal and state governments that enable more flexible and effective management and preservation processes under changing climate conditions.

**Development of explicit central policy and clear guidelines**

The development of explicit central policy and clear guidelines (34 mentions) was frequently cited as an institutional need to reduce climate change vulnerabilities and safeguard cultural resources for present and future generations. Additionally, respondents noted prioritization processes are needed to determine which cultural resources are most in need of adaptation. It is important to note that, although the NPS Policy Memorandum 14-02 indicates that the most vulnerable and the most significant resources should be prioritized, there is currently no process for making distinctions between the relative significance of cultural resources listed on the NRHP. Respondents also explained that the allocation of financial resources for climate adaptation should also look at the strategies that most efficiently reduce climate change risks. Additionally, some respondents noted that policy and guidelines need to focus on maintaining cultural resources by defining a new range of feasible operations and maintenance treatments that consider changing climate conditions.

**Provision of political commitment & support**

Respondents mentioned that decision-making processes in the context of current cultural

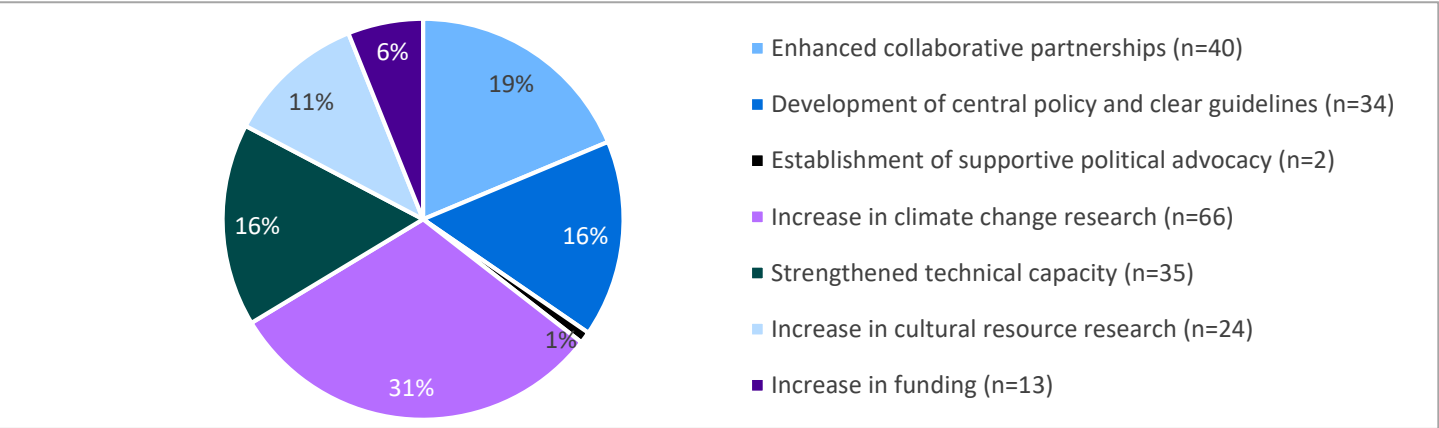


Figure 5. Percentage and number of mentions for institutional needs (in blue colors), technical needs (in green colors) and financial needs (in orange color) to overcome barriers to current cultural resource management and historic preservation given climate change.

resource management and historic preservation under changing climate conditions requires the establishment of more supportive political advocacy (2 mentions). Specifically, these individuals explained that there is a need for increased awareness of the anthropogenic nature of climate change and the removal of inefficient bureaucratic rules and procedures that hinder current management and preservation by slowing climate adaptation planning and decision-making.

### ***Technical Needs***

#### **Increase in climate change research**

The main technical need that can enable multi-level actors to alleviate or overcome the barriers identified by experts was an increase in climate change research to improve knowledge of climate change impacts and the effectiveness of adaptation strategies (66 mentions). A systematic, complete and up-to-date assessment of regional climate models and associated climate change scenarios, together with data about impacts to cultural resources from SLR, storms and hurricanes and coastal flooding, are fundamental to support management and planning efforts. Similarly, respondents highlighted that cultural resource adaptation planning and decision-making would be enhanced by having information on feasible climate adaptation strategies for cultural resources (i.e., carefully considering compliance with preservation standards established by the National Historic Preservation Act), information on mechanisms of cultural resource deterioration, and information on innovative and creative solutions for shoreline and ecosystem protection and restoration.

#### **Strengthened technical capacity**

Respondents also frequently explained that it is important for government agencies, non-governmental organizations, and practitioners to strengthen their technical capacity for directing and overseeing climate change adaptation and disaster preparedness and recovery efforts (35 mentions). It was stressed that training was needed in a few

specific realms: the use of proper materials and techniques; GIS mapping and modeling of coastal risks and vulnerability assessments; 3D imaging for documentation and inventorying (including deterioration); and emerging techniques for maintaining and repairing cultural resources. Moreover, some respondents opined that of critical need is to provide education and training to property owners, as well as to organize multi-disciplinary workshops and courses among various multi-level experts to transfer technical knowledge and skills, as well as provide training necessary for securing funding for climate adaptation.

#### **Increase in cultural resource research**

Respondents noted the need for cultural resource related research (20 mentions). Specifically, these individuals described the need for research to help them transparently assess the values of cultural resources, update and identify new techniques for cultural resource documentation (and to consider thorough documentation as a climate adaptation strategies), and develop methods and approaches for measuring and analyzing the significance of cultural resources. Relatedly, a few respondents explained that building bridges across the different research disciplines is needed to overcome the often single-disciplinary studies. More specifically, these respondents indicated that there is a need to integrate diverse research approaches and methods to achieve more efficient and effective cultural resource management and historic preservation given the multi-disciplinary challenge of climate change.

### ***Financial Needs***

#### **Increase in funding**

Increased funding (13 mentions) for research and technical skills was noted as necessary to support the assessment of cultural resource vulnerabilities and improved scalable climate change modeling and scenarios, which in turn can inform decision-making for both cultural resource management and climate adaptation. Some of these respondents

also mentioned that increased funding is needed to: support engagement and communication with the public, share best practices with diverse stakeholders, and foster collaboration with local, state and national governments and academia. As such, the experts who participated in this study recognized that adequate funding can prevent or minimize deterioration and reduce a risk of cultural resource loss.

Considerations for Climate Adaptation Prioritization

None of our comparative statistical analyses showed a significant relationship between experts’ responses to the questionnaire items that assessed the importance of 20 prioritization considerations and their type of organization, years of experience, and region(s) where they worked; therefore, the results presented here are for the total sample only. The distribution of responses for

each consideration are illustrated in Figure 6. Descriptive statistics for each prioritization consideration are presented in Table 2.

The most important (i.e., “extremely important”) considerations when prioritizing historically designated buildings for climate adaptation planning were the national importance of the historic building ( $\bar{X}$  = 4.7) and being unique across the cultural landscape ( $\bar{X}$  = 4.6). The following prioritization considerations were “very important”: high scientific value ( $\bar{X}$  = 4.3), a prominent role in the cultural landscape ( $\bar{X}$  = 4.2); potential to experience the most immediate storm-related flooding and coastal erosion ( $\bar{X}$  = 4.2); buildings that may experience the most immediate SLR impacts ( $\bar{X}$  = 4.1); highest interpretive potential ( $\bar{X}$  = 4.1); historic buildings that represent the foundation of a community ( $\bar{X}$  = 4.1),

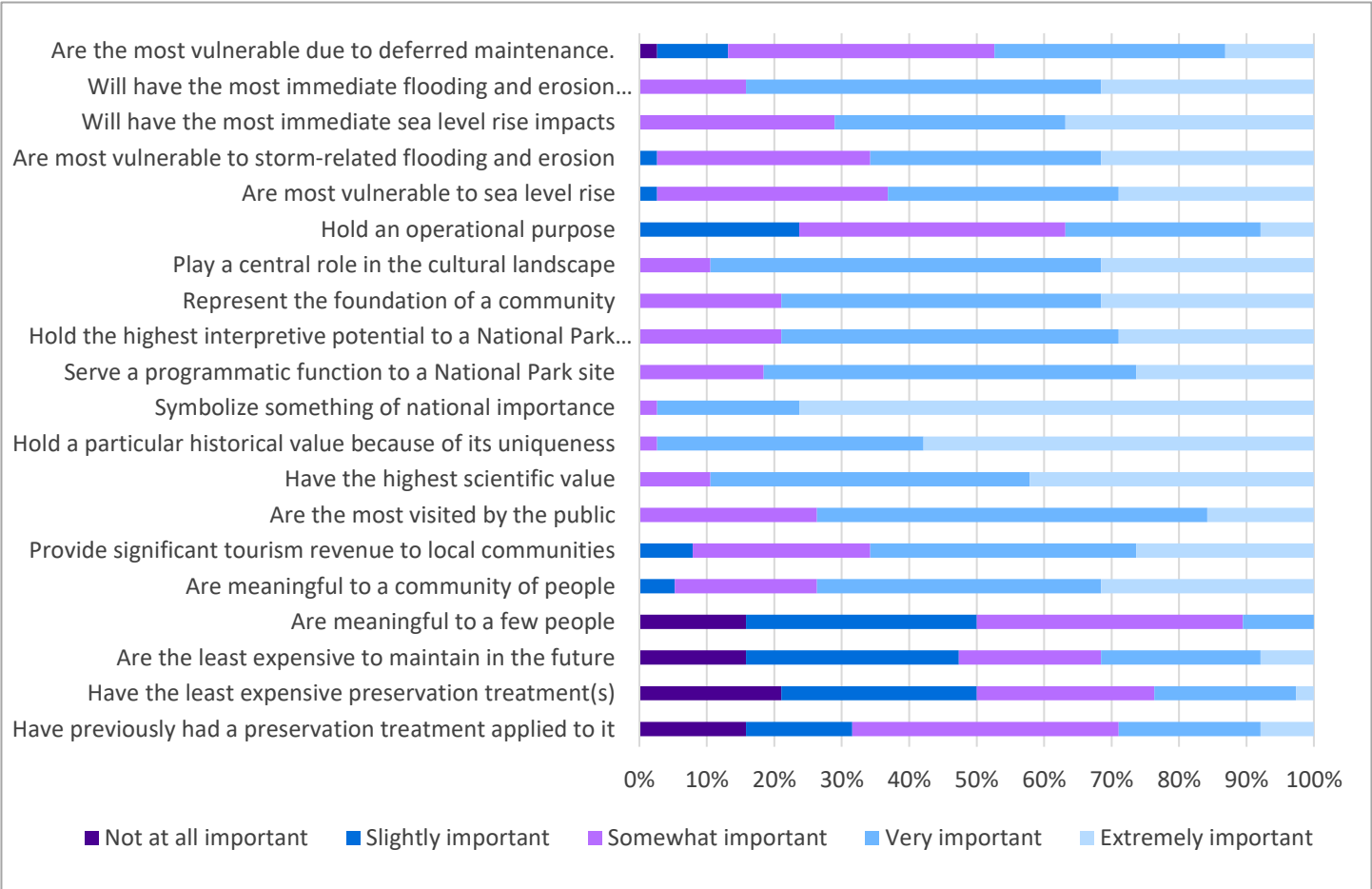


Figure 6. Response distribution for prioritization considerations.

Table 1. Questionnaire data reflecting range of barriers that can limit cultural heritage management and historic preservation given climate change risks, together with suggested needs for overcoming these barriers.

Barrier	Questionnaire quote of barrier	Need for overcoming barrier
Lack of climate adaptation process	<i>"Coastal areas more susceptible to deterioration that contain historic resources need better protections for how to prepare and react when sea levels rise, storms occur, etc."</i>	<i>"Adaptation through public engagement and acknowledgment of need for change."</i>
Lack of guidelines	<i>"Administrators need clarity as to what legal options are available (for current stewards to divest threatened resources they can no longer protect, to form partnerships with others to provide the protection, etc.)."</i>	<i>"Illustrated guidelines from NPS defining acceptable applications of the Standards."</i>
Lack of funding	<i>"No budget to maintain required protections."</i>	<i>"Provide funding to identify needs and preparation for climate change."</i>
Lack of knowledge on climate change and cultural heritage	<i>"Yes, there are challenges in terms of the SLR and frequent storms. How serious are they in a short and long run? We need to have enough evaluation, information and data which show the impact of the climate change on the resources. Lack of seasonal inspection and evaluation of the impact of the climate and the rise of sea level on the resources is a challenge."</i>	<i>"Modeling - sea level and/or climate change modeling should be mandated."</i>
Lack of knowledge on historic integrity changes	<i>"Lack of knowledge, information and education. This includes the resource's values, knowing historic materials and the cultural heritage technique of construction, environment impact on the historic materials overall and in particular."</i>	<i>"The CRM community needs to determine what, if any changes are necessary or applicable to properties threatened by SLR, etc. For example, can certain buildings be relocated when that would not otherwise be an acceptable treatment. Is it ok to raise floor levels in cases where the building sees water infiltration on a daily basis due to rising tides? Those of us who interpret and apply preservation standards are challenged by these questions and to approve work that would not otherwise be appropriate in the absence of specific guidance."</i>
Lack of climate adaptation prioritization	<i>"In light of stagnant public funding and increasing threats to cultural resources, need info as to how to prioritize among the resources..."</i>	<i>"A framework for evaluating vulnerability and significance to prioritize resources."</i>

<b>Barrier</b>	<b>Questionnaire quote of barrier</b>	<b>Need for overcoming barrier</b>
Lack of central policy	<i>"Need broader policy options for dealing with the threats. Think outside the box of current administrative rules and policies."</i>	<i>"Providing policies, guidelines and procedures in this regard."</i>
Lack of technical expertise	<i>"Repeated and frequent events challenge agencies (governmental, non-profit) with limited staffing and financial resources to provide the technical assistance needed by property owners. So too there are limited craftsmen and trades people, and they are not able to do all of the work required and in the timeframe necessary."</i>	<i>"More climate change training on adaptation options and vulnerability assessments."</i>
Lack of knowledge on "letting go"	<i>"These climate changes are challenging us to really consider feasibility of long term preservation and forcing us to consider letting resources go to redirect limited funds or to preserve other resources."</i>	<i>"Increase inventory and monitoring of resources that cannot be saved and plan accordingly."</i>
Lack of consensus decision-making	<i>"Lack of unified response among state and federal agencies."</i>	<i>"Early consultation with Tribal nations and Tribal Historic Preservation Offices."</i>
Lack of documentation and inventory	<i>"Having inadequate inventories of resources so the risk of loss is unknown."</i>	<i>"Undertake comprehensive resource inventories."</i>
Lack of political commitment	<i>"Lack of support from political leadership on climate change and SLR initiatives."</i>	<i>"Education of politicians and policy makers."</i>
Lack of engagement and collaboration	<i>"Deference to local knowledge and decision-making may result in losses that can be addressed by decision-making frameworks at a larger scale."</i>	<i>"Creation of multidisciplinary teams to explore adaptation strategies at case study sites."</i>
Lack of sense of urgency	<i>"Convincing people that time is of the essence."</i>	
Lack of integrated management	<i>"Managing cultural landscapes and biotic cultural resources."</i>	<i>"Approaching adaptation as a cultural and natural integrated effort."</i>
Lack of NRHP revaluation	<i>"50 year [eligible criteria for listing in NRHP] has to be revaluated - lots of potential, future resources are threatened and need to be revaluated."</i>	

Table 2. Experts' perceptions of the importance of considerations for prioritizing historically designated buildings for climate adaptation planning on a 30-year time horizon.

Prioritization Consideration	Mean <sup>1</sup>	SD	Min	Max
Symbolize something of national importance.	4.7	0.50	3	5
Hold a particular historical value because of its uniqueness (e.g., only one like it; singularity).	4.6	0.55	3	5
Have the highest scientific value (helps us better understand aspects of the past).	4.3	0.66	3	5
Play a central role in the cultural landscape (e.g., prominent).	4.2	0.62	3	5
Will have the most immediate storm-related flooding and erosion impacts (urgency of action).	4.2	0.68	3	5
Represent the foundation of a community (e.g., is the reason other buildings were built).	4.1	0.73	3	5
Serve a programmatic function to a National Park site (e.g., a contributing factor to designation or listed as a foundational resource).	4.1	0.67	3	5
Hold the highest interpretive potential to a National Park site (e.g., link to the site's interpretive plan).	4.1	0.71	3	5
Will have the most immediate SLR impacts (urgency of action).	4.1	0.82	3	5
Are meaningful to a community of people.	4	0.87	2	5
Are most vulnerable to storm-related flooding and erosion (severity of risk).	3.9	0.87	2	5
Are most vulnerable to SLR (severity of risk).	3.9	0.86	2	5
Are the most visited by the public.	3.9	0.65	3	5
Provide significant tourism revenue to local communities.	3.8	0.92	2	5
Are the most vulnerable due to deferred maintenance.	3.4	0.95	1	5
Hold an operational purpose (e.g., the building currently serves as a visitor center).	3.2	0.91	2	5
Have previously had a preservation treatment applied to it.	2.9	1.16	1	5
Are the least expensive to maintain in the future.	2.8	1.22	1	5
Have the least expensive preservation treatment(s).	2.6	1.13	1	5
Are meaningful to a few people.	2.4	0.89	1	4

<sup>1</sup> Response scale from 1 (not at all important) to 5 (extremely important).



and/or serve a programmatic function to a National Park site (e.g., a contributing factor to the designation of the site or listed as a foundational resource) ( $\bar{X} = 4.1$ ). Conversely, experts noted that historic buildings that are meaningful to only a few people ( $\bar{X} = 2.4$ ) and is or will be the least expensive to maintain ( $\bar{X} = 2.6$  and  $2.8$ , respectively) were the least important (i.e., of “slight importance”) considerations in prioritizing historically designated buildings for climate adaptation planning

## **Geovisualization Decision Support Tool**

The results from the geovisualization component of the survey questionnaire demonstrate several distinct patterns within experts’ responses. The pattern of results are provided below with interpretation. As previously mentioned, the descriptive statistics reported should not be generalized, as the number of responses per historic building ranged from 4 to 12.

### ***Perceptions of Spatial Significance***

Respondents perceived most CALO building as being slightly to moderately important in terms of national heritage. Mean scores, overall, for importance to local communities tended to be higher with most buildings rated as moderately to very important.

The most highly rated buildings in terms of importance to national heritage included: the Life-Saving Station (Portsmouth Village, PV), the Coast Guard Station and the 1873 Keeper’s Quarters (both in Cape Lookout Village, CLV). The Henry Pigott House (PV) was the only building to receive a mean rating below 2 for national heritage importance.

The most highly rated buildings in terms of importance to local communities included the 1873 Keeper’s Quarters, the Roy Robinson House (PV), and the Post Office and General Store (PV). All buildings received mean ranking above a 2 (*slightly*

*important*) for local community importance; however, the Dennis Mason House (PV) received the lowest mean rating (2.25) in this category.

While these ratings comprise only one consideration for climate adaptation of cultural resources, completing this type of evaluation for all buildings within a historic district could provide managers with a new strategy for prioritizing action. For example, the NPS may choose to prioritize buildings that are not only significant nationally but also locally. Such a strategy may be viewed as a way to not only adapt the most iconic buildings or those that are associated with federal maritime history (Life-Saving Station, Coast Guard Station, Keeper’s Quarters) but also those buildings perceived to hold the most value to proximate communities (the Roy Robinson House, the Post Office and General Store).

### ***Perceptions of Vulnerability, Impact Certainty, and Adaptation Priority***

Respondents generally perceived that the buildings they viewed using the geovisualization tool were moderately to highly vulnerable to SLR (Table 4). The buildings rated as most vulnerable were the 1873 Keeper’s Quarters, the Coca Cola House, and the Coast Guard Station (all in CLV). The buildings receiving the lowest average vulnerable ratings were former residences in Portsmouth Village, specifically the Frank Gaskill House, the Henry Pigott House, and the Tom Gilgo House.

Respondents typically reported at least some uncertainty in about potential future impacts from SLR (Table 4). Respondents were fairly certain about impacts to those buildings that they also perceived to have high SLR vulnerability (Coca Cola House, the Coast Guard Station, Coca Cola House, the Roy Robinson House, and the 1873 Keeper’s Quarters).

We found that mean responses about buildings’ adaptation priority ranged from low to high priority, suggesting that experts were able to differentiate

among buildings listed on the NRHP and located within designated historic villages and that those differences are evaluated in relation to the significance and/or vulnerability of a building. The buildings with the highest perceived priority for adaptation were the Jesse Babb House (PV), the 1873 Keeper's Quarters and the Coast Guard Station (CLV). These findings loosely align with those building around which there was high perceived vulnerability and high certainty of impacts. Likewise, buildings that perceived to have lower SLR vulnerability and higher uncertainty of impacts were those with lower prioritization ratings (e.g., the Henry Pigott House, the Dennis Mason House, and the Frank Gaskill House, PV).

It is important to note that experts who completed this section of the survey did not uniformly perceive any one of the buildings included in the study to be of very high vulnerability and most evaluations of vulnerability were associated with uncertainty of impacts. Potential explanations for this finding could be related to the fact that the geovisualizations were related to projections of land cover type change and not inundation projections, as well as the fact that we learned after the tool was developed and the survey was launched that there were likely some **holes** (i.e., missing data) in the datasets used in the land cover change analysis, particularly near Portsmouth

Table 3. Experts ranking of buildings' national and local importance.

Building	<i>n</i> <sup>1</sup>	National Heritage <sup>2</sup> <i>Mean (SD)</i>	Local Communities <sup>2</sup> <i>Mean (SD)</i>
<b>Cape Lookout village</b>			
Coast Guard Station	7	3.5 (0.84)	3.6 (0.79)
1873 Keeper's Quarters	9	3.4 (1.01)	3.9 (0.64)
Fishing Cottage 1	9	2.6 (1.24)	3.3(0.49)
Coca Cola House	8	2.0 (.076)	3.3 (0.49)
<b>Portsmouth village</b>			
Life-Saving Station	7	3.6 (0.79)	3.4 (0.79)
Life-Saving Station Summer Kitchen	8	3.0 (1.31)	3.0 (0.93)
Washington Roberts House	12	2.9 (1.24)	3.4 (1.01)
Post Office & General Store	12	2.7 (1.56)	3.8 (0.75)
Carl Dixon House	12	2.7 (0.89)	3.5 (0.91)
Jesse Babb House	12	2.7 (0.78)	3.3(0.49)
Tom Gilgo House	6	2.2 (0.75)	3.8 (0.75)
Frank Gaskill House	7	2.1 (0.69)	3.5 (0.91)
Methodist Church	11	2.1 (0.83)	3.3 (0.82)
McWilliams-Dixon House	6	2.0 (0.63)	3.7 (0.52)
Roy Robinson House	6	2.0 (0.89)	2.9 (0.64)
Dennis Mason House	4	2.0 (0.82)	2.3 (0.96)
Henry Pigott House	8	1.9 (0.99)	2.9 (0.84)

<sup>1</sup> "n" refers to how many respondents were randomly assigned to assess a specific building.

<sup>2</sup> Five-point response scale with options of: (1) not at all important, (2) slightly important, (3) moderately important, (4) very important, and (5) extremely important.

Island, that may have resulted in the display of less severe change than what may be experienced at CALO. Alternatively, some experts who elected not to complete this section of the study contacted us to explain that they felt uncomfortable making personal judgments about SLR vulnerability, which suggests that training may be necessary if such a geovisualization tool were to be adopted by the NPS for informing cultural resource climate adaptation planning. Regardless, future research is needed with climate change data that has been downscaled to a more local level to enhance resolution of the changes in land cover.

Additionally, future research that includes displays of SLR inundation projections may result in different (e.g., more heightened) vulnerability perceptions and evaluations of certainty of impact; such a simpler display may also increase cultural resource management and historic preservation experts' **level of comfortability in making adaptation recommendations when site visits are not possible.**

### ***Recommended Adaptation Strategies***

After evaluating significance, vulnerability, impact certainty, and adaptation priority level, respondents were asked to select an adaptation strategy that would best meet the needs of the building. Survey respondents were also allowed to write in an 'other' option for adaptation strategies. The write-in option generated three responses, including:

- *Do minor maintenance and do not repair if major flooding damages the building. Then document and release.* (Recommended for the Tom Gilgo House.)
- *Put inspection and the maintenance of the building as the first priority. Keep data of the impact of the climate on the resources such as maintenance data.* [One respondent applied this comment to 4 of the buildings they reviewed: the 1873 Keeper's Quarters, the Portsmouth Life-Saving Station, the Portsmouth Life-Saving Station Summer Kitchen, and the Washington Roberts House, PV).]

- *Since on piles, ensure that they are stable. Remove all hydrophilic coverings and surfaces with non-water absorbing materials. Ensure that water can pass through the building and drain quickly. One building looks to be in the water pretty soon - may need to document and release it after it is no longer in a tenable spot.* [Recommended for the Henry Pigott House (PV).]

The remaining responses were categorized within the seven pre-defined adaptation strategy response categories (see Table 5 for a summary of these results).

The most often selected adaptation strategy was to *improve building's resilience*. Improving resilience was selected by at least one respondent for each of the buildings included in the assessment. *Document and release* was the next most frequently selected strategy, followed by *leave things as they are* and *manage change*. Overall, these results illustrate that survey respondents felt strongly that a building should either be fortified (improved resilience) or released (after documentation). These options (fortify/release) could be viewed as opposites on a

spectrum of strategies for the most vulnerable buildings. For example, nearly half of respondents who assessed the Coast Guard Station (CLV) (perceived as high vulnerability) recommended improving its resilience, while over one-third of those who assessed either the 1873 Keeper's Quarters (CLV) and Life-Saving Station (PV) (perceived as high vulnerability) felt these buildings should be documented and released. *Managing change* and *leaving things as they are*, on the other hand are commonly applied strategies for buildings perceived as less vulnerable.

While *relocation* was selected as an option for many buildings included in the study, in most cases only one respondent selected this for any given building. On the other hand, many (43%) of those

who assessed the Coca Cola House (CLV) selected the *relocation* option (second highest in terms of vulnerability rating). It is possible that *relocation* was selected as an action for this particular building given the fact that the aerial view shows no other buildings nearby.

Other less common options included *take offsite action* and *interpret the change*. For those buildings that did have respondents assign *off-site action* or *interpretation*, these were not the dominant strategies for those buildings (i.e., only one respondent selected this strategy for any given building). These results may imply that cultural resource management and historic preservation experts view these strategies (off-site action and interpretation) as less favorable or appropriate for CALO buildings. Alternatively, these results may also be illustrating experts’ unfamiliarity with these strategies. It is important to note that since the time when the questionnaire was approved by the Office of Management and Budget (OMB), the NPS has documented that *interpret the change* should be considered in combination with other adaptation strategies (Rockman et al., 2016).

### Adaptation Impacts to Cultural Landscape

After recommending adaptation strategies, respondents indicated the extent to which their recommended action would detract or enhance the cultural landscape. In general, results indicate that respondents felt that any adaptation strategy would detract slightly from the overall cultural landscape in both historic districts (Table 6). Since few respondents selected taking off-site action or interpreting the change, these results should be viewed with caution (i.e., not enough cases to determine trends in perceived impacts to cultural landscapes). Documenting and releasing buildings

is perceived to have the greatest impact (detracting) on the cultural landscape. Leaving things as they are and improving resilience, on the other hand, are likely to have little impact on the cultural landscape.

Table 4. Perceptions of impacts to the CALO cultural landscape, resulting from various adaptation strategies.

Adaptation strategies	n	Impact Mean (SD)
Leave things as they are	25	-0.24 (.436)
Take offsite action	2	-1.00 (.000)
Improve resilience	35	-0.37 (.808)
Manage change	26	-0.54 (.508)
Relocate	15	-0.67 (.488)
Document and release	31	-1.06 (.512)
Interpret the change	4	-1.00 (.000)

<sup>1</sup> “n” refers to how many respondents were randomly assigned to assess a specific building.  
<sup>2</sup> Five-point response scale: (-2) substantially detract, (-1) slightly detract, (0) no change, (1) slightly enhance, and (2) substantially enhance.

### Trends within Adaptation Recommendations

We were curious to explore how respondents’ recommendations for specific adaptation strategies were related to their expertise and their evaluation of the other questionnaire items within the geovisualization decision support tool section. Significant differences were found<sup>10</sup> in the selection of adaption strategies among respondents with various organization affiliation, their total years working cultural resource management, their perceptions of a building’s SLR vulnerability rank, and the degree to which they were certain of SLR impacts (Table 7). Given the small sample size, these findings should be viewed as preliminary. Additional research is required to fully explore and (explain) these relationships.

<sup>10</sup> A Pearson chi-square test was used to explore differences between groups (within the predictor variables) that differ

statistically significantly from one another in regards to the dependent variable (selection of adaptation strategy).

Table 5. Perceived levels of vulnerability, certainty, and adaptation priority for select buildings at CALO.

<b>Building</b>	<i>n</i> <sup>1</sup>	SLR vulnerability <sup>2</sup> <i>Mean (SD)</i>	Certainty of impact <sup>3</sup> <i>Mean (SD)</i>	Priority to take action <sup>4</sup> <i>Mean (SD)</i>
<b>Cape Lookout village</b>				
Coca Cola House	8	4.3 (0.71)	3.4 (0.52)	2.8 (0.71)
1873 Keeper's Quarters	9	4.3 (0.87)	3.00 (0.71)	3.6 (0.92)
Coast Guard Station	7	4.0 (0.82)	3.3 (0.76)	3.6 (0.79)
Fishing Cottage 1	9	3.8 (0.67)	3.0 (0.71)	2.9 (1.36)
<b>Portsmouth village</b>				
Life-Saving Station	7	3.9 (0.69)	3.0 (0.58)	3.4 (1.13)
Roy Robinson House	6	3.7 (1.21)	3.2 (0.75)	3.3 (1.03)
Washington Roberts House	12	3.5 (0.52)	2.8 (0.45)	3.2 (0.84)
Methodist Church	11	3.5 (0.67)	2.7 (0.47)	2.7 (0.65)
Life-Saving Station Summer Kitchen	9	3.4 (0.73)	2.6 (0.73)	3.0 (0.87)
Jesse Babb House	12	3.3 (0.89)	2.9 (0.52)	3.2 (0.84)
Post Office & General Store	12	3.0 (0.74)	2.7 (0.49)	3.0 (1.35)
McWilliams-Dixon House	6	3.0 (0.63)	2.7 (0.52)	2.8 (0.41)
Dennis Mason House	4	3.0 (0.82)	2.5 (0.58)	2.5 (1.00)
Carl Dixon House	12	2.8 (0.84)	2.5 (0.52)	2.8 (0.72)
Tom Gilgo House	6	2.7 (0.52)	2.7 (0.52)	2.8 (0.75)
Henry Pigott House	8	2.4 (0.74)	2.4 (0.92)	1.9 (0.64)
Frank Gaskill House	7	2.1 (0.69)	2.4 (0.54)	2.6 (0.54)

<sup>1</sup> "n" refers to how many respondents were randomly assigned to assess a specific building.

<sup>2</sup> Five-point response scale: (1) very low vulnerability, (2) low vulnerability, (3) moderate vulnerability, (4) high vulnerability, and (5) very high vulnerability.

<sup>3</sup> Four-point response scale: (1) not at all certain, (2) not very certain, (3) fairly certain, (4) very certain.

<sup>4</sup> Five-point response scale: (1) very low priority, (2) low priority, (3) moderate priority, (4) high priority, and (5) very high priority.

Table 6. Summary of the adaptation strategies recommended for select historic buildings at CALO.

Building	Frequency (% of those who assessed a building selecting a given adaptation strategy)						
	Leave things as they are	Take offsite action	Improve resilience	Manage change	Relocate	Document and release	Interpret the change
<b>Cape Lookout village</b>							
1873 Keeper's Quarters	12%	12%	25%	—	12%	38%	—
Coast Guard Station	—	—	49%	17%	17%	17%	—
Coca Cola House	—	—	14%	14%	43%	29%	—
Fishing Cottage 1	22%	—	34%	22%	11%	11%	—
<b>Portsmouth village</b>							
Carl Dixon House	17%	8%	34%	25%	—	17%	—
Dennis Mason House	50%	—	25%	—	—	25%	—
Frank Gaskill House	43%	—	15%	15%	—	27%	—
Henry Pigott House	12%	—	12%	12%	12%	39%	12%
Jesse Babb House	8%	—	42%	25%	8%	17%	—
Life-Saving Station	17%	—	17%	17%	17%	32%	—
Life-Saving Station Summer Kitchen	25%	—	12%	25%	12%	25%	—
McWilliams-Dixon House	16%	—	16%	16%	16%	16%	16%
Methodist Church	18%	—	18%	27%	—	46%	—
Post Office & General Store	17%	—	25%	25%	8%	17%	8%
Roy Robinson House	40%	—	20%	20%	20%	—	—
Tom Gilgo House	33%	—	16%	16%	16%	16%	—
Washington Roberts House	9%	—	37%	18%	9%	18%	9%

Table 7. Significant relationships of predictors and selection of adaptation strategies.

Factor	P
Building group (residence, maritime)	n.s.
Organization type (government, private)	.001
Total years working in CRM*	.003
National importance ranking	n.s.
Local importance ranking	n.s.
SLR vulnerability ranking	.010
Impact certainty ranking	<.001
Priority ranking	n.s.

n.s. = not a significant relationship

\*Entered as a continuous variable.

In terms of organizational affiliation<sup>11</sup>, federal government employees were most likely to select *improve resilience*, state government employees were most likely to select *manage change*, and local government employees most often selected *document and release*. Further, historic preservation personnel and private consultants were most likely to choose *leave things as they are* and academically-affiliated (University) respondents were most likely to select *relocation*. These differences could be related to typical cultural resource management scenarios to which various personnel are exposed (because of their organizational affiliation), the resources their organization has access to in order to manage cultural resources (e.g., financial feasibility of adaptation strategies), or their (organization's) role in the process of listing buildings on the NRHP.

Related to the number of years working in cultural resource management, the main relationships uncovered were related to early and late career professionals and the number of adaptation strategies typically recommended. Specifically, experts who have been working in cultural resource management for fewer than ten years or more than forty years were likely to recommend only one or two strategies, while those who have been working between 10-39 years typically recommended five different strategies. Further, early career experts typically recommended *improve resilience*, while later career experts typically recommended *manage change*.

SLR vulnerability ratings were significantly related to respondents' selection of adaptation strategies. For buildings with *very low* and *low* vulnerability ratings, *leave things as they are* was the most commonly selected strategy. For *moderate* vulnerability, respondents were most likely to select *manage change*. For *highly* vulnerable buildings, *improve resilience* was most often selected, and for *very highly* vulnerable buildings *document and release* was the most commonly applied strategy (see Figure 7). The intuitive nature of these results (i.e., if not vulnerable, no need to adapt; if moderately vulnerable, improve resilience or manage change; if highly vulnerable, prepare for loss) suggest that cultural resource management and historic preservation experts are able to fully integrate perceptions of vulnerability into their logic when recommending adaptation strategies. As



Figure 7. Relationships between perceived SLR vulnerability and the selection of adaptation strategies.

<sup>11</sup> Due to low sample size (e.g., only 3% of the sample are local government personnel) these findings should be interpreted cautiously.





Figure 8. Relationships between perceived certainty of impact and selection of adaptation strategies.

such, it seems that decision-makers may want to consider using a similar geovisualization support tool when on-site consultation of cultural resource management and historic preservation experts is not available.

Lastly, certainty of impact was significantly related to respondents' selection of adaptation strategies. For those buildings about which experts were *not at all* certain if impacts would occur, they were most likely to select the option of *leave things as they are*. For buildings where they were *not very* certain, they were most likely to select *manage change*. For buildings about which they were *fairly* certain there would be impacts, respondents most often selected *improve resilience* and for buildings about which they were *very* certain there would be impacts, they were likely to select *document and release* or *relocate* (see Figure 8).

## Recommendations

We identified five key areas of recommendations for future actions in managing and preserving cultural resources given climate change risks:

### Improve spatial and temporal evaluations within climate adaptation planning for cultural resources

Cultural resources must be managed in a way that takes climate change into account. There is a need to ensure better site-based data collection and analysis to identify changing climate conditions on different types of cultural resources. A vulnerability

assessment tailored to diverse cultural resource types (e.g., historic buildings, structures, objects, archeological sites) can identify those aspects of values that are likely to be adversely affected or lost in a changing climate. Periodic surveys and maintained inventories of cultural resources, together with adequate monitoring of decay and deterioration of diverse cultural resources should be critical components of vulnerability assessments. Additionally, developing a geovisualization decision support tools can help site managers better access expert opinion, particularly in remote locations and locations where staff shortages exist within cultural resource management and historic preservation programs. Linking vulnerability assessments within and between sites—and at state, regional and international scales—can help preserve diverse types of cultural resources and subsets of specific types of cultural resources (e.g., different categories of historic buildings, like former residences, federal maritime buildings, community structures) across broader landscapes.

### Apply measurement frameworks for assessing historical significance and use potential of historic buildings, and synthesize these into more holistic modeling efforts

NPS park units should apply a value-focused and climate-informed frameworks or tools that can provide more effective cultural resource management rather than just protection for the persistence of existing cultural resources. In

developing such frameworks and tools, it is important to engage a multi-disciplinary and multi-organizational team with diverse expertise (both from social and natural sciences and federal, state and local agencies with preservation mandates and authorities), as well as to consider the preservation values and preferences of local community members and other relevant stakeholders (e.g., park visitors and members of partner organizations).

This holistic approach can ensure that complex issue of historical significance is more fully addressed within the cultural landscape and in relation to other conservation priorities, and that the views of different stakeholder groups' values are considered. For example, Fatorić and Seekamp (2017) used a co-production of science approach in their development of a measurement framework for assessing the relative historical significance and use potential of buildings within historic districts, which provides a novel, transparent and structured approach to prioritizing buildings for adaptation. The ability to rank buildings can quickly separate historic buildings that are less competitive for limited budgets from those that require more serious considerations for management and preservation.

When combined with vulnerability assessment, the framework can prioritize strategic and tactical actions for climate adaptation planning, while considering technical (i.e., strategies that will not damage the integrity of building) and economic feasibilities, and high probability of preserving diverse types of historic buildings under a range of climate change scenarios. Eventually the NPS and State Historic Preservation Offices could benefit from the expansion of this initial framework to other types of cultural resources, as well as its application at broader landscape scales.

## **Mainstream cultural resource climate adaptation into sectoral policies**

Planning for climate adaptation is more effective when integrated with other planning processes such as emergency preparedness or urban renewal. This is particularly important when the NPS and State Historic Preservation Offices operate on limited budgets, limited technical expertise, and/or when climate change is one of many concerns, often not the most immediate threat to their management and preservation tasks. The NPS and State Historic Preservation Offices need to consider mainstreaming climate vulnerability and risk information into annual budget allocations and requests. One potential strategy would be to first evaluate respective portfolios of cultural resources for existing risks and then offer recommendations to mitigate those risks in the next budget cycle. Over time, the agencies can build on those first steps to increase the level of climate vulnerability and risk information incrementally, as well as their ability to respond.

## **Enhance communication and dissemination of best practices**

Building climate adaptation capacity of the NPS starts with a commitment to include climate change in discussions with diverse stakeholders and State Historic Preservation Offices, and supporting NPS managers in bringing climate change issues into their daily operations. There is a need for collaborative programs, iterative networks and online training courses for knowledge exchange. In seeking information and advice, it is also important to reach out to local and indigenous communities to ensure that their values and preferences are fully considered prior to adaptation decision-making. Additionally, enhanced communication among scientists, stakeholders, and decision- and policy-makers can increase climate literacy. Increased climate literacy may reduce the contentiousness of climate change related funding (research, training, adaptation

planning, taking adaptation actions) within local, state and national governments, which would likely reduce many of the other challenges facing cultural resource management and historic preservation experts.

### **Improve interpretation of climate change-cultural resources nexus**

Interpretation and information about the climate change impacts on park's diverse cultural resources need to be available at NPS visitor centers through such means as exhibitions and displays, interpretive videos and films, and published literature (comprised predominately of figures, images and non-technical language). Equally important is to provide interpretive panels and signs that communicate the story of changing climate and its impacts on cultural resources in situ. Some of the cultural resources that are not open to the public due to its limited accessibility (e.g., away from main road, bad condition of the path) or for safety reasons could be accessible by audiovisual presentations and exhibitions in the visitor center. Such strategies may increase the climate literacy of visitors and enhance various values of the cultural resources being at risk from climate change.

Additionally, based on these survey results, there is a need to examine the differing perspectives of experts and the visitors, and to explore the interpretive opportunities that these differences may signal. Future research may explore why the experts rank the prioritization of historic buildings differently than the visitors. Interpretive materials described above may be enhanced by an assessment of whether the experts have information or perspectives about the relative historic value of the buildings that visitors would find informative and useful.

## **Concluding Remarks**

This report contributes to a relatively new body of research by exploring three important but understudied challenges of cultural resources climate change adaptation: (1) barriers to current cultural resource management and historic preservation given climate change impacts together with needs for overcoming the identified barriers; (2) the importance of factors influencing climate adaptation prioritization; (3) the potential utility of a geovisualization decision support to provide site managers with experts' recommendations for adaptation. Although we contextualized our study with coastal climate change impacts to cultural resources in the southeastern U.S., we found that the findings on barriers and needs together with factors influencing climate adaptation prioritization are likely transferable to other regions and, perhaps, national and international scales.

We found that cultural resource management and historic preservation given climate change risks are impeded by institutional, technical and financial barriers. Additionally, our analysis highlighted that these three types of barriers are often interdependent and most frequently tied to financial constraints. Additionally, while there are only a few scientific studies that discuss how barriers can be overcome (e.g., Eisenack et al., 2014), we identified institutional, technical and financial needs to overcome the barriers identified. Importantly, this study demonstrates that barriers to current cultural resource management and historic preservation were often identified and discussed as both barriers and needs, revealing the interchangeable perspectives provided within expert opinion. As such, barriers are not insurmountable or absolute, but can just as easily be seen as future opportunities for improving cultural resource management and historic preservation. For instance, the lack of a prioritization process for adapting cultural resources to climate change impacts was identified as

meaningful limitation within current preservation planning efforts. Yet, increasing research and improving knowledge of the various intersections of climate change and cultural resources was one of the most salient means of developing a climate adaptation prioritization process to reduce the vulnerability of cultural resources.

Some recent studies highlighted that there is an increasing need for transparent prioritization processes to enhance climate adaptation planning of various cultural resource types (e.g., Carmichael et al., 2017; Dawson, 2015; Fatorić and Seekamp, 2017b, c). This is particularly relevant as the preservation of all cultural resources is likely to be financially and/or technically unfeasible. We found that the most salient factors in prioritizing historically designated buildings for climate adaptation planning were (a) the national importance of the historic building and (b) its uniqueness or being the only historic building of its type across the cultural landscape. In contrast, the least salient factors influencing prioritization of climate adaptation planning were (a) the importance of historic building to only a few people and (b) having the least expensive preservation treatments. There is a further need to robustly explore the array of factors for climate adaptation prioritization (e.g., through predictive modeling and by documenting the prioritization preferences of other stakeholders), as well as to mainstream climate adaptation prioritization into current cultural resource management and historic preservation.

The results from the geovisualization exercise demonstrate the relationship between adaptation strategy selection and building conditions, perceptions of building vulnerability, and certainty of impact. In particular, the findings suggest that buildings which are perceived to be vulnerable may be a best fit for either active reinforcement or strategic release. Additionally, as certainty of impact increases so does the likelihood that a more active type of adaptation strategy (e.g., improve resilience) is selected; conversely, those building

about which experts were less certain tended to have more passive (e.g., manage change), strategies recommended. This exercise demonstrates the feasibility of asking cultural resource management and historic preservation experts to make climate adaptation recommendations using a geospatial decision support tool.

The findings presented in this report are important not only for advancing scientific knowledge of cultural resources and climate adaptation but also for informing timely and effective climate change adaptation decisions at the park, state and regional scales. Yet, considering the perspectives of cultural resource management and heritage preservation experts in planning and decision-making must also be balanced with those of other relevant stakeholder groups, such as local community members, partner organization members, and park visitors. Moreover, climate adaptation planning and decision-making could benefit from modeling efforts that provide site and regional managers with scenarios that reflect budget allocations, adaptation costs, vulnerability assessments, and metrics that quantify the relative historical significance and use potential of buildings. Such holistic approaches may enhance climate change-related policies and appropriations, and ultimately, better enable the preservation of cultural heritage across the landscape.

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# Appendix A: Site Descriptions

## 1.1 Portsmouth Village

### 1. *The Portsmouth Island Life-Saving Station:*

The federal government expanded its role in ensuring maritime safety with the construction of new and larger lighthouses and establishment of the Life-Saving Service and a U.S. Army Signal Corps weather observation station. The Life-Saving Station, built in 1894, illustrates the importance of Portsmouth Village during early US maritime history, which was a robust sea village between the mid-1700s and the mid-1800s providing "lightering" services (i.e., unloading of shipping vessels) to transport goods on smaller vessels through the shallow Ocracoke Inlet.

The Life-Saving Station was a source of employment and influence in the Portsmouth community, with crews made up from local citizens. A nightly guard scanned the waters for vessels in trouble and foot patrols walked the ocean beaches; the crews assisted over 85 vessels. It was used as a hunting and fishing club after being decommissioned by the US Coast Guard in 1937.

The current building is open to public, with interpretation on the life and jobs of those employed by US Life-Saving Service and replicas of boats and equipment used to assist stranded and wrecked vessels. The complex of structures around the Life-Saving Station includes a summer kitchen that is currently used to house volunteers who staff the Portsmouth Island Visitor Center between May and October. Please only consider the Station House building in this set of evaluations.

### 2. *Portsmouth Island Lifesaving Station Summer Kitchen:*

This kitchen is thought to have been constructed in 1908. It was originally a single room with shingles on the exterior walls. Around 1942, a dining room

was built onto the east end of the structure with the outside finished with shiplap siding. A brick chimney exists at the west gable end of the structure. The NPS rehabilitated the summer kitchen between 1978-1984. Shingles were installed over the entire building by the NPS in 1980. In 2003, the NPS replaced the window sashes and exterior doors in order to comply with public usage requirements.

The current building is a gable-roof structure with exterior walls covered with wood shingles. The original part of the building is on a concrete foundation, but the dining room addition is on wood posts. The kitchen was deemed to be in good condition in 2006.

The building currently houses park volunteers. There is a kitchen, bedroom, and bathroom inside the structure, all with modern appliances. The structure is not open to the public.

### 3. *The Methodist Church:*

The original Methodist Church, established at Portsmouth Village in 1840, was destroyed by a hurricane in 1899. It was rebuilt in 1901, but was destroyed by another hurricane in 1913 (along with a second church on the island; only the Methodist Church was rebuilt again (in 1915). With the help of the Methodist Conference, much of the time and money spent on rebuilding the church came from the residents of Portsmouth. The community cared about their place of worship and came together to collectively rebuild the church that was the center of most social events on the island. The church held regular services and Sunday school through the 1950s. The end of World War II and the opening of Hatteras Inlet led to the gradual and steady decline of Portsmouth as a maritime port, and church services were eventually discontinued as the island's population dwindled.

The current building features Gothic Revival-style elements and was assessed in 'fair' condition in 2006 due to a leaning foundation and brick piers in



need of repair. Hurricane Sandy (2012) further damaged the structure (leaning and weakness in walls), closing it to the public. In 2013, funding as part of the Hurricane Sandy recovery effort was used to stabilize and straighten the church. The preservation work was performed by the National Park Service Historic Preservation Training Center. The building is currently in good condition.

The church is open to the public and furnished with many original elements including the pews, pulpit, and organ; no additional exhibits were added during the 2009 exhibit plan to not intrude on its historic character or conflict with the religious significance of the church. A partner organization, Friends of Portsmouth Island, uses volunteers to regularly clean the inside and holds regular “homecoming” events at the church (hosted every two years); the church has also been used occasionally for baptisms and weddings.

#### *4. The Portsmouth Island Post Office and General Store:*

The Portsmouth Post Office and General Store was constructed circa 1900-1909 in an area known as Middle Community, about 1 mile south of its current location. Joe Dixon was the original owner of this structure. Around 1929, this structure, as well as the adjacent house, were purchased by Theodore Salter and moved to the current location.

The Post Office/General store was the center of social life on the island in the early 20th century. All of the residents of Portsmouth received their mail and bought goods at the store. Many residents of Portsmouth served as the island’s postmaster throughout the years. Every weekday, the mail would arrive by boat and around 4:00 (Alfred Dixon followed by his son Carl Dixon, would meet the boat on a skiff), everyone would gather at the Post Office to receive their mail and catch up on social events. Both the post office and store were closed in the 1950s. When the Post Office was closed in 1959, mail was sent over from Ocracoke three times per week. Annie Dixon Slater and her

daughter Dorothy Saltier were the last two postmasters.

Supported by wood posts, the gable roof structure has painted clapboard and vertical wood board siding. The roof is wood shingles with a galvanized metal ridge cap. There is a door in the center of the front of the building with six-over-six double-hung windows on either side. The building had an adjoining warehouse, which is no longer standing. In 1997, the structure was stabilized. Interior damage was sustained from Hurricane Isabel in 2003. The structure was assessed in fair condition in 2006.

This structure is open to the public and contains many interpretive displays. The displays include replicas of many of the goods islanders obtained at the store such as fabrics, thread & needles, groceries like cheese, salt pork and canned goods, gasoline, kerosene & oils, molasses and candy.

#### *5. The Portsmouth Island Schoolhouse:*

The Portsmouth Schoolhouse was constructed in the 1910s near the Old Straight Road. It is possible that the current schoolhouse replaced one or two earlier schools that existed on the islands in different sites. The original entrance door was removed for rehabilitation at some point between 1943 and the acquisition of the site by the NPS in the 1970s.

The Portsmouth Schoolhouse was an integral part of the Portsmouth community, as it was the only school, and was where all of the children of Portsmouth went to learn grades one through eight. To be educated beyond eighth grade, students would have to go to the mainland. The school was closed in 1943, and families with children had to find a way to get their children to schools on the mainland or move to do so.

The structure is supported by brick piers and has clapboard siding painted white. The hip roof has wood shingles with galvanized metal ridge caps.

Dark green painted shutters exist on the sides of the six-over-six double-hung windows. The schoolhouse has a brick chimney and a cylindrical cistern. The structure was assessed in fair condition in 2006.

The Schoolhouse is open to the public and contains a full room of students' desks and interpretive materials that convey a working classroom of the early-mid 1900s.

#### *6. The Washington Roberts House:*

Likely one of the oldest surviving structures in the village, the Washington Roberts house was built in the late 1840s. Washington "Wash" Roberts, a Life-Saving Service crewman, carpenter, boat builder, and Portsmouth's unofficial coffin maker, grew up in the house, acquired it as an adult, and lived there until 1933 when he moved to the mainland. After Wash moved to the mainland, he allowed his friend, Joe Abbott, to move into the house. Abbott was one of the descendants of Earls Ireland's slaves. It is suggested that Joe Abbott's mother was actually Earls Ireland's daughter, which explains the close relationship between the Roberts and Abbott families. After Abbott moved in 1946, the house was reportedly vacant.

The kitchen/dining room wing addition was constructed circa 1910. The additional wing was destroyed by Hurricane Isabel in 2003 and was reconstructed by the NPS. This structure is an example of the traditional island house style called a "story and a jump" (1-1/2 stories). There used to be a rear porch, but only the wood posts remain. The unpainted clapboard siding is topped with a wood shingle gable roof. The house has nine-over-six double-hung windows. The house was assessed in poor condition in 1998. In 2007, the house was rehabilitated with new siding, doors, and windows.

After rehabilitation, the house was opened to the public with an interpretive panel outside that explains the architectural elements that help the

building withstand strong winds (i.e., braced-frame construction, plaster and lath, and bird's mouth storm brace), which is why the building was known as a "storm house" (a place for neighbors to seek refuge during hurricanes). The rehabilitation left some of the interior walls exposed to display these construction elements.

The house is open to the public, with an interpretive panel outside the building.

#### *7. The Dennis Mason House:*

The Dennis Mason house was constructed circa 1895. The original structure consisted of three rooms. After Dennis Mason, the house was owned by Captain David Willis and then by Harry Dixon, who substantially remodeled it in the 1920s. Dennis Mason was part of the first Lifesaving Station crew at Portsmouth.

Supported by wood posts, this structure is a dormer front bungalow that also has two small one-story wings (on the west side and the rear side). The clapboard walls are yellow and the windows are twelve panes (six-over-six). There is a brick chimney, and the roof is wood shingle. A partially covered front porch with brick piers stretches across the front (south side) of the house. Craftsman-style details include eave brackets and tapered porch columns. In 2006, the house was assessed in good condition.

The house is not open to the public and does not contain any interpretive materials.

#### *8. The Henry Pigott House:*

Harmon Austin, a carpenter from Ocracoke, built the Henry Pigott house in 1902. Henry Pigott was one of seven children born on Portsmouth Island to descendants of slaves. In 1904, Rosa Abbot, a mid-wife who also acted as the sole medical professional for the island, purchased the house, which was eventually passed down to her grandson Henry and his granddaughter Lizzie. Henry fished for a living the first half of his life, but

in his later years he was the “mailman” for Portsmouth Island. Henry would retrieve the mail by poling a small wooden boat into the Pamlico Sound to meet the mail-boat and provide the Captain with a list of needed items from Ocracoke, as the General Store and Post Office were no longer in operation. Henry’s death in 1971 marked the end of residency on Portsmouth Island, as the two remaining residents (Elma Dixon and Marion Babb) left the island soon after his passing.

The T-shaped house has a front-facing gable at the base of the T and is supported on wooden posts. The clapboard siding is painted yellow, and the wood shingle roof has a galvanized metal ridge cap. The house was yellow for most of its existence, but for many of Henry’s later years it was painted pink due to a mixed up paint order. There is also a brick chimney. A small porch extends across the entire front of the house. A white-painted wood picket fence partially encloses the yard. Also on the property are a cool house, a kitchen, two sheds, a privy, and a cistern. In 1932 the house was raised to avoid flooding, at which time two outbuildings were also added. The outbuildings include a summer kitchen, cold house, shed, a privy, a wood cistern, and the remains of a “net house.”

The Friends of Portsmouth Island partnered with the National Park Service to restore the house and furnish it in the style of the period of significance. In 2012, the house was opened to the public during the Friends of Portsmouth Island’s “Homecoming” celebration (an biennial event for the organization). The partner organization continues to partner with the NPS to maintain the building.

#### *9. The McWilliams-Dixon House:*

This structure was built in 1910 near the Life-Saving Station. Keeper Charles (Charlie) McWilliams was the original owner who built this house. Charlie was well-known for his work to rebuild the Methodist Church after it was destroyed in the 1899 storm. Charlie traveled to the mainland, as far as Washington, NC, to stand

on street corners begging for money and/or materials to help rebuild the church. Charlie was also a cattle dealer and a horse trader, famous for his ability to make money with anything.

Ed Dixon purchased the house circa 1937 after the Life-Saving Station closed, leaving many houses available for sale. Dixon was a boat and house carpenter. Ed and his brother Harry were renowned carpenters of Portsmouth, one left-handed and the other right-handed. Ed is credited for much of the reconstruction of the Portsmouth Methodist Church.

Ed Dixon moved the house to its current location in 1939. Another wing was added to the house around 1955, but was removed around 1984. Within the house’s white picket fenced enclosure there is also a cool house, a shed, and a privy. The shed, used as a washhouse, was moved from the George Dixon house to its current location in the late 1930s. The T-shaped house has vertical wood board siding, currently painted yellow. The gable roof has wood shingles with a galvanized metal ridge cap. It is supported on wood posts. A porch with Queen Anne style posts extends across the front (south) of the house. The windows are six-over-six double-hung units. The house was assessed in good condition in 1998.

The house is not currently open to the public and does not contain any interpretive materials.

#### *10. The Tom Gilgo House:*

The Tom Gilgo house was originally built near the Life-Saving Station circa 1920 as part of the Coast Guard Station complex to house Coast Guardsmen. It was moved to its current site in 1928 by Tom and Lucy Gilgo, who purchased the house for ten dollars. After moving the two-room home consisting of a living room and bedroom, Tom added a wing to the back of the house, which included a kitchen and dining room. Tom Gilgo served in the Navy after WWI and married Lucy Beacham Gilgo, a schoolteacher, in 1925. For most

of his life, Tom was a commercial fisherman, but briefly operated a store across from the Post Office. Tom and Lucy left the island after the storm of 1933 and moved to Oriental, NC.

Supported on wooden posts, the house has a combination of clapboard siding and unpainted board and batten siding. The roof has wood shingles. An uncovered porch extends across part of the front of the house. The windows are six-over-six double hung units. In the 1990s, the NPS significantly rehabilitated the structure. In 2002, the structure was stabilized, and the addition from the 1950s was removed. This stabilization included new siding, installation of new foundation pilings, repair/replacement of damaged sills and studs, and a new roof. In 2006, the structure was assessed in good condition.

The house is not open to the public and does not contain any interpretive materials.

#### *11. The Roy Robinson House:*

The Roy Robinson house (known as the Lionel & Emma Gilgo House) was built circa 1926. It was built on the already-existing foundations of the old Marine Hospital. Lionel Gilgo, Sr. and Emma Hunnings Gilgo moved it to its current location in 1935. Lionel was a lifelong fisherman. He also raised geese as hunting decoys until the practice was made illegal. The Gilgo family left the island in 1942 when the School closed. After moving, the family continued to use the house for weekend and summer visits until Lionel Sr. died in 1983.

The house is a singly-story, rectangular, hip-roof structure that is on top of wooden posts. The front end (north) has a hip-roof porch, and the southeast corner (rear of house) has an open platform porch. The house was originally painted grey, and currently the siding is board-and-batten that is painted a grey-blue color. All windows are four panes except for two twelve-pane windows on either side of the front door. In 2006, this house was assessed in fair condition at which time some

termite damage was identified. The building was under a private lease until August 5, 2011.

It is typically closed to the public and there are no interpretive panels outside of the building. However, the interior of the house contains some furniture and old photographs (displays created by the Friends of Portsmouth Island), and is occasionally opened for events such as the Portsmouth Island Homecoming.

#### *12. The Carl Dixon House:*

The Carl Dixon house was constructed circa 1930. There is a kitchen directly adjacent to the house structure. Carl's father, Alfred Dixon, previously owned a home on this same site, but Carl tore that house down and built his own. The foundations of his father's house are still visible under the west end of the current structure. After his father's retirement, Carl ran the mail boat for more than twenty years. He also transported people between Ocracoke and Portsmouth, as there was no other transportation. When Carl left Portsmouth Island and moved to Harker's Island, Henry Pigott took over the mail boat. Carl Dixon was known to host many square dances in his home throughout the 1920s and 1930s.

Supported by wooden posts, the house is a front gable structure. The front porch is supported on brick piers rather than wooden posts and has a hip roof. The house and kitchen have two-over-two double-hung window units. The exterior is painted clapboard with a shingled roof and the kitchen has unpainted clapboard siding with a sheet metal roof. The house was occupied through the historic lease program and underwent the following changes since 1979: removal of the front porch, addition of a widow's walk, replacement of the roof and changed paint color from yellow to white. The structure was assessed in poor condition in 2006.

The house is not open to the public and does not contain any interpretive materials.

### *13. The Frank Gaskill House:*

The Frank Gaskill house was built circa 1930. Son of John W. Gaskill and Elizabeth Gaskill, Frank Gaskill was known as a “true islander” with a depth of knowledge regarding island life and ecology. A master boater and fisherman, Frank was an expert at finding the best fishing spots and repairing even the most worn fishing nets. In the winter he would guide game hunters, with certainty that they would bring back a bounty. Frank often was asked to recite eloquent prayers at the church services. Frank never married, but his house was never empty, as it became a sanctuary for all of the island’s stray cats.

This building is supported on wood posts and has horizontal clapboard siding painted white. The hip roof has wood shingles and a galvanized metal ridge cap. There is a small open platform porch outside the front door. The windows are six-over-six double-hung units, and there is also a brick chimney. A shed with sheet metal walls also exists on the property (not considered a historic structure). In 2006 the structure was assessed in good condition.

The house is not open to the public and does not have any interpretive materials.

### *14. The Jesse Babb House:*

The Jesse Babb house was built by Babb circa 1935, and is also known as the Marian Gray Babb House. Jesse Babb was a cook and a machinist at the Coast Guard Station. Jesse served in the Coast Guard until 1941. After his retirement, he fished, clammed, and oystered to make a living. Jesse was also quite well-known for his fiddle-playing abilities and would often play at the island’s square dances. After the closing of the Coast Guard Station, this house held the only telephone on the whole island. This house was the first in the village to have battery-powered electricity. Jesse married Lillian Dixon and they had three children: Edna Earl Babb, Jesse Lee Babb, and Marian Gray Babb.

Marian was one of Portsmouth’s last permanent residents.

The structure is a dormer from bungalow with yellow clapboard siding and three-over-one double-hung windows. There is a brick chimney, and the roof is wood shingle. There is a large covered porch across the entire front of the house and another porch in the rear at the northeast corner. Craftsman-style details include eave brackets. Several outbuildings exist behind the Jesse Babb house: a kitchen, a garage, a generator shed, and a privy. These outbuildings are mostly raised on wood posts and have wood shingle roofs and vertical wood board siding. The building’s septic tank was replaced in 2004. This house was assessed in good condition in 2006.

The house is not currently open to the public but has a small interpretive panel, identifying the home outside the picket the fence.

## 1.2 Cape Lookout Village

### *1. The Cape Lookout Lighthouse:*

The Cape Lookout Lighthouse that stands today was constructed in 1859, which replaced the original 1812 lighthouse to improve the efficiency of the light as an aid to coastal navigation. The Lighthouse currently exists as a 163-foot tapered, cylindrical brick masonry structure. It is painted with a black and white diamond pattern. The walls are 9 feet thick at the base of the Lighthouse and taper to 19 inches thick at the top.

The Lighthouse was damaged during the Civil War but was fully repaired by 1867. In 1866-1867, a new cast iron staircase was installed to replace the original wooden stairs of the 1859 brick Lighthouse. The Lighthouse Bureau added a radio beacon to the Lighthouse in 1933. An underwater power cable from Harkers Island led to the full automation of the Lighthouse in 1950. After 1972, the NPS began restoration work on the Lighthouse.

The diamond pattern on the Lighthouse was recently repainted by the NPS in 2015 (the NPS manages the structure and the Coast Guard ensures the light is operational).

The Lighthouse is considered a community symbol and is a prominent focal point of the area. The Lighthouse has served an essential purpose of guiding ships through the shoals off Cape Lookout. It is a sentinel for commercial and recreational fishermen and has been an aspect of maritime and social history for the area. The shoals off Cape Lookout are particularly dangerous to navigate.

A wooden boardwalk system connects the new visitor center/restroom/ferry complex to the Lighthouse and adjacent 1873 Keeper's Quarters. The structure still functions as a navigation aid and is considered to be in fair condition. The Lighthouse, CALO's most highly visited structure, is open for climbing the 207 steps to the gallery between late May and late September. Visitors can view the barrier island from the observation platform outside the gallery.

## *2. The 1873 Keeper's Dwelling:*

The 1873 Keeper's Dwelling is part of the Lighthouse complex, visible from the sound-side approach to the main dock. The original 1812 Keeper's Dwelling is no longer standing. Congress appropriated \$5,000 for the construction of a new lighthouse keeper's dwelling in 1872, and by the spring of 1873, the brick structure was completed. At the same time, the lighthouse was painted with the black-and-white diamond pattern.

The structure housed the lighthouse keepers and their families for more than thirty years. Keepers with children often had to spend most of the year alone while their wives stayed on the mainland so the kids could attend school. The keepers and their families often maintained gardens for produce and raised livestock.

When the third lighthouse keeper's quarters was built in 1906-1907, the 1873 structure became the assistant keeper's dwelling. Along with the decline of full-time residents in Cape Lookout Village after WWII, Coast Guard and lighthouse-related occupations also began to disappear, and the structure was eventually vacant. Although the 1907 Keeper's Quarter was sold and moved to several miles south to the area of private residences, the 1873 Keeper's Quarters remained next to the lighthouse.

The 1873 Keeper's Dwelling is a two-story, painted white brick structure with dark green shutters. The Keeper's Dwelling is one of the few structures in the historic district built with brick rather than wood. Between 1988-1990, the NPS reconstructed the building's two porches, both with roofs and extending all the way across both the front and rear of the structure. In 2003, the building went under renovation with new railings added to the porch, extension of the roof eaves, the addition of shutters, and the replacements of the downspouts. The structure was assessed in good condition in 2005. However, dredging to maintain Barden's Inlet (the location of the Coast Guard Station's pier) has caused erosion and retreat of the shoreline on the soundside of the 1873 Keeper's Dwelling. Other structures in the complex include a summer kitchen and the foundation of a coal shed.

Today, the first floor of the 1873 Keeper's Quarters is open to the public, and hosts a small museum with interpretive displays about federal maritime history at CALO and the history of the lighthouse on the first floor. Modernized housing for park volunteers is located on the second floor (not open to the public). A few exhibits also portray the cultural and natural history of the island. The porches are currently lined with benches and rocking chairs for visitors to use for rest and viewing either the lighthouse or the sound-side beach. Before it was turned into a museum, the structure was previously used as Cape Lookout Village's visitors' center and public restroom prior

to the construction of the modern current visitors' center and restrooms, located ½ mile to the north by the ferry docks. A wooden boardwalk system connects the new visitor center/restroom/ferry complex to the 1873 Keeper's Quarters and the Cape Lookout Lighthouse.

### *3. The Cape Lookout Coast Guard Station:*

The main station house (other contributing structures in the Coast Guard Station Complex include a galley, equipment building and storage building) was built between 1916 and 1917 on the site of the original 1887 Cape Lookout Village Life-Saving Station, and provided office space and living/sleeping quarters for the station crews. From the watchtower, crew scanned surrounding waters for ships in distress within the Cape Lookout Shoals, the shallow waters that extend ten miles into the Atlantic Ocean that present significant shipping hazards. The Station operated until 1982. It was listed on the National Register of Historic Places in 1989. It is currently documented as being in poor condition.

The structure is currently closed to the public due to continued deferred maintenance. It has previously been used by the North Carolina Maritime Museum as a field school (during National Park Service ownership).

### *4. Fishing Cottage #1:*

Fishing Cottage 1 was constructed in the 1950s. It is a one-story wood framed building. It is supported by concrete block piers and wooden posts. The low pitch cross gable roof has roll asphalt roofing. The walls are white painted plywood. On the front of the structure is a screened porch with a corrugated metal roof. The structure was assessed in fair/poor condition in 2005 Cultural Landscape Report for Cape Lookout Village.

The building is not open to the public and does not have any interpretive materials.

### *5. The Coca-Cola House:*

The Seifert-Davis house, commonly known as the Coca-Cola house, was constructed by the Seifert family in 1928, who held stock in the soft drink company and painted red and white. It was one of the first vacation houses in the Cape Lookout Village and was built by a non-Carteret County resident. The Coca-Cola house is a vernacular, utilitarian wood-frame house supported on cast-in-place concrete piers. It was designed to withstand severe winds, including hurricanes and sited to take advantage of a wind corridor that affords cooling breezes, providing relief from heat and mosquitos.

The residence was purchased in 1953 by one of the more notable residents on Cape Lookout, Harry T. Davis who was a geologist and the director of the North Carolina Museum of Natural Sciences from 1937-1966. In the 1950s and 1960s, Davis used his home on Cape Lookout as a base for his studies of birds, as a retreat for the North Carolina Shell Club, and for other organizations. The configuration of the building was altered in the 1950s by the removal of the southwest and southeast sides of the original wrap-around porch. The house was considered to be in poor condition in 2005.

The building is not open to the public and does not have any interpretive materials.