

AN ASSESSMENT OF SHORELINE MANAGEMENT OPTIONS ALONG THE SOUTH CAROLINA COAST



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Executive Summary

Coastal ecosystems are dynamic particularly along the land/sea interface of both beach and estuarine systems. Conflicts between static human development patterns and shifting coastal shorelines have increased over the past half century given greater development activity along the water's edge. The prospect of continued coastal development at still greater density and climate induced change including accelerated sea level rise is focusing increased attention on shoreline change and management options to address long-term change.

In South Carolina, the issue of shoreline change was addressed with the establishment of the State Blue Ribbon Committee on Beachfront Management in 1986. Building on recommendations of the committee, the Beachfront Management Act of 1988 established a framework to address shoreline change with Amendments enacted in 1990. The act was proactive with the establishment of precise setback lines as well as restrictions on hard structures and the size of buildings in erosion zones and a stated policy with regard to erosional beaches. Although challenged in the Lucas Case, the Beachfront Management Program remains the state's legal and programmatic basis for addressing long-term shoreline change. Now, twenty years removed from the original act, the state has established the South Carolina Shoreline Advisory Committee to examine options for addressing shoreline change as background to an update of the South Carolina Beachfront Management Plan. The report that follows provides findings of a parallel study commissioned by the Office of Ocean and Coastal Resource Management of the South Carolina Department of Health and Environmental Control. The study has three parts that include:

1. an examination of historical, current and emerging trends in shoreline management in coastal states in the US,
2. an assessment of the effectiveness of beachfront management in reducing losses along the South Carolina shoreline, and
3. a compilation of stakeholder input to identify key issues and options for addressing long-term shoreline change in the state in South Carolina.

Part 1 of the project provides a series of steps to triangulate information on national trends and outlook for shoreline management. Those steps include a literature review drawn from primary and secondary resources and a legal assessment based on a thorough review of coastal state statutes, implementing rules and regulations and state management plans. Based on that background two surveys were prepared and administered to state coastal managers. Program directors in all coastal states including

the Great Lakes states were contacted; 29 of the 30 coastal states participated. The survey addressed current management programs and assessed of their effectiveness, program needs and impediments, and innovative approaches being considered or implemented. Based on the 29 responses, the majority of states allow various forms of hard structures ranging from 27 states that allow jetties to 22 states that use groins although limitations exist for the placement of new hard structures. Among soft stabilization approaches, all of the states had some type of beach nourishment program, while 27 states had an active vegetation program in place and roughly two-thirds of the states (20) allowed bulldozing/scraping. Among development modifications, the most common approach used was land purchase (22) followed by fixed setbacks (20). Other building restrictions employed included post hazard building limits (14) and rolling easements (13). Particularly in the case of rolling easements, variability exists in terms of both definition and implementation policies.

When respondents were asked to identify their program needs, data on which to make good decisions was the most frequently cited need (16). Other information needs mentioned included examples of success in reducing risk/vulnerability and more research and modeling capacity. Respondents also cited funding shortfalls for staff, land acquisition, beach nourishment, and planning as well as better coordination between agencies with coastal authority/influence. Correspondingly, the greatest perceived impediments were funding constraints, lack of environmental regulatory support and lack of data. When asked their overall rating of their state's shoreline management plan, two of the respondents rated their state's program a 5 on a 5 point scale with the remainder of the ratings ranging from 2 to 4. The mean rating for all states was 3.46 suggesting that coastal managers felt their programs were at least adequate but that there may be some opportunity for improvement.

States have been managing the effects of sea level rise since state programs were initiated. Yet the prospect of accelerated sea level rise (ASLR) from climate change is becoming a more serious issue for coastal managers, and several coastal managers suggested that ASLR could be a catalyst for better shoreline management plans. When asked about it, 42.1 percent of states indicated that ASLR was or would be incorporated into their shoreline management plans. But variability exists in the accounting for ASLR, ranging from the incorporation of historical trends into setback lines to a more proactive incorporation of accelerated sea level projections into shoreline configurations with corresponding adaptation measures such as building restrictions or retreat strategies. More than a few coastal managers stated that they and their staff recognize ASLR as an important issue, but several obstacles impede action. These obstacles include lack of formal recognition of climate change and ASLR on the state government level, the

large spreads between low and high SLR scenarios, and/or lack of assurance that proposed remedies will adequately address impacts.

The status quo in coastal management may or may not be effective with this new challenge, emphasizing the need for coastal management adaptation and innovation. In order to better identify the nuances in each state's management, as well as to trace the evolution of innovation and its replicability, a follow-up interview instrument was administered to nine "innovative" states. Those states were deemed innovative using a combined assessment of the legal analysis of the statutes, rules, regulations, and plans (where available), the survey responses, and primary sources. In reviewing the historical progression of state shoreline management programs, there appear to have been three distinct periods of innovative initiatives. Although the majority of the initial but arguably most powerful innovations were products of foresight and the freedom that accompanied the CZMA and state-level program inception, the first wave preceded the CZMA, with TX and OR adopting state-wide beach management and planning acts. The second wave crested in the late 1970s and early 1980s as states established their coastal management programs with a realization that hard structural solutions were increasingly leading to conflicts between private property protection and the public beach and dune system. The third wave appears to have come in the current decade as states attempt to deal with proliferating coastal development contending with the reality of ASLR and the questionable economic viability of perpetual renourishment. In between, concerns over property rights and consequent legal challenges dominated agendas. Most of the first two waves of innovation were regulatory in character, while the third is predominately cooperative and voluntary, gradually replacing older, often unsustainable engineering approaches with longer-term, physically-appropriate management strategies for the particular shoreline stretches and their associated resources.

Eight of the nine states have a regulatory setback based on either erosion rates or distance measures. In general, it is felt that setbacks have failed to meet initial expectations due to variances at the local level and because 30 or even 40 years is not enough of a buffer. As an alternative to standard setbacks, one or more states is using one of the following tools: designation of erosion hazard areas, delineation of low/high risk zones, banning infrastructure provision in high risk areas, and developing guidelines for local erosion response plans. Rolling easements are utilized in some form in six of the nine states, although the legal justifications and regulatory incorporation vary as much as the definition of the tool itself. Rhode Island incorporates a rolling easement in deeds, Hawaii uses the public trust, and Texas relies on its Open Beaches Act. However, concern exists over potential and actual challenges to the concept, given the frequency and magnitude of coastal storm events and associated property values.

Given the high cost of coastal property, land purchase is being used only on a limited basis, and often by wealthy local governments, rather than at the state level. Similarly, abandonment and relocation are used on a limited basis. The general consensus is that those tools may work in low density, relatively new areas but in historic and established cities like Galveston or Charleston, there is too much invested to justify large scale relocations. A consistent observation is that strategies need to dovetail and reinforce each other, and that programs need to be in place before natural disasters occur so that they can be implemented immediately after the storm event. Additionally, in the majority of the states, there is a difference between tools used in urban, residential and commercial areas, and those for relatively undeveloped areas.

Part 2 of the study assessed the effectiveness of beachfront management in South Carolina in avoiding losses associated with shoreline change. To examine shoreline change a composite of the 1984-87 shoreline compiled by NOAA's Coastal Services Center was compared to updates for both 1999 and 2006 compiled by the SC Department of Natural Resources and Dr. Scott Harris at the College of Charleston. It is estimated that the state lost 564 acres of shoreline over the past 20 years with a loss of 1467 acres in unincorporated areas of the state and a gain of 903 acres in beachfront municipalities and resort communities. The primary influence in shoreline retreat/accretion appears to be the extent of beach nourishment along the state's more developed beachfronts. An inventory of beach nourishment activity found that 46,904,364 cubic yards of sand have been applied to the state's shoreline at a cost of \$251,556,981 (at time of construction). The bulk of that activity has occurred after the enactment of the Beachfront Management Act – 95.0 percent in terms of expenditures and 71.0 percent in terms of sand volume. The majority of gains occurred in the municipalities of Myrtle Beach, North Myrtle Beach and Hilton Head along with the resort islands of Kiawah and Seabrook.

Case studies at Hilton Head and Pawleys Island were conducted to compare shoreline change and development patterns. The shoreline at Hilton Head has been relatively stable in recent decades tied in large part to a series of beach nourishment projects that began in 1969. Over the past two decades, Hilton Head has applied 8.6 million cubic yards of sand to its beaches at a cost of \$40.9 million. Currently, the town of Hilton Head lists 21,911 parcels with an appraised value of \$13.6 billion; beachfront properties account for \$1.98 billion in land and building value. The average property value for single family residences is \$637,021 with an average value of \$2,225,291 for beachfront properties. Structures encroaching on the 2000 setback line exist on 240 of those parcels accounting for 34.9 percent of all beachfront structures - 44.0 percent of those structures have been built since 1988. The average size of single family structures built within the setback line since 1988 is 7,314 square feet, a figure above the 5,000 square

foot cap. That issue is of less immediate concern in areas of the island that have accreted through beach nourishment. The town of Hilton Head has identified the accreted land as the Critical Storm Protection and Dune Accretion Area and restricts permanent structures within that zone. The town has been proactive in other aspects of its beach management efforts. A two percent accommodation tax generates approximately \$4.4 million annually that funds scientific and technical studies as well as beach nourishment projects. In addition, locally generated revenues have allowed the town to purchase \$20 million of beachfront land for conservation and public use.

At Pawleys Island, the shoreline has been maintained due in large part to nourishment activity that pumped 470,000 cubic yards of sand onto the beach between 1989 and 1998. Despite some loss over the past decade, on balance the island has gained 4.9 acres of beachfront over the past 20 years. A major nourishment project is proposed at a cost of \$9 million. The south and north ends of the island along Pawleys and Midway Inlets remain vulnerable to inlet migration. Currently 54.6 percent of developed parcels are on the beachfront accounting for 65.7 percent of the \$619.3 million in property value on the island. Average property values are \$1,236,073 for the island as a whole and \$1,496,549 for beachfront properties. Of developed parcels, 56 parcels have structures within the 2000 setback line, and all but seven of those structures are on Springs Avenue along the island's narrow south end. Twenty-two of those structures were completed since 1988 with a total value of \$35.9 million. The majority of those structures were part of the rebuilding effort following Hurricane Hugo in 1989 that caused extensive property damage to the island. The challenges at Pawleys Island will continue to be shifting shoreline conditions particularly along Midway and Pawleys Inlets.

The final part of the study incorporated public input from focus groups along the coast. Focus group meetings were held in Charleston, Myrtle Beach and Hilton Head in late October 2008. Primary concerns expressed by the public with respect to shoreline management related to negative effects on private property particularly regarding restrictions on beach stabilization structures. Among management options, the public preferred beach nourishment to stabilize beaches and protect property, while expressing concern over the concept of retreat as a long range strategy. In terms of who should pay the cost for beach stabilization, the most often cited sources were local communities and property owners. There was a general concern that one size does not fit all in terms of shoreline management options. While the general sentiment was toward more local control, there was at least some realization that local authority might go hand in hand with greater local and private responsibility including bearing the bulk of beach stabilization costs.

A primary objective of the state's beachfront management program is to promote good decision-making by both public and private entities. A central theme in discussions with coastal managers was the need for better data bases on coastal processes and shoreline change including simulation models to identify vulnerable areas. Ultimately, the aim is to provide good information at the point of contact of individual decisions along the shoreline where the ultimate responsibility must rest. Information exchange must be targeted to user needs and include the provision of technical assistance to local governments and educational programs for the public.

A significant finding of this study is that the state's shoreline, at least in beachfront municipalities and resort communities, has been stabilized in recent years due in large part to a series of beach nourishment projects at an estimated cost of \$ 252 million. Beach nourishment is a viable option to stabilize the beachfront, although it is expected that it will be a more costly option with greater frequency of application and additional oversight over sand borrow areas to address rights of access, near shore sand movement, and ecological considerations. In addition, the important question of who pays must be addressed – to not do so would be fiscally irresponsible. Coastal tourism is vital to the state's economy, and adequate revenue options to support healthy beach communities must be in place. It is essential therefore that local governments be given a full menu of revenue sources to address impacts associated with changing shoreline configurations.

Effective shoreline management requires a mix of management tools as no one approach will fully address the implications of change under dynamic shoreline conditions. Although less of a regulatory impact than originally envisioned, setbacks can and should be used to delineate areas with a high vulnerability and an implied risk as part of both beachfront and estuarine shoreline management plans. State investments should provide leverage to assist local governments to adopt long-term approaches to address shoreline change. While not used extensively, abandonment and relocation should be a larger part of the funding mix as those two options may in some cases be far more cost effective than other management options including shoreline stabilization. Strategic retreat also must be included as part of the management mix. Difficult to implement and not an option of choice in highly developed beachfront communities, retreat may be the only long-term option in some communities where the projected loss does not warrant costly and recurring beach stabilization efforts.

Moving forward, the state will continue to bear a responsibility to protect public trust resources and to provide a baseline regulatory framework. Yet, the new round of beachfront management can and should build on the considerable expansion of local government capacity in South Carolina over the past 30 years since the implementation

of the state coastal management program. Although local government entities have the authority to restrict development in high hazard areas, greater proactive involvement on the part of local entities is becoming more common and should be encouraged. At the same time, that added authority comes with greater responsibility to minimize potential development conflicts and to bear costs associated with corrective actions. A new round of local beachfront management plans should be developed reflecting physical characteristics, development patterns, areas of vulnerability, shoreline protection options, and funding strategies. Technical assistance should be provided by the state in developing and implementing those plans.

Once again, a primary role of the state should be to assist individuals and local governments to make more informed decisions. In that capacity, assembling and distributing information is essential with adequate resources necessary to accomplish that task. Individuals as well as government entities must take a long-term view in addressing shoreline change. A series of short-term fixes will lead to costly recurring corrective actions. Intergovernmental coordination is often a problem because of overlapping responsibilities and should be addressed with information sharing and technical assistance to develop sound local plans that complement and add an additional layer of authority to the state plan. Resources to develop and implement the next round of beachfront management at both the state and local levels must be made available. Sound planning at this point in time will result in substantial cost avoidance in the long-run.

Table of Contents

<i>Executive Summary</i>	i
Introduction	1
Part I: Trends and Outlook for Shoreline Management among Coastal States	3
Part II: Changes along the South Carolina Coast since the Beachfront Management Act	39
Part III: Focus Group Meetings	61
Summary and Conclusions	64
Appendices	69
References	127

List of Tables

Table 1.	Regional Program Characteristics	13
Table 2.	Hard Stabilization Use and Average Ease* of Implementation, by Region.....	16
Table 3.	Soft Stabilization Use and Average Ease* of Implementation, by Region	16
Table 4.	Modification of Development Use and Average Ease* of Implementation, by Region.....	17
Table 5.	Level of Funding for State Coastal Management Programs.....	20
Table 6.	Funding Commitments for Shoreline Management Options.....	22
Table 7.	Funding Commitments for Shoreline Management, by Region	22
Table 8.	Incorporation of Innovation into Current Shoreline Management Programs.....	24
Table 9.	Anticipated Incorporation of Innovation into Current Shoreline Management Programs.....	25
Table 10.	Incorporation of Accelerated Sea Level Rise into Current Shoreline Management Programs	26
Table 11.	Innovation & ASLR Incorporation into Shoreline Management Plan, by Region	26
Table 12.	Development Pressure Perception	27
Table 13.	Ranking of States on Innovation Criteria	31
Table 14.	The First Innovation Criterion for the Innovative States	31
Table 15.	South Carolina Population Estimates and Change by Coastal County, 1970-2007	40
Table 16.	South Carolina Population Projections and Change by Coastal County, 2007-2035	41
Table 17.	Relative Shares of Population and Economic Activity along the Coast of the Carolinas and Georgia for the Year 2000	42
Table 18.	Change in Beachfront Area (acres) Since Beachfront Management Act.....	45
Table 19.	Beach Nourishment Projects along the South Carolina Coast.....	46
Table 20.	Source of Revenues for Beach Nourishment Projects along the South Carolina Coast	48
Table 21.	Development History at Hilton Head.....	51
Table 22.	Development History of Hilton Head: Beachfront Properties.....	51
Table 23.	Development History of Hilton Head: Parcels with Structures Intersecting or Seaward of the Setback Line.....	52
Table 24.	Hilton Head Development Summary	53
Table 25.	Pawleys Island Development History	57
Table 26.	Pawleys Island Development History: Beachfront Properties	57
Table 27.	Development History of Pawleys Island: Parcels with Structures Intersecting or Seaward of the Setback Line.....	58
Table 28.	Development Activity on Pawleys Island	59
Table 29.	Issues Identified in Focus Group Meetings.....	63

List of Figures

Figure 1. Coastal States in the U.S.	4
Figure 2. Predominant Shoreline Type.....	12
Figure 3. Hard Stabilization Options.....	13
Figure 4. Soft Stabilization Options	15
Figure 5. Development Modification	15
Figure 6. Rating of State's Shoreline Management Plan	18
Figure 7. Greatest Needs Identified by Coastal Managers	19
Figure 8. Impediments to More Effective Coastal Management	21
Figure 9. South Carolina Coastal Change over the Past 20 years.....	44
Figure 10. South Carolina Beach Renourishment Projects.....	47
Figure 11. Hilton Head Island.....	49
Figure 12. Pawleys Island	56
Figure 13. Development within the Setback Line of Pawleys Island	60

Appendices

Appendix 1. Coastal Manager Survey	70
Appendix 2. Innovation Initiatives of Coastal State Management Programs	77
Appendix 3. Follow-up Coastal Manager Questions	83
Appendix 4. South Sea Pines Historical Shorelines.....	88
Appendix 5. North Sea Pines Historical Shorelines	89
Appendix 6. Forest Beach Historical Shorelines.....	90
Appendix 7. Shipyard Historical Shorelines.....	91
Appendix 8. Palmetto Dunes Historical Shorelines.....	92
Appendix 9. Folly Field Historical Shorelines.....	93
Appendix 10. Port Royal Historical Shorelines	94
Appendix 11. South Sea Pines Development.....	95
Appendix 12. North Sea Pines Development	96
Appendix 13. Forest Beach Development	97
Appendix 14. Shipyard Development	98
Appendix 15. Palmetto Dunes Development	99
Appendix 16. Folly Field Development	100
Appendix 17. Port Royal Development.....	101
Appendix 18. Pawleys Inlet Historical Shorelines	102
Appendix 19. Springs Avenue Historical Shorelines.....	103
Appendix 20. Myrtle Avenue - South Historical Shorelines	104
Appendix 21. Myrtle Avenue - Middle Historical Shorelines.....	105
Appendix 22. Myrtle Avenue - North Historical Shorelines	106
Appendix 23. Atlantic Avenue Historical Shorelines	107
Appendix 24. Midway Inlet Middle Historical Shorelines.....	108
Appendix 25. Pawleys Inlet Development	109
Appendix 26. Springs Avenue Development	110
Appendix 27. Myrtle Avenue - South Development	111
Appendix 28. Myrtle Avenue - Middle Development.....	112
Appendix 29. Myrtle Avenue - North Development.....	113
Appendix 30. Atlantic Avenue Development.....	114
Appendix 31. Midway Inlet Development.....	115
Appendix 32. Participant Responses to October 2008 Focus Group Meetings.....	116

Introduction

Oceanfront areas are dynamic natural systems influenced by wave energy, tidal action, nearshore currents and changes in sea level elevation. In their natural state, barrier islands and mainland beaches migrate as one or more of the shoreline determinants change. The predominant trend in recent geologic time has been one of gradual erosion that followed rapid sea level rise at the end of the last Ice Age. Over the past century, sea level rose by an average of 17 cm. The prospect of accelerated global warming suggests that the historical record may be too conservative a trend line when projecting shoreline conditions over the next century (IPCC, 2007).

Although natural systems gradually adjust to changing shoreline configurations, the proliferation of post-World War II coastal development has increased the frequency and severity of conflicts between shifting coastal systems and static human development patterns. Those conflicts were instrumental in the establishment of the US Coastal Zone Management Program and associated state coastal programs. Shoreline protection has been an integral part of the State of South Carolina's Coastal Management Program (SC CZMA, 1978). In 1986, the state convened a Blue Ribbon Panel to address issues of shoreline change, culminating in the South Carolina Beachfront Management Act of 1988 (amended in 1990). The Act established baseline conditions and building setback lines based on historical erosion rates in an attempt to minimize conflicts between development and changing shoreline conditions. Despite these efforts, the rapid rate of coastal development continues in South Carolina and around the country. Compounding the development proliferation problem, the prospect of accelerated shoreline change makes it essential that shoreline protection plans be reviewed and updated periodically.

Now more than 20 years since the Beachfront Management Act's adoption, the state of South Carolina has initiated an assessment of current conditions and options for addressing shoreline change. As part of this process, the Office of Ocean and Coastal Resources (OCRM) of the South Carolina Department of Health and Environmental Control (SCDHEC) convened the Shoreline Change Advisory Committee comprised of coastal experts, academics, NGOs, local and state officials, and industry representatives. The Committee has been meeting over the past 18 months to make coastal management and program change recommendations.

To augment and parallel their efforts, SCDHEC-OCRM tasked the Clemson research team to generate the following:

- a compilation of literature-based historical and emerging approaches to coastal management;
- an in-depth assessment of states' self-identified coastal management needs and innovations in addressing shoreline change and accelerated sea level rise (ASLR), as well as a detailed critical analysis of the perceived failures in the present coastal management system on a national scale;
- an examination of the physical changes and development patterns in coastal South Carolina, both pre- and post-Beachfront Management Act, to determine whether the legislation has had its intended effect; and
- a compilation of coastal South Carolina stakeholder input on program effectiveness, potential for application of innovative management strategies culled from other states, and suggestions for improvement to the South Carolina Coastal Management Program.

This report is divided into three parts, with associated methodological detail and findings in each. Part I includes the trends and outlook for shoreline management across coastal states with certified coastal management programs, gathered from a literature review, legal analysis, state coastal manager surveys, and in-depth interviews with innovative states. Part II examines the physical changes and development patterns along the South Carolina coast since the Beachfront Management Act, showing the physical manifestations of the law and associated coastal management policies. Part III includes the findings from focus group meetings with South Carolina coastal communities on current and future South Carolina coastal management, as well as the reception to shoreline management innovations used in other coastal programs.

Part I: Trends and Outlook for Shoreline Management among Coastal States

Part I of the project used four methodological steps to triangulate findings on the historical, current and emerging forms of shoreline management in the U.S., particularly focusing on recent and emerging innovations for addressing shoreline change. The research objectives were to identify state-level shoreline management innovations across geographically diverse coastal areas, to trace their derivation and to assess their applicability in different contexts, particularly as they relate to shoreline management in South Carolina.

To do so, the researchers started with a literature review of primary and secondary documentation on evolving trends in shoreline management, focusing particularly on the period after the initial implementation of state coastal zone management programs. This review allowed the team to locate a full range of management approaches, which were integral in the survey construction in Step 3. The second step involved extensive legal research, including gathering and generating a database of all available statutes, state-level implementing agencies' rules and regulations, and state or area-level management plans (where available), across 30 coastal states (including the Great Lakes states). The team sought to determine if, where and how shoreline management innovation was occurring in the guiding legal authorities for each coastal program. In the third step, the researchers built on Susanne Moser and John Tribbia's ASLR local-level coastal management survey in California, adapting and significantly altering it to apply to the current study's research objective. (Moser and Tribbia, 2007) The survey served two purposes; first, to verify the innovations, tools and coastal management evolution revealed in the legal analysis and second, to give insight into future or anticipated innovations not yet codified in the program's guiding authorities. In the fourth step, the researchers created a weighted set of criteria for defining "innovation," since the coastal literature has yet to do so.¹ The criteria allowed the team to narrow the states to those with the most innovative shoreline management approaches since the inception of the coastal management program, and the team then followed up with 1 – 2 hour phone interviews with those coastal managers to determine the causes for inception and promulgation of the innovation(s).

¹ Although there is no innovation work, Hershman et al. conducted sound research in 1999 on the effectiveness of the CZMA and states' programs (individually and collectively) in meeting aspects of the law (Hershman et al. 1999). Our innovation assessment compliments these findings, adding a new dimension to possible evaluation measures in coastal management.

For the purposes of this research, the team defined “coastal” as a state that borders the Atlantic or Pacific Oceans, the Gulf of Mexico, or the Great Lakes (Figure 1). Illinois and Wisconsin were not part of the statutory analysis in Step 2 but were included in the survey. Illinois has a formerly-approved program and currently manages its shoreline while working toward re-approval. Wisconsin was included in the survey process because its lack of statutory information increased the importance of gathering survey information, with the caveat that their responses could not be statutorily verified.

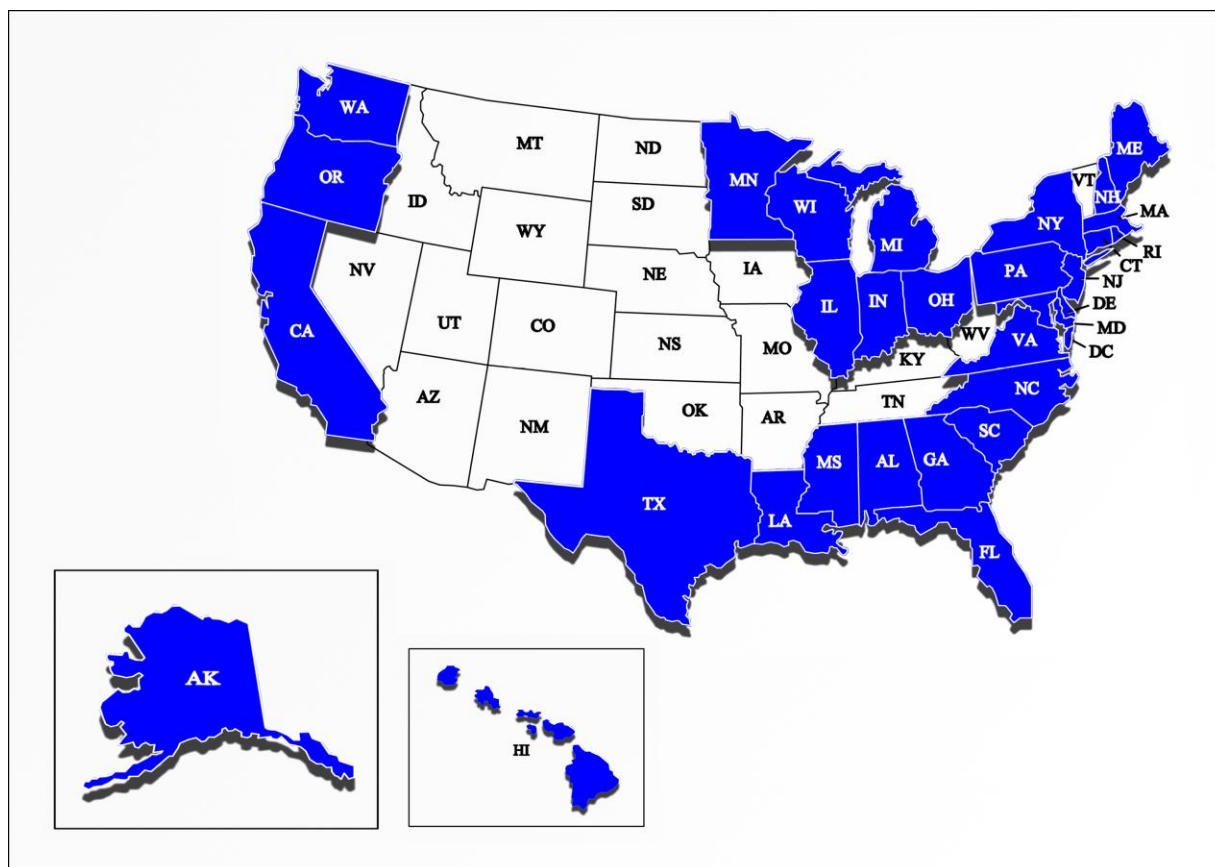


Figure 1. Coastal States in the U.S.

Step 1: Historic Analysis of Beachfront Management

As indicated above, coastal systems are dynamic, adapting to wind and wave energy at the land/sea interface. As a result, barrier islands and mainland beaches shift and migrate over time. Natural erosion occurs as the result of a variety of factors: basic processes that move sediment (wind, waves, and currents), the rate of rise and fall in

sea level, land subsidence, frequency and severity of storms, total volume of sand size, and seasonal fluctuations. (Beatley et al., 2002) Natural erosion can therefore be long-term (as the result of sea-level rise), short-term (in response to seasonal fluctuations), or episodic (due to storm events). (NRC, 1995; NRC, 1990; Platt, 1985)

Although shorelines have been retreating on balance since the end of the last Ice Age, the focus on shoreline management has been more recent. Development of beachfront areas as recreational areas began in the US in the 18th Century. In Southern states, planters began to move their families to summer beach cottages to escape the fever that seemed to occur more frequently at plantation houses along the rivers. Still, beachfront development comprised of relatively low density beach cottages did not warrant large scale intervention.

By the early Twentieth Century, federal coastal management still consisted of navigation improvement and the National Seashore Program. (Platt, 1985) The era of Army Corps of Engineers (the Corps) civil works projects expanded with the realization that shoreline erosion was threatening established beach communities, such as Cape May and Long Branch/Monmouth, New Jersey. (O'Brien, 1984) In 1930, Congress' Public Law 71-520 authorized the Corps to provide comprehensive erosion studies in collaboration with state agencies. (NRC, 1995) The Corps subsequently created the Beach Erosion Board, which initially used hard structures such as groins, jetties, and seawalls to stabilize the coast. Beach renourishment was considered an option as well, although extensive use came about in subsequent decades (NRC, 1995). The hard structure approach to stabilization appeared successful, largely because coastal development was less intensive and because longer-term impacts weren't immediately or blatantly manifested.

However, heavy development pressure in the post-World War II era has exacerbated the conflicts between natural beach systems and human development patterns. New highway projects and higher rates of automobile ownership associated with increased per capita income began to carry people out of the city to homes in commuter suburbs. More expendable income resulted in greater leisure time, and the nation's coastal areas became increasingly valued for their recreational opportunities. Witnessing the great economic development that could occur in these areas, coastal towns began to market themselves more aggressively to tourists. This trend accelerated through the 1950s and 60s, and soon people began to view coastal regions of the US as places not only to vacation, but also to create permanent year-round homes. This year-round trend continued with older generations retiring to coastal communities with favorable year-round climates and has expanded to include people of all ages favoring coastal communities in a variety of climates (Beatley et al., 2002; NRC, 1995).

Post-World War II development generated stronger pressure to protect beachfront property from retreating shorelines and spawned two major shifts in shoreline management practice. The first was toward beach nourishment rather than hard structures to protect property. A principal factor in this shift was the loss of public beach, an unexpected by-product of hard stabilization structures. The second major shift was one of institutional change through federal and state coastal management programs to address both development and resource management issues in the coastal zone.

In 1969, the Stratton Commission recognized that conflicting uses and resource management in coastal areas were exceeding local government's capacity. In its seminal report "Our Nation and the Sea" (1969), the Commission recommended the establishment of both the National Oceanic and Atmospheric Administration and state coastal management authorities implemented under the future Federal Coastal Zone Management Act of 1972 ("CZMA"). The CZMA enabled a federal-state partnership for coastal management (NRC, 1995; Stratton Commission, 1969), and, among the program provisions, Section 306 required participating states to develop a shoreline erosion management program to study and evaluate ways to control or lessen the impact of shoreline erosion and to restore areas negatively affected by of such erosion (CZMA,1972).

The trends in shoreline management shifted after the establishment of the CZMA. Although the Army Corps' beach stabilization efforts continued to be an important component of erosion control, coastal zone management brought in a third approach largely based on regulatory and planning tools. State action in coastal zone management is a two-part process. On a broad scale the federal government sets the guidelines; on a more narrow scale the state then has flexibility within those guidelines to use coastal zone management techniques that fit its unique characteristics and needs. There are several trends currently emerging on the national level.

When considering how to manage the shoreline, there are three general approaches recognized: (1) protect the shoreline, (2) retreat from the shoreline, and (3) accommodate erosion and shoreline change (Deyle et al., 2007; Titus, 1998). Protecting the shoreline includes traditional armoring and structural reinforcement like those projects completed by the Corps in the early Twentieth Century. Retreat uses tools such as the rolling easement and setback lines to encourage development to move back from the shoreline as it erodes (Deyle et al., 2007). The third approach, accommodation, suggests short-term accommodation by elevating structures and/or the land, and longer-term approaches such as setbacks, prohibiting development, and limiting (or prohibiting) above ground infrastructure (Deyle et al., 2007). Within these

three general approaches, there are multiple techniques and tools used for implementation, and there are four frameworks within which to do this on the state level: (1) regulatory measures, (2) planning tools, (3) direct land management, restoration, and acquisition, and (4) information provision, i.e. disclosure and mapping (Heinz Center, 2000). The research team examined all four forms. After many coastal states established successful coastal zone management programs in the late 1970s and early 1980s, they began to experiment with the planning and regulatory tools available to them and tailor their coastal zone management programs to their individual state needs.

For instance, in South Carolina, the Coastal Management Program was adopted in 1977, and the Blue Ribbon Committee on Erosion was established in 1986 to consider specific options to ameliorate coastal erosion. The Committee findings led to the enactment of the South Carolina Beachfront Management Act in 1988, which mandated a Beachfront Management Plan. The plan formalized state policy on erosion along the state's beachfront. The Act also established a 40-year retreat policy, using a long-term erosion-rate based setback to limit development/shoreline erosion conflicts. (§ 48-39-280(A)) The Act was subsequently challenged in Lucas v. South Carolina Coastal Council 505 U.S. 1003 (1992), and the state amended the Act to allow construction seaward of the beachfront jurisdictional baseline. "Special permits" may allow property owners to build structures no larger than 5000 square feet seaward of the baseline, as far landward as possible, with no impact to the primary sand dune or active beach. Property owners understand that they build at their own risk; if the beach erodes, and the permitted structure is situated on the active beach, DHEC-OCRM may order the property owner to remove the structure (§ 48-39-290 (D)) Even with the special permit concession, South Carolina's Beachfront Management Plan is recognized as one of the best in the nation at informing the public of the hazards of building along the shore. (Vernberg and Vernberg, 2001)

Nationally, it is estimated that approximately 350,000 structures are located within 500 feet of the nation's beachfront (including ocean, gulf, and Great Lake waters) in the lower 48 states and Hawaii. That number does not include metropolitan areas like New York, Chicago, Los Angeles and Miami. (Heinz Center, 2000) Currently, costs to coastal property owners from losses due to shoreline erosion amount to \$530 million per year. Over the next 60 years, it is estimated that shoreline erosion will claim one in every four homes currently located within 500 feet from the shoreline. (Heinz Center, 2000) Shoreline management policy is now poised at a critical precipice. Several new issues with the potential to greatly influence shoreline management effectiveness and individual states' policy responses have been emerging on the national level since 2000. Climate change effects are anticipated to manifest in accelerated sea level rise that gradually inundates coastal areas, causing an increase in erosion and flooding from

coastal storms, increased flood risk, stronger hurricanes, and increased biodiversity threats (Deyle et al., 2007). Accelerated sea level rise will have four major impacts concerning comprehensive coastal planning: (1) inundation and shoreline recession, (2) increased flooding from severe weather events, (3) saltwater contamination of ground water and surface water supplies, and (4) elevated coastal water tables (Deyle et al., 2007). These impacts have major implications for the coastal zone. They require changes in land use that account for varying scenarios and management tools that can implement the changes. The remaining analysis examines the state of coastal management and emerging innovations and adaptations in light of the new challenges brought on by continued coastal development patterns.

Step 2: Legal Analysis

As previously mentioned, the CZMA permitted each voluntarily-participating state to determine its own program structure and accordingly allocate power between state and local governments. The five program structures that evolved are:

1. Direct (a single state agency regulates);
2. Direct / LCP (a single state agency regulates but may delegate power to a local government under a local coastal program [LCP]);
3. Networked (a single state agency coordinates the activities of other state and local agencies who have regulatory power);
4. Networked/LCP (same as Networked with the addition of enforceable LCP);
5. Networked/Regulatory (a lead state agency shares regulatory authority with other state agencies) (Hershman, p. 134, citing to NOAA (1998)).

Consequently, program structure and power (as well as its legal location) differ considerably by state (Beatley et al., 2002; Christie and Hildreth, 1999), increasing the difficulty in direct comparison across programs. NOAA has a review of each state CZM program (see <http://coastalmanagement.noaa.gov/mystate/>), which served as the regulatory starting point and a source for the innovation assessment described in step four. Individual program descriptions are available at their associated NOAA and individual websites.

Despite the structural differences, legal authorities are likely to harbor innovations and trends in state-level coastal management. In order to receive NOAA program approval, “. . . the program must identify the means and legal authorities by which the state can carry out the program and the organizational structure to implement the program.” (Christie and Hildreth, p. 63) By comparing the content codified in the statutes and other guiding legal authorities, the team could identify and assess the volume and

specificity of the innovations, as well as the regularity of program updates. Arguably, volume and specificity correspond to clear guidance, implementability, and possible enforceability of innovative coastal management planning. The regularity of regulatory amendment indicates an attention to/actual program evaluation (per NOAA requirements) and an ability to incorporate innovation. The team's analysis of the legal authorities ultimately was used to determine whether innovation and management success or failure could be correlated with institutional structure and codification.

Methodology

To do so, the methodology involved a compilation of all available statutes, associated statutes referenced within the coastal management statutes (whether described in the official program or through searching terms related to coastal management in the state's statutory section of the legal database, LexisNexis), state-level implementing agencies' rules and regulations codified in administrative codes or agency handbooks, and state or area-level management plans (where available) across 30 coastal states. In general, state-level comprehensive coastal plans beyond initial CZM plans were noticeably absent.

The guiding legal authorities were compiled into a matrix that provided basic information about the legal structure supporting the programs, and the significant variation in quantity of statutes or other legal authority and content associated with different programmatic structures. It documented the location/title of the coastal management statutes and administrative codes, the years in which they were first adopted and then significantly amended (e.g. incorporating retreat or ASLR strategies), references to other codes, quantity of shoreline-related statutes/rules/regulations, and content-based analysis. That analysis included the statutory and/or program rule citation(s) of shoreline management or erosion control (if at all) and whether there were provisions for "erosion," "shoreline retreat" or "plans" (including their sections and a quick summary of approach where present). The volume of statutes, rules and regulations varied widely from state to state, with over 1800 in California, and only one in Massachusetts. Surprisingly, 15 states did not refer to erosion control directly in their statutes.

Seeing little to no pattern in the content or volume of statutes, rules, and regulations, the researchers created a second matrix. This matrix had two purposes: to ascertain if there was specificity in the statutes and rules guiding the plans, and to verify information gathered during surveys of the coastal managers. This matrix also allowed analysis of connections between the statutes, rules, regulations, and plans. It contained a set of potential management tools for coastal retreat, culled and modified from Schwartz et al.'s *Encyclopedia of Coastal Management* (2005) and the literature review. The tools were categorized into the following groups: hard stabilization (e.g. seawalls, revetments,

jetties, bulkheads, groins, etc.), soft stabilization (e.g. beach renourishment, vegetation, bulldozing, etc.), modification of development (e.g. differential tax districts, building elevation, utility and service line location, seller notification, etc.), retreat policies (e.g. abandonment, relocation, setbacks—fixed and rolling, hazard zoning, etc.), and an “other”/innovation groupings. If the tools were enumerated in the statutes and/or the administrative codes, their location was recorded, accompanied by a brief note (where needed).

Findings

The two matrices revealed a pattern in codification; namely, that the majority of tools and innovations—if present—were codified in administrative codes, not the coastal management statutes themselves. This may be attributed to the fact that agencies have more discretion when they interpret statutes to create their rules and regulations. Changing or adding a tool in a statute requires state-level legislative approval, which can be politically-charged and contentious.

Additionally, the institutional program structure did not appear to be correlated with the quantity or specificity of statutes, verified by a crosstab in the survey analysis in Step 3. Eleven states have one main statute governing shoreline management. Three states have two statutes, and nine states have three or more statutes. The amount of statutes, and number of code sections for both the statutes and the administrative codes vary significantly from state to state and within institutional frameworks.

Having a shoreline management plan in place allows a coastal state to manage its shoreline in an organized manner on the state level by incorporating mandates from the statutes, rules, and regulations into one document available to a variety of users. Shoreline management plans can be manifested in a variety of forms, and there are varying ideas as to what constitutes a shoreline management plan. Part of the variation in shoreline management plans has to do with different interpretations of ‘beach’ and ‘shoreline’ and associated terms that have similar and sometimes interchangeable definitions. Even states that do not claim to have a shoreline management plan do in fact use many of the tools that comprise such a plan; these tools could instead be promulgated in the state’s statutes, rules and regulations, or other plans not specifically denoted as a shoreline management plan. For this study, a shoreline management plan is defined as an overarching plan to manage all coastal areas of the state in place and available to the public. Currently, three states have an overarching shoreline management plan in place. South Carolina has a Beachfront Management Plan that is a result of the Beachfront Management Act the state passed in 1988. Rhode Island has a series of special area management plans that manage the shoreline, and Texas has an erosion control plan entitled “Texas Coastwide Erosion Response Plan.” The

remaining twenty-two states consider their shoreline management plan to exist in combination of their statutes, rules and regulations, and plans. Finally, eighteen states refer to erosion and erosion control in their coastal management statutes. For the majority of states, erosion control is a focus in their statutes, meaning that it should also be incorporated into rules, regulations, and plans.

Step 3: Survey of Coastal States' Managers

The survey had three purposes: (1) to gather information not available in the codes (e.g. innovations, costs, and information on data), (2) to verify content or identify discrepancies in the regulatory matrices, and (3) to examine perceptions of the programs by program officers (as compared to independent assessment solely through the codes).

Methodology

The survey was designed to be administered over the phone in 15 – 30 minute pre-arranged interviews with the head coastal manager or a designee. All 30 coastal state managers were contacted by phone and e-mail, with both a copy of the study protocol and the survey itself. They were asked to set up a time to conduct the survey. Not all interviews were conducted with the head coastal manager; in some cases another member of the coastal management staff responded or the coastal manager and another coastal management staff member completed the survey together. Twenty-nine of the 30 coastal states participated; only Alaska was unavailable. Survey responses were compared with the actual legal structure, confirming or contradicting the verbal responses.

Building off of the structure from Moser and Tribbia's (2007) California survey, the 14-question survey structure was divided into four main sections, including: Coastal Characteristics and Shoreline Management Tools; Shoreline Management Planning and Regulations; Data and Funding Issues Related to Shoreline Management; and Innovations and Future Directions for Shoreline Management (Appendix 1). It included a combination of 5-point Likert-scale ranking, multiple choice, yes/no, and open-ended formats, depending on the section and topic. Questions with the potential for political or otherwise sensitive responses were contained in one group of the survey (Shoreline Management Planning and Regulations, Questions 7-9) with an identifying label stating that results would only be disseminated in aggregate format and that no state would be identifiable. In the survey, coastal managers were asked to identify shoreline management tools used in his or her respective state from a list of nineteen tools adapted from Schwartz et al.'s *Encyclopedia of Coastal Management* (2005) and the

literature review. To correspond to the matrices, the tools were broken into the categories of hard stabilization tools, soft stabilization tools, and modification of development tools. The response area included an opportunity for coastal managers to list other tools used in his or her state that were not found on the list.

Findings

The 29 respondent states vary in terms of shoreline type and geography. Nine of the states indicated that their predominant shoreline consisted of eroding bluffs and cliffs followed by six with barrier islands and another six with crystalline bedrock formations (Figure 2,). Most of the states indicated more than one shoreline type along various stretches of their coastline.

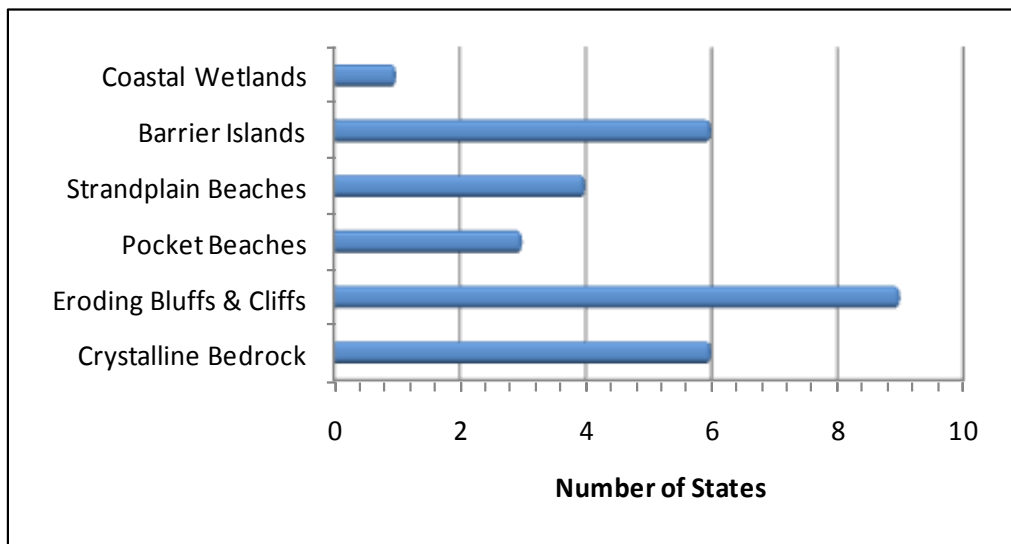


Figure 2. Predominant Shoreline Type

Understanding that the geographic differences may influence the shoreline management programs in each state, the research team analyzed the survey responses in total and by region. NOAA has defined different coastal regions, and for the most part, the team used their assessment. However, NOAA includes Florida in both the Gulf of Mexico and Southeastern regions. For the purposes of this research, the team included Florida only in the Southeastern region. Table 1: Regional Program Characteristics shows the basic program characteristics by region. All states with actual shoreline plans are on the Eastern seaboard or Gulf Coast. Additionally, the networked program structure was the most prevalent, regardless of region. It was distantly followed by the direct/LCP structure, which was largely found in the Gulf and West Coasts.

In assessing the tool choice across all of the states, the majority allow multiple forms of hard structures, with 27 states permitting jetties and 22 states permitting groins. Revetments (25), bulkheads (24) and seawalls (24) are all commonly used, although restrictions on new hard structure construction are increasingly prevalent (Figure 3). After statutory verification, of the 24 states that responded affirmatively to using seawalls in the survey, only 4 (South Carolina included) completely prohibit any new seawall use. With varying degrees of stringency, 13 of the 24 states continue to allow new seawall construction, provided that applicants meet enumerated criteria (e.g. circumstances, type of property, environmental effects, etc.) in a state-mandated permitting process.

Table 1. Regional Program Characteristics

Regional Grouping	No. of States in Each Region	Shoreline Plan			Institutional Structure				
		Yes, have an actual plan	Another element = the plan	No plan	Direct	Direct/LCP	Net-worked	Net-worked/LCP	Net-worked/Reg'y
Northeast	5	1	3	0	1	1	3	0	0
Mid-Atlantic	5	0	4	1	1	0	3	0	1
Southeast	4	1	3	0	1	0	2	1	0
Gulf of Mexico	4	1	3	0	0	2	2	0	0
West Coast	3	0	3	0	0	2	1	0	0
Great Lakes	7	0	5	2	1	0	2	1	3
Hawaii & Pacific Islands	1	0	1	0	0	0	1	0	0
Total	29	3	22	3	4	5	14	2	4

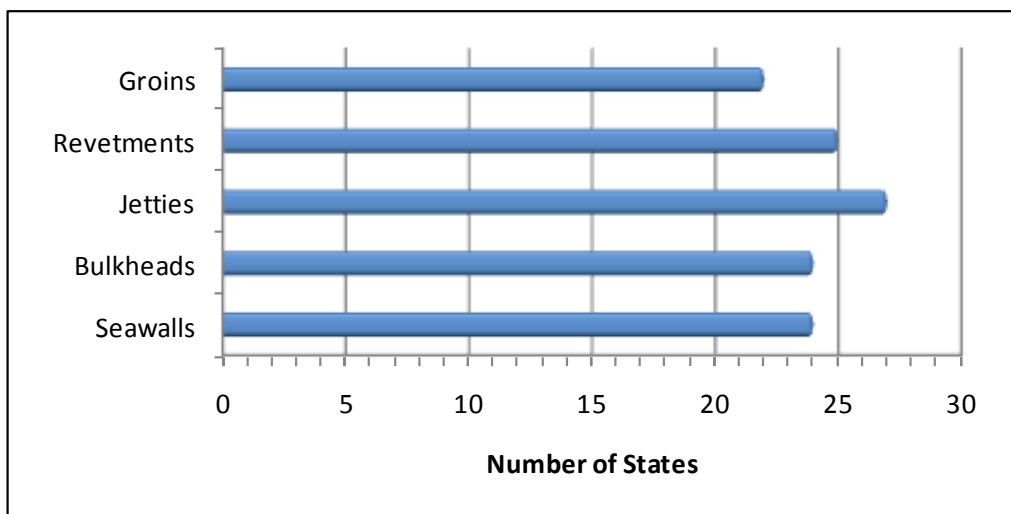


Figure 3. Hard Stabilization Options

When hard stabilization tools were examined by region (Table 2), seawalls are used in all states in the Northeast, the West Coast, and Hawaii. The Mid-Atlantic, West Coast, and Hawaiian regions have a majority—if not all—of their respective states using the full list of hard stabilization tools. However, the Northeast, Southeast, Gulf of Mexico, and Great Lakes states display more variation across the tools (Table 2). This is particularly interesting, considering that the managers' ratings of the average ease of implementation for each of the hard stabilization tools never exceeded a 3, or "average" on a 5-point Likert scale of 1 ("difficult") to 5 ("very easy"). Most were around 1, or in some circumstances, below 1 (where a respondent indicated "not applicable", which was scored with a 0). The discrepancy between tool use and ease of implementation can be explained by the fact that many of the hard structures were first utilized in the post-WW II coastal development boom, and that the prohibition at the state level is relatively recent. Additionally, there is a federal (if not state) environmental review now associated with hard structure placement, further complicating the implementation.

In response to impacts on public beaches associated with hard structure placement, states turned to soft stabilization options, and all but one state responded that it uses some type of beach nourishment program (Figure 4). Twenty-seven of those had an active vegetation program in place, while roughly two-thirds of the states allow bulldozing/scraping (20). Twenty states allow increasing sand dune volume, but they were not necessarily the same states using the other tools.

Regionally, there is only one state on the West Coast that doesn't use renourishment; all the rest of the regions have a 100% response rate to this tool (Table 3). And yet, the average ease of renourishment implementation ranges by region from 1 ("difficult") to 3.25 (slightly easier than "average"), with four regions averaging a 2 ("somewhat difficult") rating. The discrepancy may be attributed to cost of the process and the problem in locating available sand supply. Vegetation is used almost as ubiquitously; only one state in the Northeast and one on West Coast don't use the tool. For those using vegetation, the ease of implementation average by region ranges from 1.67 (slightly easier than "difficult") to 4 ("easy"), with six of the seven regions rating the implementation above 3 ("average"). Of the soft stabilization tools, vegetation and renourishment are geographically universal management strategies.

A more recent category in the shoreline management toolbox, the development modification tools are less likely to share the renourishment and vegetation ubiquity. The survey revealed that the most common development modification tool is land purchase (22), followed by fixed setbacks (20) (Figure 5). Other building restrictions included post hazard building limits (14) and rolling easements (13) with relocation and abandonment used to a lesser extent. Only nine states used limitation of utility or

service line extension (not shown in the figure). Variability in both definition and implementation policies exists in all of these tools, particularly rolling easements. The nuances and details of the evolution for these shoreline management tools will be explored in the interviews described in Step 4.

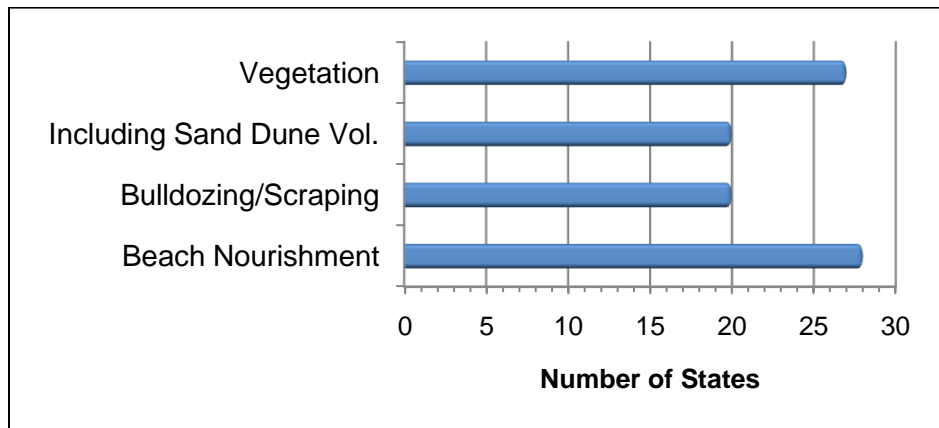


Figure 4. Soft Stabilization Options

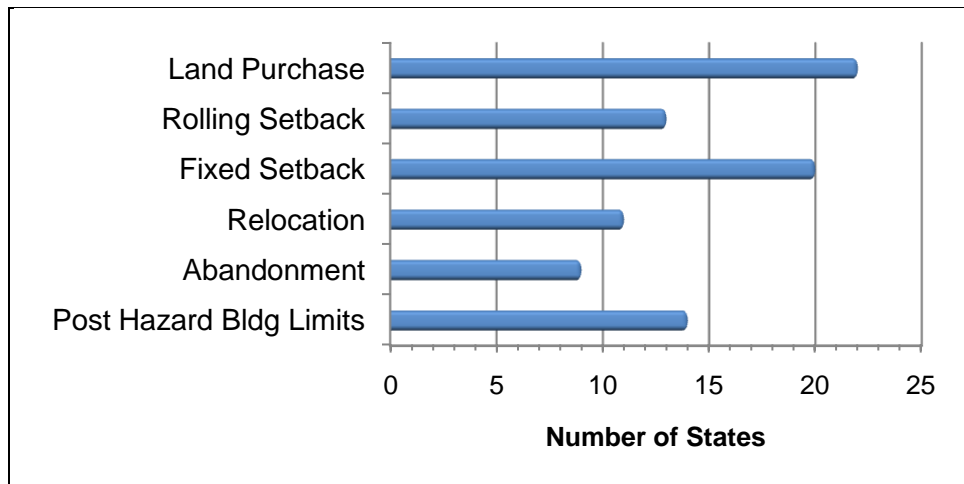


Figure 5. Development Modification

In the Northeast region, building elevation, fixed setbacks, hazard zoning, and land purchase were used by every state (Table 4). Only two of the five Northeastern states used utility or service line extension limitation and relocation, likely because of small amounts of remaining developable land. The Mid-Atlantic region was much more heterogeneous in its development modification tool use. Land purchase was the only ubiquitous development modification tool, and no state used utility or service line extension limitation. In the Southeast, hazard reconstruction limits and building elevation requirements were the two tools used by all four states, with three states using fixed setbacks. There was no universal tool in either the Gulf of Mexico or Great Lakes

Table 2. Hard Stabilization Use and Average Ease* of Implementation, by Region

Hard Stabilization Tools	Northeast (5 states)	Mid-Atlantic (5 states)	Southeast (4 states)	Gulf of Mexico (4 states)	West Coast (3 states)	Great Lakes (7 states)	Hawaii (1 state)
Seawall	5 100%	4 80%	2 50%	3 75%	3 100%	6 85.7%	1 100%
Avg. Ease	1	1.2	1.62	0.75	1.33	1.27	2
Bulkhead	4 80%	5 100%	2 50%	4 100%	2 66.7%	6 85.7%	1 100%
Avg. Ease	1.25	1.8	1.88	1.75	0.67	2.29	3
Jetty	4 80%	5 100%	4 100%	4 100%	3 100%	6 85.7%	1 100%
Avg. Ease	1.25	1.6	2.88	1	0.33	1.86	3
Revetment	4 80%	5 100%	3 75%	2 50%	3 100%	7 100%	1 100%
Avg. Ease	1.25	2.2	2.62	1.5	1.67	3.57	3
Groin	3 60%	5 100%	4 100%	2 50%	2 66.7%	5 71.4%	1 100%
Avg. Ease	1	1.6	3	1.25	0.33	1.93	3

* Any value below 1 indicates that at least one respondent answered "not applicable", which was scored with a 0.

Table 3. Soft Stabilization Use and Average Ease* of Implementation, by Region

Soft Stabilization Tools	Northeast (5 states)	Mid-Atlantic (5 states)	Southeast (4 states)	Gulf of Mexico (4 states)	West Coast (3 states)	Great Lakes (7 states)	Hawaii (1 state)
Beach Renourishment	5 100%	5 100%	4 100%	4 100%	2 66.7%	7 100%	1 100%
Avg. Ease	3.25	3.2	2.75	2.25	1	2.57	2
Bulldozing/Scraping	4 80%	4 80%	2 50%	2 50%	3 100%	4 57.1%	1 100%
Avg. Ease	2	2.8	1.25	2	2	1.79	3
Dune Addition	4 80%	4 80%	4 100%	4 100%	2 66.7%	2 28.6%	0 0%
Avg. Ease	3	2	3.5	2.38	1	1	0
Vegetation	4 80%	5 100%	4 100%	4 100%	2 66.7%	7 100%	1 100%
Avg. Ease	3.25	3.8	4	3.12	1.67	3.86	4

* Any value below 1 indicates that at least one respondent answered "not applicable", which was scored with a 0.

Table 4. Modification of Development Use and Average Ease* of Implementation, by Region

Modification of Development Tools	Northeast (5 states)	Mid-Atlantic (5 states)	Southeast (4 states)	Gulf of Mexico (4 states)	West Coast (3 states)	Great Lakes (7 states)	Hawaii (1 state)
Hazard Reconstruction Limits	3 60%	3 60%	4 100%	1 25%	1 33.3%	2 28.6%	0 0%
Avg. Ease	0.75	1.4	1.25	1	0	0.71	0
Building Elevation	5 100%	4 80%	4 100%	3 75%	3 100%	3 42.9%	1 100%
Avg. Ease	3.12	2.3	1.75	1	2.33	1.29	4
Low-Density Development	3 60%	1 20%	2 50%	0 0%	2 66.7%	3 42.9%	1 100%
Avg. Ease	1.25	0.4	0.5	0.25	0.33	1.36	2
Utility/Service Line Limits	2 40%	0 0%	1 25%	2 50%	1 33.3%	3 42.9%	0 0%
Avg. Ease	0.25	0.6	0	0.25	0	1.29	0
Abandonment	3 60%	1 20%	1 25%	1 25%	2 66.7%	1 14.3%	0 0%
Avg. Ease	0.75	0.2	0.75	0.25	1.33	0.29	0
Relocation	2 40%	1 20%	2 50%	2 50%	3 100%	1 14.3%	0 0%
Avg. Ease	1	0.2	1	0.5	1	0.29	0
Fixed Setback	5 100%	5 100%	3 75%	2 50%	2 66.7%	2 28.6%	1 100%
Avg. Ease	1.75	1.4	1.5	0.75	0.67	0.71	3
Rolling Setback	3 60%	2 40%	1 25%	1 25%	2 66.7%	3 42.9%	1 100%
Avg. Ease	0.25	0.6	0.75	0.5	0.67	1.29	2
Hazard Zoning	5 100%	4 80%	1 25%	3 75%	3 100%	5 71.4%	0 0%
Avg. Ease	1.25	0.6	0.75	0.75	2	2.29	0
Land Purchase	5 100%	5 100%	2 50%	2 50%	2 66.7%	5 71.4%	1 100%
Avg. Ease	0.75	1.4	1	1	1	1.86	2

* Any value below 1 indicates that at least one respondent answered "not applicable", which was scored with a 0.

region states; rather, three out of the four Gulf of Mexico states used building elevation and land purchase. On the West Coast, all three states used building elevation, relocation, and hazard zoning, with only one state using post-hazard reconstruction and utility or service line extension limitations. For all of the regions, the average ease of implementation for the modification of development tools were relatively low, ranging from less than 1 (where other states' "not applicable" responses average into the rating from the state(s) using the tool) to at most, 3.12 (slightly above "average") on only one tool. The majority were just slightly above 1, suggesting that these tools are much harder to implement. This is likely attributed to the resurgence in property right protection, and resistance to regulatory shoreline management (see discussion in Step 4).

To determine the perceived success or failures of their coastal management programs, the coastal managers were asked for an overall rating of their state's shoreline management plan. This question was included in the section of questions that assured anonymity. Two of the respondents rated their state's program a 5 on a 5 point scale, with two other respondents rating their state's efforts a 2 on that same scale (Figure 6). Beyond those four outliers, the remainder of the ratings ranged from 3 to 4. The mean rating for all states was 3.46, suggesting that state programs are at least adequate in addressing shoreline management, but that there may be some opportunity for improvement. The shoreline managers' assessment of their shoreline plans cannot be broken down by region because at least one state would be identifiable.

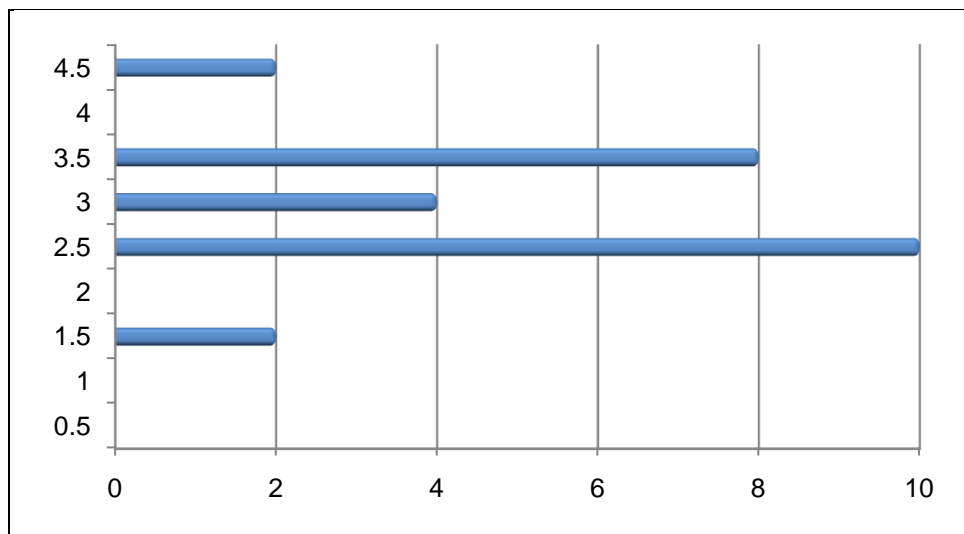


Figure 6. Rating of State's Shoreline Management Plan

Data can change the quality of a plan and associated shoreline management decisions. Consequently, the most frequently cited need was data, identified by 16 of the

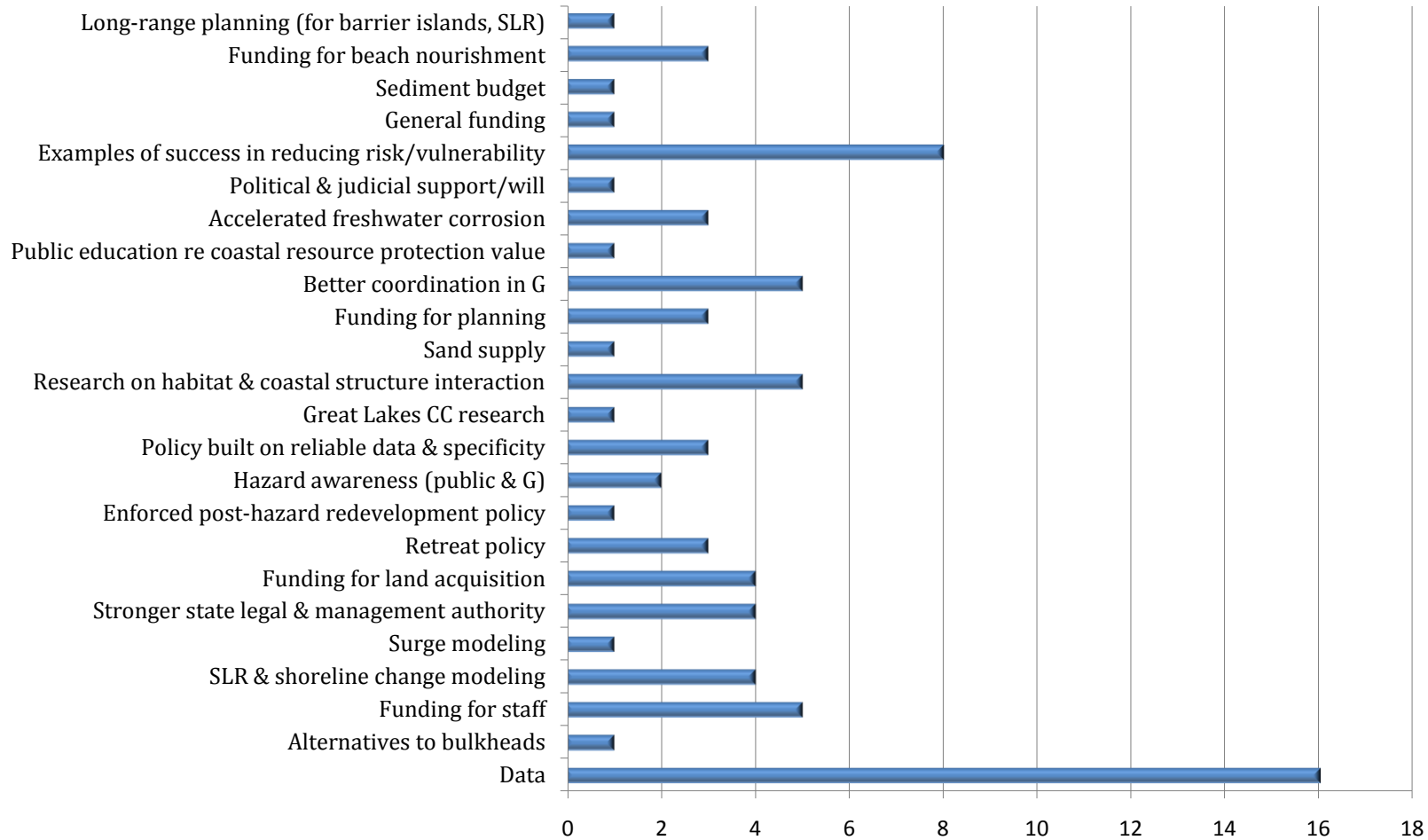


Figure 7. Greatest Needs Identified by Coastal Managers

respondents (Figure 7). Other information needs included examples of success in reducing risk/vulnerability (8) and more research and modeling capability (4). Collectively, funding issues were often cited, including staff funding (7) and funding for land acquisition (4), beach nourishment (3), and planning (3). Better coordination (7) and greater authority (4) were the next most cited needs.

The greatest impediments to coastal management were the lack of both funding availability (10) and environmental regulatory support (10), followed closely by no data (9) (Figure 8). Jurisdictional issues were also mentioned frequently (7) and lack of local support figured prominently (6), which is logically supported by the fact that the majority of the programs were networked, increasing their reliance on interjurisdictional cooperation. The impediments reinforce agency need for resources.

Despite the ubiquity of the funding impediment, the funding resource disparity between programs is substantial, with a range of less than \$1 million in one state to more than \$15 million in four states (Table 5). The vast majority of states (75 percent of the total responding states) have a funding level between one and five million dollars per year.

Table 5. Level of Funding for State Coastal Management Programs

Funding	Frequency	Percentage	Valid Percent
Less than \$1 million	1	3.4	3.6
\$1 - \$4,999,999 million	21	72.4	75
\$5 - \$9,999,999 million	2	6.9	7.1
\$15 million or greater	4	13.8	14.3
Sub-total	28	96.6	100
Missing	1	3.4	
Total	29	100	

The level of funding commitment for shoreline management options varies among states (Table 6). Among states with beach nourishment programs, a third of the programs (8) have no funding availability while another two states indicated that staff time was the extent of state commitment. The majority were in the Northeast and the

Great Lakes states (Table 7). The remaining states indicated that funding varied by year. A majority of those states having funding availability were able to calculate average appropriations, while a lesser number of states found that figure difficult to estimate. For states with land conservation programs, more consistency and funding assurance appears to exist. Average or exact estimates are available for half of the states with land conservation programs. Only three states indicated that no funding for

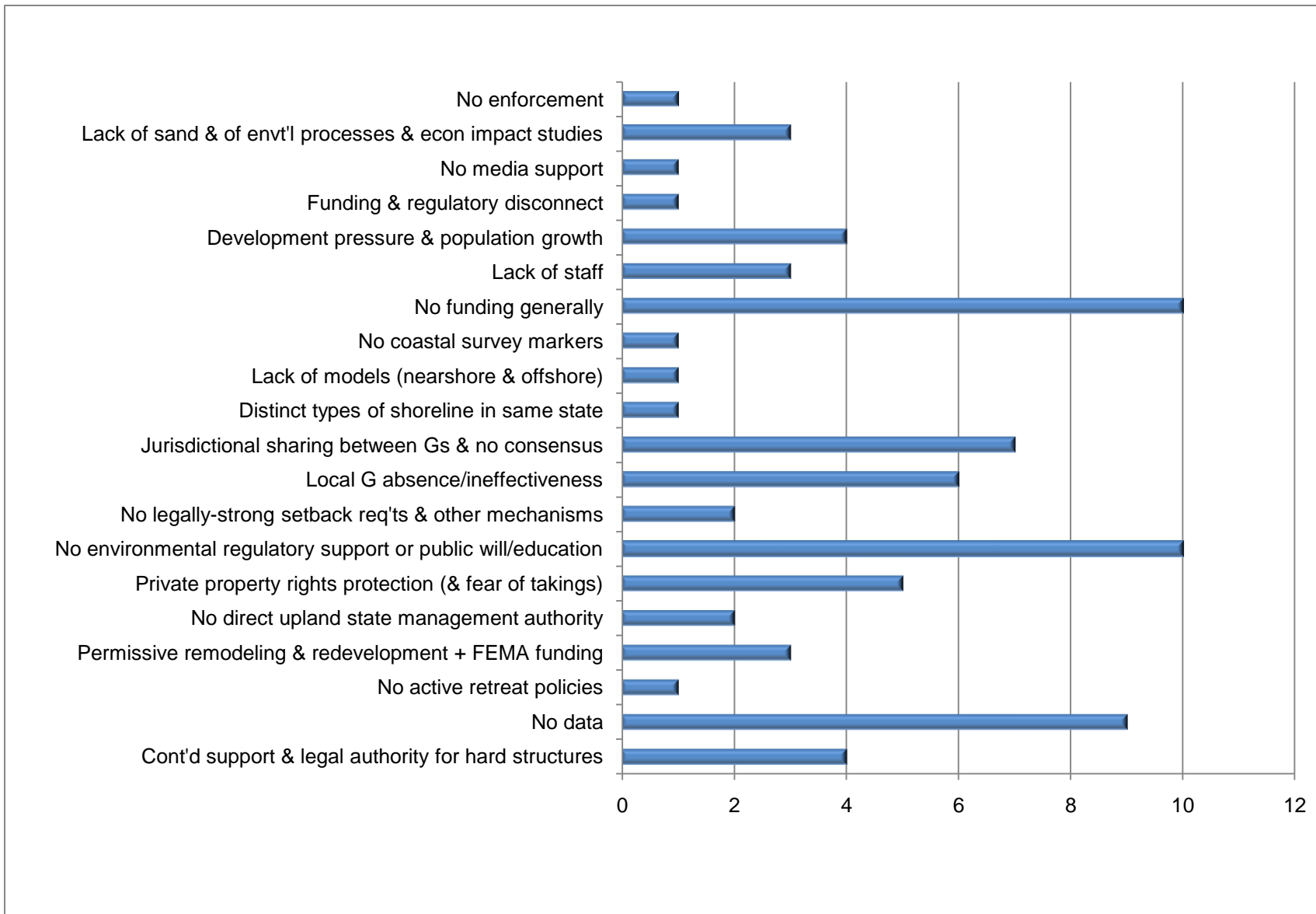


Figure 8. Impediments to More Effective Coastal Management

the program existed. Retreat programs exist in 15 states. Of those states, four have no funding while another four states have minimal support except for staff time.

Table 6. Funding Commitments for Shoreline Management Options

	Beach Nourishment Fund	Land Conservation Fund	Retreat Fund
Zero	8	3	4
Varies year to year	3	5	1
Average estimate	7	9	4
Minimal except employee	2	1	4
Difficult to estimate	4	1	1
Exact amount available	0	1	1
Not applicable	4	8	13
Sub-total	28	28	28
Missing	1	1	1
Total	29	29	29

Table 7. Funding Commitments for Shoreline Management, by Region

Region	Commitments	Zero	Varies year to year	Average estimate available	Minimal except employee time	Difficult to estimate	Exact amount available	Not applicable	Total
Northeast (5 states)	Beach nourishment	3	0	0	0	1	0	0	4
	Land conservation	1	1	1	0	0	0	1	4
	Retreat	1	0	0	0	1	0	2	4
Mid-Atlantic (5 states)	Beach nourishment	1	1	1	0	2	0	0	5
	Land conservation	1	0	2	0	1	0	1	5
	Retreat	0	0	1	2	0	0	2	5
Southeast (4 states)	Beach nourishment	1	1	2	0	0	0	0	4
	Land conservation	0	1	2	0	0	0	1	4
	Retreat	1	0	1	0	0	0	2	4
Gulf of Mexico (4 states)	Beach nourishment	0	0	1	0	1	0	2	4
	Land conservation	0	2	1	0	0	0	1	4
	Retreat	1	1	0	0	0	0	2	4
West Coast (3 states)	Beach nourishment	0	0	1	1	0	0	1	3
	Land conservation	0	0	1	0	0	0	2	3
	Retreat	1	0	0	1	0	0	1	3
Great Lakes (7 states)	Beach nourishment	3	1	2	0	0	0	1	7
	Land conservation	1	1	2	0	0	1	2	7
	Retreat	0	0	2	0	0	1	4	7
Hawaii (1 state)	Beach nourishment	0	0	0	1	0	0	0	1
	Land conservation	0	0	0	1	0	0	0	1
	Retreat	0	0	0	1	0	0	0	1
	Total	15	9	20	7	6	2	25	

The “not applicable” response is attributed to one of at least two possibilities. First, the state may not use the tool, and funding is not applicable. Second, the tool may be in use, but the funding structure is supplied by another source, such as matching grants between the Corps and local governments. That also explains the lack of beach renourishment funding and/or the minimal commitment, except for staff time.

Part of the iterative shoreline management planning process is identifying failures where they occur. As addressed earlier, states need data and funding, followed by additional information and stricter regulations, plans, and policies. Further investigation into data collection impediments and access and quality improvements are merited. States rely on data to aid in the development of shoreline management strategies and to support these strategies. Increased quality and availability of data will boost coastal managers’ knowledge in various areas, allowing them to significantly enhance the quality of shoreline management. In this study, it became apparent that some states are developing methods of shoreline management that use data and funding wisely. For example, Maine has developed efficient and cost-effective field surveys that include personal watercraft-based beach profiling and volunteer teams doing monthly beach profiling. Such methodology is inexpensive, but does generate consistency questions, and substantial time must be spent on training. However, methods such as this shed light on the future of shoreline management and also what can be accomplished when these creative methods are combined with increased data and funding.

To gather the current set of innovations across coastal U.S. states, such as the one in Maine, the respondents were asked to list any innovations or new approaches to shoreline management strategies in their state, particularly those related to shoreline change. Twenty-six of the twenty-nine states identified innovations that varied in quantity and approach, and are included in Appendix 2: Innovation Initiatives of Coastal State Management Programs, but most of them fell into the category of planning tools and plans. This is encouraging because it suggests a possible increase in states using more comprehensive shoreline management plans or modification of development tools to control pressure on the shoreline before it begins. The category of mapping, modeling, data, and photography was the second highest innovation category. States recognize their need for data and information and are actively developing new methods that will boost shoreline management. For example, Georgia completed a digital representation of all historical shoreline positions, which provides electronic reference of all shoreside structures and will aid in assessing value of homes in the event of coastal hazards. Delaware and Florida are embarking on regional sediment management activities. Hawaii has an Ocean Resources Management Plan that identifies the land/ocean connection, sets out to preserve ocean heritage, and promotes stewardship and collaborative governance.

The innovation list was also a starting point for characterizing innovation (as further described in Step 4), ultimately identifying nine states as “innovative”, and the remaining survey results compare both the larger survey respondents group as a whole (or by region) with the innovators. The innovative states, when compared to the larger group or base states, are only minimally different in their current levels of self-identified innovation (Table 8). Half of the base states indicated that they were currently incorporating innovative approaches into their shoreline management plans. Among innovative states, a slightly higher share of states (5 of 9) indicated that they were incorporating innovative approaches into their shoreline management programs. Implications of those ratings must be tempered by the fact that these are self-assessments and the innovative states may be setting higher expectations for themselves.

Table 8. Incorporation of Innovation into Current Shoreline Management Programs

	Frequency	Percentage	Valid Percent
Conventional States			
No	9	45	50
Yes	9	45	50
Sub-total	18	90	100
Missing	2	10	
Total	20	100	
Innovative States			
No	4	44.4	44.4
Yes	5	55.6	55.6
Total Frequency	9	100	100

Carrying that assessment a step further, 54.5 percent of respondents from the base states indicated that they anticipated incorporating innovation into their shoreline management programs. Among innovative states, only 33 percent (3 of 9) anticipated incorporating additional innovation into their shoreline management plans in the near future (Table 9). Again, this discrepancy may be attributed to the fact that the innovative states have already incorporated some of those changes and are starting from a higher base.

States have been managing the effects of sea level rise since state programs were initiated. Yet, as previously mentioned, the prospect of accelerated sea level rise

(ASLR) from climate change is becoming a more serious problem for coastal managers, and several coastal managers suggested that the issue of ASLR could be a catalyst for

Table 9. Anticipated Incorporation of Innovation into Current Shoreline Management Programs

	Frequency	Percentage	Valid Percent
All States			
No	5	25	45.5
Yes	6	30	54.5
Sub-total	11	55	100
Missing	9	45	
Total	20	100	
Innovative States			
No	6	66.7	100
Yes	3	33.3	
Total Frequency	9	100	

better shoreline management plans. Among state coastal managers surveyed, 42.1 percent of respondents indicated that ASLR was or would be incorporated into their shoreline management plans (Table 10). The majority of the Northeast, Mid-Atlantic, Southeast and West Coast states has or will do so (Table 11). Only one state in the Great Lakes region has incorporated ASLR into its management plan (Wisconsin), but the Great Lakes are projected to drop in sea level, and Wisconsin intends to incorporate the effects of climate change more generally. In contrast to the base group, 88.9 percent (8 of 9) of innovative states respondents indicated that ASLR is or will be included in their shoreline management plan. Here again, some variability exists in the accounting for sea level rise, ranging from an incorporation of historical trends into setback lines (not based on future acceleration) to a more proactive incorporation of accelerated sea level projections into shoreline configurations with corresponding building restrictions or retreat strategies. Additionally, one of the innovation assessment criteria was whether a state incorporated ASLR into its coastal management planning, which introduces some bias into the comparison. Finally, several state coastal managers stated that they and their staff recognize ASLR as an important issue, but some of the same obstacles identified as impediments or needs in coastal management impede action on ASLR. These impediments include lack of formal recognition for climate change and sea level rise on the state government level, lack of the necessary scientific data to completely address it, or lack of assurance in methods to address it.

Table 10. Incorporation of Accelerated Sea Level Rise into Current Shoreline Management Programs

	Frequency	Percentage	Valid Percent
All States			
No	11	55	57.9
Yes	8	40	42.1
Sub-total	19	95	100
Missing	1	5	
Total	20	100	
Innovative States			
No	1	11.1	11.1
Yes	8	88.9	88.9
Total Frequency	9	100	100

Table 11. Innovation & ASLR Incorporation into Shoreline Management Plan, by Region

	Innovation incorporated?		ASLR incorporated?	
	Yes	No	Yes	No
Northeast	2	2	4	0
Mid-Atlantic	2	3	4	1
Southeast	2	2	3	1
Gulf of Mexico	2	2	2	2
West Coast	1	1	2	1
Great Lakes	4	3	1	6
Hawaii	1	0	0	1

And they must accommodate this with perceived or real development pressure. Using a question from Moser and Tribbia (2007), survey respondents were asked to rank their perception of their development pressure in each state’s coastal zone on a 5-point Likert scale, with 1 being no development pressure and 5 being extreme development pressure. The average pressure was 3.75, which falls closest to 4 on the Likert scale (“significant development pressure”). Coastal managers of some states rated development as falling between two numbers on the Likert scale. These states display a development/redevelopment pressure-rating ending in 0.5 (Table 12).

Table 12. Development Pressure Perception

State	Development/ Redevelopment Pressure Rating	Percent Change of Persons per Coastal Mile (2000-2008)
Alabama	4.0	7.49%
California	4.0	4.04%
Connecticut	4.0	2.34%
Delaware	2.5	11.42%
Florida	4.0	13.05%
Georgia	3.0	10.73%
Hawaii	4.5	6.33%
Illinois	3.0	-0.23%
Indiana	3.0	3.43%
Louisiana	4.0	-8.78%
Maine	4.0	4.47%
Maryland	4.0	5.61%
Massachusetts	3.5	2.38%
Michigan	3.0	-0.67%
Minnesota	4.0	-0.64%
Mississippi	4.0	-1.42%
New Hampshire	3.0	7.62%
New Jersey	5.0	2.90%
New York	4.0	3.31%
North Carolina	4.0	13.77%
Ohio	4.0	-3.94%
Oregon	4.0	5.81%
Pennsylvania	3.0	-1.53%
Rhode Island	5.0	0.93%
South Carolina	4.0	19.67%
Texas	4.0	14.29%
Virginia	4.0	8.64%
Washington	3.7	10.42%
Wisconsin	3.0	3.02%

Several states disparately rated development pressure on different parts of their coastline, and their ratings were averaged. These states are Delaware, Pennsylvania, Georgia, and Louisiana. The Delaware shoreline consists of 77 percent state-owned land, which has little to no development pressure. In Pennsylvania, growth pressure

was described as a 2 (“slight”) on its Lake Erie shoreline and a 4 (“significant”) on its Delaware Bay shores. This difference is attributed to both the geology of bluffs and cliffs along Lake Erie and the high percentage of agricultural land use. Georgia only has four barrier island beaches accessible by car, and for those islands development pressure is a 5 (“extreme”). But for the remaining nine barrier islands managed by federal or state government, there is no development pressure, or a 1 rating. For these three states, development pressure is limited where state or federal government acquired the land. In contrast, Louisiana’s growth pressure variation is generated by different land uses, not land types. Louisiana rated its growth pressure as a 5 (“extreme”) for the land uses of oil, gas, port, and energy, but rated its pressure for residential development only a 3 (“moderate”). It is important to note that except in these cases, no state rated its development pressure as anything less than a 3 (“moderate”). All states feel that they are experiencing some level of development pressure but land areas owned by the state or federal government experience significantly less pressure no pressure at all. This suggests that land acquisition is one of the most powerful tools a state can use to protect coastal areas from increased growth.

The team then compared the accuracy of the perception with coastal population change from 2000 – 2008, to roughly compare relativity across states and verify the responses (Table 12). To do so, the team divided the population change of a state’s coastal counties from 2000 through 2008 by the miles of coastal shoreline available on each state’s NOAA CZM page (based on each state’s individual definition of its coastal zone). There were several embedded assumptions in this approach. First, the population estimates for 2008 were generated by the Census, with their associated estimation assumptions (Census, 2009a). Second, the coastal miles include undeveloped land (as indicated with the exceptional states above), but there was no way to distinguish developed and undevelopable land, so the figure for each state would be more accurate if offset by undevelopable land. Third, some states have a significant amount of development already at the coastline, so the discrepancy between the state coastal manager’s response and the actual population growth may be attributed to the desire to grow but an inability to support the population.

Generating the table also introduced potential for error through objectivity. The state coastal programs don’t delineate the coastal counties on their NOAA “my state” sites or on their own coastal program sites in most circumstances. To determine whether a state was “coastal,” the team started with NOAA’s list of coastal counties (NOAA no date), which is submitted to the Census Bureau. However, NOAA uses a fairly broad definition, including any counties with at least 15 percent of the coastal watershed within its bounds. The team narrowed the list by going to the county maps for each state

(Census 2009b), including only the counties with coastal and estuarine shoreline and those with tidal influence in their rivers.

The process resulted in some accurate, and perhaps understated development perceptions, as well as some that were quite overstated. Florida, North Carolina, South Carolina, and Texas all rated their development pressure a 4 (“significant”), and their percentage change exceeded 13 percent over those eight years. South Carolina’s assessment might be understated, given its 19.67 percent increase in population. In contrast, Louisiana, Minnesota, Mississippi, New Jersey and Rhode Island rated their development pressure at 4 or 5 (“significant” or “extreme”) but their actual population change was less than three percent, and even negative for a majority of those states. However, each state’s perceptions could take into account elements of development/redevelopment pressure greater than just population growth (e.g. land use). For example, Louisiana’s development pressure rating of a 4 (“significant”) was specifically for the land uses of oil, gas, port, and energy, which will not be directly reflected in population data.

The surveys from 29 out of a possible 30 coastal managers provided a fairly comprehensive and current snapshot of shoreline management and innovations around the country, but they could not reach the genesis of coastal management innovation. And from the population changes in Table 12, it is evident that regardless of the states’ perceptions, increasing coastal growth will inevitably collide with ASLR projections. The status quo in coastal management may or may not be effective with this new challenge, emphasizing the need for coastal management adaptation and innovation. In order to better identify the nuances in each state’s management, as well as to trace the innovation evolution and its replicability, the team conducted follow-up interviews with “innovative” states.

Step 4: Follow-up Interviews with Innovative States

Innovation Determination

Before tracing the innovation evolution, the team had to develop a methodology to compare innovative character, which would lead to follow-up, in-depth interviews with those states’ coastal managers. The team researched a model in the literature but found little guidance, save the plan assessment approach from Berke et al. (2006). The NOAA-CSO (2007) visioning findings state that “[i]nnovative [coastal management] ideas are those that address emerging issues or present new solutions for ongoing challenges” (p. 10). Consequently, the team generated its own criteria under this

definition, using a combined assessment of the legal analysis of the coastal states' statutes, rules, regulations, and plans (where available), the survey responses, and primary sources, tempered by their expertise in policy assessment.

The team determined innovation based on whether and to what extent a state exhibited the following five criteria:

- it used new tools or a unique combination of existing tools (located in the regulatory structure and/or self-identified in the surveys);
- it incorporated ASLR (or drop, if a Great Lakes state) into its regulatory structure;
- it had relevant specificity in its regulatory structure;
- it used a publicly-accessible physical plan to manage coastal areas; and
- it made information about shoreline management publicly and readily available via the Internet.

Using team input, the criteria were weighted to reflect their relative importance in determining innovation, and a final score out of a possible 7 total points (6 for the Great Lakes states, given the projected sea level drop) was assigned to each coastal state. However, through the point assignment, four states (AK, IL, MA, WI) were excluded because they either did not have the legal information available for analysis and/or had programmatic status issues, or they did not participate in the survey. Twenty-five of the 26 remaining states were eligible for the innovative program assessment.²

Ultimately, the seven states with scores at or above 4.5 were deemed innovative (Table 13). These states and their respective scores were HI (5), ME (6), MD (5), NY (4.5), OR (4.5), RI (6.5), and TX (5). The states of SC and NC, both of which fell slightly below the threshold, were added as regional bases of comparison.

In developing the first criterion, the team incorporated the NOAA-CSO (2007) findings showing that incorporating public outreach and knowledge may increase coastal management and stewardship support, in turn improving its effectiveness. It is also the reason for the fifth criterion. Additionally, although the coastal managers self-identified innovations in the survey, the team tempered their responses with the content in the regulatory instruments, identified innovations in the literature, and the ways in which

² California did not complete a few key elements of the survey, and was unavailable for response during the innovation assessment, so the state was not considered eligible for innovation comparison.

management tools were combined. Innovations identified for the nine innovative states are indicated in Table 14.

Table 13. Ranking of States on Innovation Criteria

Number of States	Score (7 possible; 6 for Great Lakes States)
1	6.5
1	6
3	5
2	4.5
1	4
6	3.5
4	3
4	2.5
2	1.5
1	1

Table 14. The First Innovation Criterion for the Innovative States

Innovative State	Use of 'other' tools and 'innovations' new to the literature or a unique combination of existing tools or unique management strategies
Hawaii	Ocean Resources Management Plan: the planning process increases public awareness and innovates by linking ocean and coastal resources management together, while maintaining/incorporating cultural customs, etc. The plan is updated and used regularly.
Maine	Combination of approaches, including: technological innovation for efficient and cost-effective field surveys (e.g. personal watercraft-based beach profiling, precision RTK-GPS dune edge and storm washover measurements, volunteer teams doing monthly Emery beach profiling)—process builds public awareness and investment in preservation, as well as a database for better management 100-year Erosion Hazard Areas WITH projected sea level rise impacts used to site beachfront development
Maryland	Combination of approaches, including: MD Committee on Climate Change, whose first charge is ASLR Initializing the use of the Living Shorelines concept—which is both legislatively supported and is now being implemented

Table 14 cont. The First Innovation Criterion for the Innovative States

Innovative State	Use of 'other' tools and 'innovations' new to the literature or a unique combination of existing tools or unique management strategies
New York	<p>Combination of approaches, including: Fire Island Project with the Corps of Engineers to address storm damage reduction along an 80-mile section of the South Shore of Long Island. The project uses multiple methods and gradually steps down engineering while increasing land use controls. Individually-tailored coastal plans generated for different parts of the coastline with public support/input Redevelopment in light of ASLR on hardened shores Prioritizes public access to the shores</p>
North Carolina	<p>Combination of approaches, including: Novel combination of estuarine, beach and inlet management planning Associated public education</p>
Oregon	<p>Combination of approaches, including: Dynamism of cobble berms (hard structures) Coordination of coastal management with the ocean resources plan Incorporation of upland land use in coastal planning Link for public outreach Continual studies and research</p>
Rhode Island	<p>Combination of approaches, including: Watershed zoning that has A ban on public infrastructure on barrier islands Barrier islands are zoned for development class 3 – which means 82% no residential or commercial structures Water type classifications with permissible activities Comprehensive special area management plans</p>
South Carolina	<p>Combination of approaches, including: Post-hazard reconstruction limits Focus on estuarine soft stabilization Prohibition of new erosion structures on the beach</p>
Texas	<p>Combination of approaches, including: Relocation monies Incentive-based setbacks Broader-scale home relocation e.g. Surfside, TX Successful implementation of rolling easements</p>

Interview Instrument and Methodology

Using the final seven innovative states, and adding both SC and NC because of the study location and geographic similarity, the team generated additional follow-up questions to examine the source of the innovation, how it evolved, the unique tools and approaches including approaches to accelerated sea level rise, the role of data in their management programs, and other questions related to possible improvement of coastal management programs at the state and federal levels (See Appendix 3).

To conduct the interviews, two researchers on the team contacted the coastal managers in the innovative states and set up 1 – 2 hour phone interview timeslots. With verbal permission from the interviewees, the conversations were recorded for comparison between interviewers and for transcription purposes. All innovative states participated, including TX, despite the aftermath of Hurricane Ike. The interviews took place over a two-month window, and were transcribed for analysis. The researchers who conducted the interviews examined the transcript responses for themes that explain the evolution of innovative approaches over time, as well as unique experiences in each state that promote/perpetuate successful coastal management, particularly with the advent of ASLR (or lack thereof). The responses were quite variable on some questions, and remarkably similar on others. In the findings that follow, the team noted the variability but did not attempt to reconcile it, given the contextual differences (e.g. public trust doctrine recognition, program structure, different regulatory authorities, etc.) for each state.

Findings

The findings emerged directly from the innovative states' coastal manager responses. Some may appear to contradict conventional interpretations of coastal management trends, but the research team is reporting the findings directly from the set of questions and associated responses.

Innovation Waves

First, there appear to be three waves of innovation, separated by decades. The majority of the initial but arguably most powerful innovations were products of foresight and the freedom that accompanied the CZMA and state-level program inception. Preceding the CZMA, TX introduced the first innovation wave with its provision for rolling easements in the Open Beaches Act in 1958, and OR followed with the Beach Bill and Statewide Planning Goals in 1967.

But the critical mass/crest of the second wave occurred in the late 1970s and early 1980s, as the state coastal programs were initially structured and certified, and there was a realization of beach/dune encroachment with a proliferation of erosion control

devices. RI adopted watershed zoning in 1981, granting both land and shoreline authority (particularly over upland land uses) to the state's direct programmatic structure. Numerous survey respondents lamented that they lacked this form of authority, which would otherwise have given them the power to prohibit development in vulnerable shoreline areas without takings challenges or problems with local government power-sharing. RI acknowledged that they would not be able to introduce this kind of control in the current, post-*Lucas* property rights climate. In 1983, HI adopted its first Ocean Resources Management Plan, creating a holistic, grass-roots land-ocean management approach with a similar intent to RI's watershed zoning. Three years later, ME adopted its Erosion Hazard Areas, allowing them to project out 100 years and mitigate development (through the Coastal Sand Dune Rules) in those erosion hazard areas. SC created the Blue Ribbon Commission and adopted its Beach Front Management Act in 1988, which created conservative setback lines for the entire state.

With the realization of ASLR and the economic viability of perpetual renourishment in question, the third wave began in 2001 and continues today. MD adopted the Living Shorelines program to replace hard structure protection or beach nourishment, instead using natural erosion control measures e.g. plantings. NY initiated the joint Fire Island/Army Corps project that gradually (over 50 years) reduces beach nourishment, replacing it with land use controls that remove development from more hazardous areas. NC adopted its Beach and Inlet Management Plan as an alternative to vertical structures.

The coastal managers attributed these waves to one of three sources; they were championed by a larger committee (e.g. MD, RI, SC), a creative, experienced CZM program and their coastal manager (e.g. NY, ME, HI, NC, RI, SC, OR), or legislation and a figure who shepherded it through (e.g. TX, NC, OR). Additionally, as the literature suggests (Bernd-Cohen and Gordon 1999), several other agencies such as the ME Geological Survey were instrumental in aiding the coastal program innovations, but they were not interviewed in this process.

Most of the first two waves of innovations were regulatory in character (Bernd-Cohen and Gordon 1999). But the third is much more cooperative and voluntary, gradually replacing older unsustainable engineering approaches with more realistic, physically-appropriate management strategies for the particular stretch of shoreline and its associated resources. It uses public-private or inter-agency partnerships to affect the shift from stabilization structures to more natural systems and eventual retreat in some areas.

The gentler approach can be attributed to several factors. The primary one is the anti-regulatory, property-rights environment that blossomed in the late 1980s and 1990s in response to the regulatory control over the predominately privately-owned shoreline. This spawned lawsuits that curtailed regulatory authority, using a Fifth Amendment violation (aka “takings”) argument. In fact, the majority of states mentioned a concern about legal takings (e.g. MD, NC, NY, OR, RI, SC, and TX). Almost every state has faced at least one takings challenge, and often several. The states that experienced precedent-setting challenges include OR, ME, TX, NC, SC, and RI. Of those, SC and RI’s cases were heard by the U.S. Supreme Court, and the outcomes—particularly the former—changed the course of coastal management and the larger body of regulatory takings precedent. (See Lucas v. South Carolina Coastal Council 505 U.S. 1003 (1992); Palazzolo v. Rhode Island 533 U.S. 606 (2001)) Post-*Lucas*, state coastal management authority is more constrained, and further confounded by the ever-increasing value of coastal property. NC and RI are always cognizant of the potential for takings suits, and it weighs heavily on local governments in NY and TX. MD has softened its approach, although it has never shied away from an action for fear of a lawsuit. For OR, the concern about a takings suit is integral to any action in which the networked program attempts to acquire coastal property through condemnation.

Local governments also were identified as an obstacle to implementation, particularly where the state coastal programs are networked (e.g. OR, NY). Six of the nine innovative states use a networked (or a variant) programmatic structure. Consequently, the third wave can also be explained by a need to encourage/cajole local support for approaches that may anger local constituents, particularly those wedded to status quo development patterns with unsustainable beach stabilization measures. The local support factor is confounded by another reason for the third wave: pure necessity in shorelines that are projected to be more susceptible to ASLR.

But approaches to accommodate ASLR are as varied as the state programs. The interviews revealed that there is inconsistency in the ability to do so, largely because there’s no uniform modeling process, and no academic or national consensus on SLR elevation projections. Every state is thinking about it, but there are varying degrees of implementation. Several were concerned about the range of estimates for inundation levels, which compound the problem of educating the public and mobilizing political support for retreat actions when public support diminishes with uncertainty. OR and ME were having success with an erosion simulation tool in working with local governments to educate and assist them in anticipating the effects of climate change. Other states called for better hard science and better inundation mapping/modeling. RI has had a positive experience with mapping local landmarks, making the potential inundation effects quite vivid for the public. But most states found it difficult to plan with widely

variable projections, and one state suggested that the federal government might aid the process by setting a threshold level for which to plan.

Innovation Toolboxes Compared

A product of the first innovative wave, eight of the states have a regulatory setback based on either erosion rates or distance measures, including HI, MD, ME, NC, NY, OR, RI, and SC. But the setbacks are perceived to have failed in the following ways: property rights interests often prevail through variances granted by state or local governments, and 30 or even 40 year erosion rates are considered too short a timeframe. NC was the only innovative state with a positive view that the regulatory setbacks are very successful. Alternatives to current setback provisions either proposed or already in place include banning infrastructure (RI), erosion hazard areas (ME), low/high risk zones (OR), and guidelines for erosion response plans for local governments (TX). One state posited that refusal to extend services is the best way to stop coastal development—whether at the local or state level.

In contrast, rolling easements are less ubiquitous than regulatory setbacks, but several states have some variant, including HI, MD, ME, NC, RI, and TX. Although the researchers quoted the Titus definition used by NOAA's OCRM, the definition is variable, and SC and HI noted the uncertainty this creates. The legal justifications and regulatory incorporation vary as much as the definition. RI incorporates a rolling easement concept in its deeds, while HI uses the public trust, and TX relies on the Open Beaches Act. A number of states are worried that the concept will be challenged. In fact, TX is currently defending a constitutional challenge to the Open Beaches Act and the rolling easement tool, brought by a rental property owner at the edge of Galveston. (See Severance v. Patterson, Docket No. 09-0387, Texas Supreme Court, no hearing date set) People are often loath to give up their property, even when faced with reoccurring, destructive events.

Consequently, only a few of the innovative states utilize abandonment and relocation. Of those that do, as a corollary to the rolling easement concept, TX has employed a structure relocation strategy with the Surfside community that became a public beach through erosion. But the state acknowledges that the tool would not work for Galveston and more urbanized areas. NC and RI employ local condemnation, justified by the police power. RI takes it a step further by using a suite of programs that “kick in and reinforce each other,” so that once a house is part of an active beach under the variant of a rolling easement, the state gets an order of removal. Building inspectors then condemn the structure, the septic must be taken out because it is beyond repair, and the state won't issue another septic permit, which is vital for rebuilding. So relocation is generally unpopular in urbanized areas but more possible in TX, based on the state statutes, and in less urbanized areas in the rest of the states. Quoting the TX coastal

manager, “if there's a general rule that can be drawn from these examples, the more intense the existing development, the more limited the options to deal with coastal erosion” (TX coastal manager, first survey).

Clearly, there is a difference between tools used in urban, residential and commercial areas, and those for relatively undeveloped areas. When asked about this, most of the states affirmed that they treated undeveloped areas differently. However, ME took a truly unique approach by attempting to ignore existing uses and focus on the natural geomorphology of the land. So they will notify someone in an urbanized area that they are actually on a dune, even if the dune is no longer physically there. But they recognize that their urban areas don't compare to some of the hardening in other coastal states, e.g. NY. Additionally, sheltered/estuarine coastlines—in terms of management tools, development pressure, and data needs—were all admittedly weaker for every state except MD.

Relationship between Land and Shoreline Management

Controlling the beach is clearly important to coastal management, which includes upland authority (where possible). Both RI and HI exercise control over the beach, through water zoning in the former and the public trust in the latter. But where that control is absent, other states have more difficulty in their coastal management programs and spend a lot of time educating local governments. Identified obstacles to innovative management strategies include concerns about the removal of hard structures and unintended coastal water quality effects. With astronomical coastal land costs, land acquisition is a prohibitively expensive adaptive measure in most coastal areas in the innovative states. In fact, the interviewees noted that the majority of innovative states lack a formal acquisition program, and few have made direct attempts to purchase land. Although the Coastal and Estuarine Land Conservation Program (CELCP) is popular as a tool, it is somewhat difficult to use. Coastal land is being set aside for other uses, such as part of state park systems (SC), open space and recreation (RI and HI), and for public access (NC). In more wealthy areas, some local governments have stepped in where the state has not, and imposed sales tax set-asides for land acquisitions e.g. South Hampton, NY. Hilton Head, another wealthy community on the South Carolina coast has successfully purchased land for conservation. But other, smaller local governments are concerned about the loss of tax base if property owners leave (whether by relocation, abandonment, or land sale to the state). Although a potential funding source, federal disaster mitigation funding is rarely used by any of the innovative states to acquire coastal property.

But several of the same coastal managers mentioned that they are preparing to act in anticipation of major events (e.g. Katrina) to introduce additional innovations that are otherwise publicly unpopular or currently prohibitively expensive. As suggested by the

second legal matrix, states confirmed that the most immediate responses to coastal issues come through agency administrative rules and regulations, not statutes. The failure to prepare in advance of natural disasters will in general result in missed opportunities.

Further Innovation Potential and Possible CZM Program Improvement

Despite all of this progress, every innovative state identified needs that would foster improvement and further innovation. For the ocean and beachfront management areas, six states (OR, ME, NC, SC, TX, RI) expressed a need for LIDAR mapping for the entire coast and three states (HI, MD, NC) sought better regional governance and data sharing between institutions. They asserted that the federal government should augment this process with better access to and data sharing, particularly LIDAR, as well as federal consensus and funding. Multiple states identified an impediment to data collection from lack of funding or staff; almost every state could use more staff for data analysis and would welcome additional hardware and software for processing. The states also identified the disconnect between universities and the federal government as a data collection impediment; this shortcoming needs to be reconciled.

In terms of federal coastal management more generally, there were two main viewpoints on future approaches. The first is that the federal government needs to decide how much it wants to affect coastal development and then mandate state action, condition funding support (e.g. infrastructure), and truly assume a hierarchical role. Otherwise, it needs to stop acting in recently-observed hierarchical manner toward partner states, and allow the states to assert the tools that prove effective in each—whether proof is directly quantifiable or not. If the federal government opts for the former, one state would like more provisions regarding regional ocean governance, while another thinks that there are good provisions for sub-regional planning in the CZMA that could be strengthened. The states were across the map about the concept of uniformity through the CZMA, with some critiquing the volume of performance standards while others were on the fence about increasing uniformity, and still others were arguing the necessity of core guidelines to make the program mandatory (particularly with a networked program that deals with local governments). From the responses, it appears that coastal management is more difficult with networked structures, despite OR's perceived success. Most states also cited the need for more localized, less standardized management (e.g. regional, place-based or watershed-based management), despite the fact that local and state management often diverge. States were concerned that the CZMA is spread too thin in too many areas, but all agree that states must now incorporate climate change into their coastal management programs adding another layer of complexity.

Part II: Changes along the South Carolina Coast since the Beachfront Management Act

The South Carolina Beachfront Management Act was enacted in 1988, to address conflicts between coastal development patterns and eroding stretches of the state's 198 mile shoreline. To minimize the potential for conflict, the act established baseline conditions with the setback lines established at 40 times the annual erosion rate for individual beach sections. Twenty years later, how effective has the state's setback provision been in protecting property along the state's shoreline? The following sections provide an assessment of the relative effectiveness of the beachfront management at protecting beachfront property and the public beach.

Demographic Trends

In South Carolina, population has grown steadily in recent decades, particularly in the coastal counties, the greater Columbia area, and along the Interstate 85 corridor. Since 1970, the state population grew by 70.1 percent compared to the national growth rate of 47.1 percent. The eight coastal counties in South Carolina grew by 116.6 percent, a rate 1.7 times the state average and 2.5 times the national average over the same time period. (US Census Bureau, 2008) Over that time period, six of the eight coastal counties exceeded both the national and state growth rates (Table 15). Population growth was particularly rapid in the coastal tourism based counties of Horry and Beaufort with the Myrtle Beach/Grand Strand beaches in Horry and Hilton Head and more recent off-island development in Beaufort County as principal drivers. Dorchester and Berkeley Counties also are experiencing rapid growth stimulated by inland expansion of the Charleston/North Charleston Metropolitan Statistical Areas (MSA).

The final report of the 2004 U.S. Commission on Ocean Policy notes that coastal counties grew between 25% and 90% for all coastal regions of the country except for the Great Lakes between 1970 and 2000. The Great Lakes numbers were much lower primarily because the cities of Detroit and Cleveland lost population during those three decades. The Southeast is among the fastest growing regions in the country, and coastal counties are experiencing much of that population increase. One of the drivers of population growth along the coast is projected to be the aging of the baby boom generation. Nationally 57 percent of population growth is projected to occur in the 65 and older age bracket over the next 30 years. It is estimated that 14 percent of the baby boom generation will relocate to the Carolinas and Georgia with much of this growth particularly in South Carolina occurring along the coast between 1995 and 2025 (Kleppel and DeVoe, 2000). That relocation will reinforce current conditions in the

Table 15. South Carolina Population Estimates and Change by Coastal County, 1970-2007

County	Population					% Change
	1970	1980	1990	2000	2007	1970-2007
Beaufort	51,136	65,364	86,425	120,937	147,316	188.10%
Berkeley	56,199	94,727	128,776	142,651	163,622	191.10%
Charleston	247,650	276,974	295,039	309,969	342,973	38.50%
Colleton	27,622	31,776	34,377	38,264	38,903	40.80%
Dorchester	32,276	58,761	83,060	96,413	123,505	282.70%
Georgetown	33,500	42,461	46,302	55,797	60,499	80.60%
Horry	69,992	101,419	144,053	196,629	249,925	257.10%
Jasper	11,885	14,504	15,487	20,678	21,953	84.70%
Coastal SC	530,260	685,986	833,519	981,338	1,148,696	116.60%
State of SC	2,590,713	3,122,814	3,486,703	4,012,012	4,407,709	70.10%

Source: Bureau of the Census, Population Estimates for selected years.

state's primary retirement areas. According to the 2000 Census, 15.6 percent of Beaufort County's population and 15.0 percent of both Horry and Georgetown County populations are 65 or older. Those figures compare to national and state averages of 12.4 and 12.1 percent, respectively. Although most of the new development and particularly the large retirement communities are off the beachfront, impacts on wetland and estuarine shorelines will be significant.

Population growth in the state and coastal region has been high and will continue to capture a substantial share of new growth in the Southeastern U.S. (DeVoe and Kleppel, 1995). That population growth is leading to still higher land conversion rates in the region. According to the U.S. Department of Agriculture's 1999 National Resource Inventory report on the 50 states, South Carolina had the 10th highest rate of conversion of undeveloped to developed land use 1992 and 1997, with 539,700 rural acres converted. On a per capita basis, the state had the 4th highest conversion rate during this time period (London and Hill, 2000). For South Carolina this acreage amounted to a 30.2 percent increase in the amount of developed land in the state over this five-year period compared to a 5.3 percent increase in population over this same time period, meaning that land conversion rates are occurring at six times the population growth rate. Urban growth trajectories for the future of coastal South Carolina indicate tremendous amounts of land conversion as indicated for the Charleston/North Charleston MSA, Beaufort County, and the Grand Strand Area (Allen and Lu, 2003).

The State Division of Research and Statistics projects a population increase of 33.3 percent for the eight coastal counties from 2007 and 2035 (Table 16). That figure compares to a state population projection of 27.9 percent. Using 2000 to 2030 figures for comparison, the coastal region of South Carolina is projected to grow at a rate 1.9 percentage points faster than the national average and 2.8 percentage points faster than the state average (US Census Bureau, 2008) although the state and county projections appear to be somewhat conservative given recent trends and continued activity along the coast despite the current economic downturn. Particularly rapid growth is projected in Beaufort and Horry Counties with population growth rates projected at 52.2 and 49.0 percent, respectively. Dorchester and Berkeley at 38.0 and 31.1 percent continue to grow as the Charleston/North Charleston MSA continues to spread inland. New growth in Jasper, Georgetown and Colleton Counties is occurring at or above the state average. Only Charleston County falls well below the state average as new growth continues to pull along the outer edges of the MSA.

Table 16. South Carolina Population Projections and Change by Coastal County, 2007-2035

County	Projected Population				% Change
	2007	2015	2025	2035	2007-2035
Beaufort	147,316	166,210	194,590	224,260	52.20%
Berkeley	163,622	172,940	194,080	214,570	31.10%
Charleston	342,973	347,910	365,450	386,140	12.60%
Colleton	38,903	42,940	46,260	49,540	27.30%
Dorchester	123,505	131,530	150,260	170,430	38.00%
Georgetown	60,499	68,250	75,530	83,080	37.30%
Horry	249,925	275,760	324,500	372,470	49.00%
Jasper	21,953	24,680	27,900	30,650	39.60%
Coastal SC	1,148,696	1,230,220	1,378,570	1,531,140	33.30%
State of SC	4,407,709	4,717,890	5,180,290	5,637,590	27.90%

Source: Bureau of the Census, Population Estimates for selected years.

While the neighboring states of Georgia and North Carolina are larger with population centers in Atlanta, Charlotte and Raleigh/Durham, South Carolina has a much heavier concentration of activity along the coast than either of the adjacent states. Based on 2000 Census figures, the relative share of the state population living along the South Carolina coast ranges from 21.5 to 23.9 percent depending on the classification used, more than twice the share of population living along the North Carolina coast and nearly

four times the share of Georgia’s population living along the coast (Table 17). Employment numbers are similar although South Carolina is the only one of the three states that has a still higher share of employment than population in the coastal zone reflecting the concentration of tourism and resort activity that exists currently.

Table 17. Relative Shares of Population and Economic Activity along the Coast of the Carolinas and Georgia for the Year 2000

State	Population		Employment	
	Oceanfront ¹	Coastal ²	Oceanfront ¹	Coastal ²
North Carolina	9.80%	9.80%	9.50%	9.50%
South Carolina	21.50%	23.90%	21.80%	24.10%
Georgia	5.40%	6.10%	5.20%	5.70%
Regional Average	10.20%	11.00%	10.10%	10.70%

Source: Bureau of the Census, Census of Population, 2000.

¹ Counties adjacent to the ocean.

² Counties classified as coastal in state coastal management program typically including those with tidal influence

Beaufort County is a prime example of a burgeoning coastal county in South Carolina. Located along the coast between Charleston (South Carolina) and Savannah (Georgia), the county is well known for historical downtown Beaufort, the resort island of Hilton Head, Hunting Island State Park and adjacency to the ACE Basin Nature Reserve. A mild winter climate, coastal amenities, and rich cultural heritage have not only attracted many in-migrants and retirees to move to this county but also led to large scale land development over the last decade. From 1990 to 2000, the county’s population increased by 39.9 percent from 86,425 to 120,937. The growth rate was triple the national average (13 percent) and led all counties in South Carolina during that time period. Targeted as one of the top seven retiree communities in the US, the county is anticipated to grow continuously at a rapid pace in the foreseeable future. Similar growth in other areas along the South Carolina Coast will create challenges given resource constraints and the extent of natural shoreline change within the state’s coastal zone.

Physical Trends

To examine shoreline change along the South Carolina coast, composite shorelines available for 1984-87 were overlaid with beachfront shorelines compiled for 1999 and 2006. The composite shoreline for the base period (1984-1987) compiled by NOAA's Coastal Services Center is a high-resolution vector representation based on multi-temporal shoreline manuscripts (T-sheets). Scales range from 1:5,000 to 1:20,000 with shoreline denoted at mean high water (MHW). Shorelines for 1999 and 2006 were updated from the earlier composite shorelines using Digital Orthophoto Quarter Quadrangles (DOQQs) from the South Carolina Department of Natural Resources. The 2006 shoreline estimates include polyline shoreline configurations compiled by Dr. Scott Harris at the College of Charleston for developed shorelines in the state. Both the 1999 and 2006 maps are based on high resolution vector shorelines at 1:3,000 and 1:10,000 scale.

Overlaying these shoreline delineations, 564 acres of beachfront have been lost over the past 20 years (Figure 9). Shoreline change has varied along the coast with Horry County having gained beachfront and Georgetown, Charleston, Colleton, Beaufort, and Jasper Counties having lost shoreline on balance. In general, municipal beaches gained beach area while unincorporated areas lost land. Municipalities gained 1102 acres from 1987 to 1999 offset in part by a loss of 318 acres from 2000 to 2006 for an overall gain of 784 acres (Table 18). Particularly through the 1990s gains in Myrtle Beach, North Myrtle Beach, Kiawah, Seabrook and Hilton Head accounted for the bulk of those earlier gains. Only Edisto Beach in Colleton County among municipalities lost land area on balance over the timeframe. For unincorporated areas, land losses were experienced during both decades with losses of 624 acres from 1987 through 1999 and 590 acres from 2000 through 2006 for a total loss of 1214 acres.

The bulk of the differences in shoreline change between municipal and unincorporated areas are due to beach nourishment activity that picked up during the early 1990s. According to figures compiled from State OCRM, local government entities and archival information, 45.9 million cubic yards of sand has been applied to South Carolina beaches at a cost of \$251.6 million (Table 19). The majority of that activity has occurred since Beachfront Management accounting for 73.5 percent of volume and 95.0 percent of total costs in current dollars. When adjusted for inflation, beach renourishment outlays are estimated to total \$325.2 million in 2008 dollars.

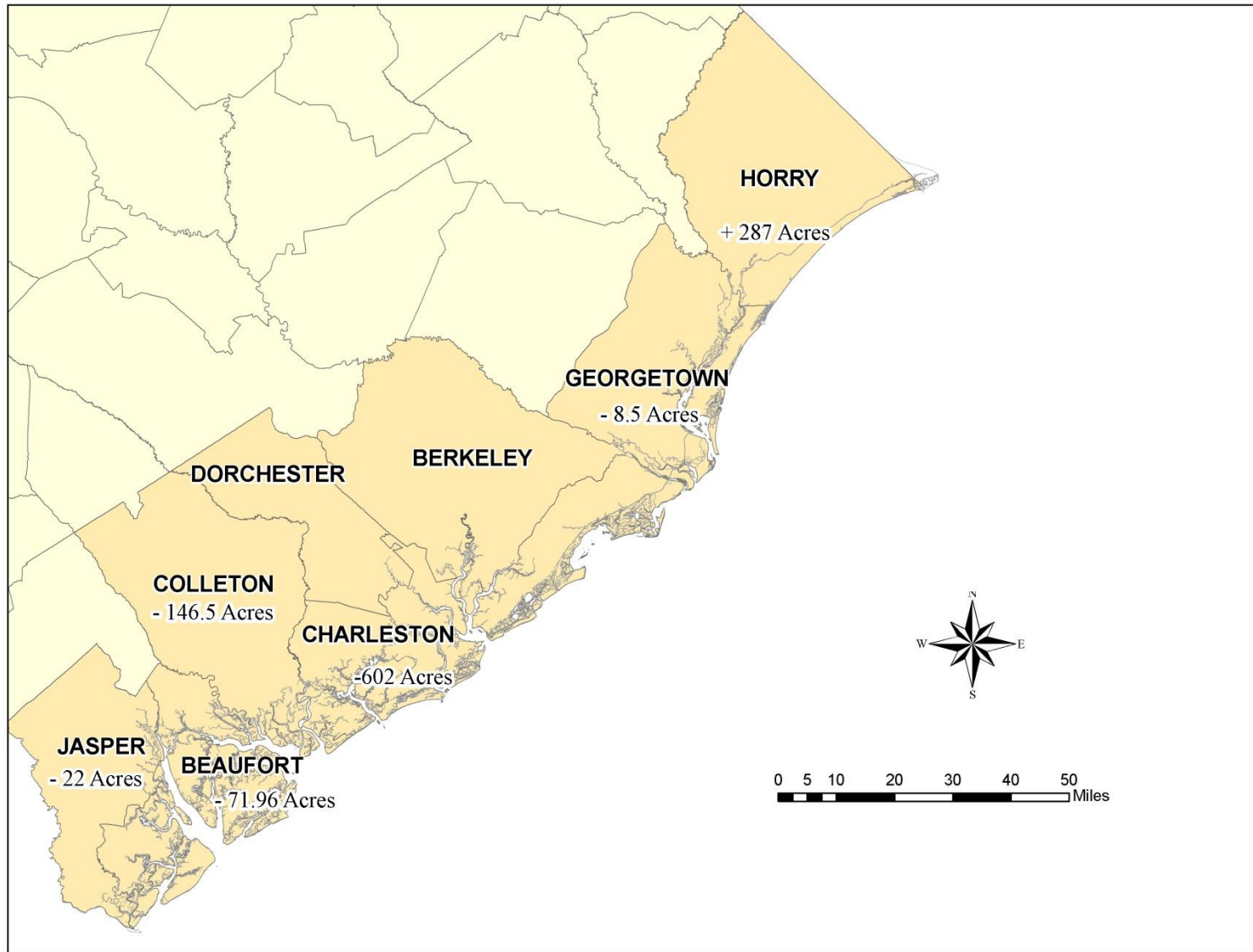


Figure 9. South Carolina Coastal Change over the Past 20 years

Table 18. Change in Beachfront Area (acres) Since Beachfront Management Act

Municipalities	1987-1999 (+/-)	1999-2006 (+/-)	Net Change
Horry County	459.07	(172.25)	286.82
North Myrtle Beach	141.33	(30.21)	111.12
Atlantic Beach	5.51	(1.91)	3.60
Briarcliffe Acres	6.27	(4.06)	2.21
Myrtle Beach	168.01	(50.44)	117.57
Surfside	23.18	(8.27)	14.91
Garden City	15.16	(7.69)	7.47
Total Municipal/Resort Beaches	359.46	(102.58)	256.88
Other Beaches	99.61	(69.67)	29.94
Georgetown County	114.19	(122.67)	(8.48)
Debordieu	(0.28)	(9.05)	(9.33)
Litchfield	23.63	(5.25)	18.38
Pawleys Island	13.86	(8.94)	4.92
Huntington Beach	15.35	(0.40)	14.95
Total Municipal/Resort Beaches	52.56	(23.64)	28.92
Other Beaches	61.63	(99.03)	(37.40)
Charleston County	(259.77)	(342.20)	(601.97)
Deweese	100.58	(6.88)	93.70
Isle of Palms	52.42	(48.31)	4.11
Sullivans Island	27.93	(17.16)	10.77
Folly Beach	40.11	37.49	77.60
Kiawah Island	255.75	(58.92)	196.83
Seabrook Island	114.62	(20.06)	94.56
Total Municipal/Resort Beaches	591.41	(113.84)	477.57
Other Beaches	(851.18)	(228.36)	(1,079.54)
Colleton County	(90.56)	(55.96)	(146.52)
Edisto Beach	3.12	(17.65)	(14.53)
Other Beaches	(93.68)	(38.31)	(131.99)
Beaufort County	194.58	(266.54)	(71.96)
Harbor Island	35.45	(27.39)	8.06
Hunting Island	(56.97)	(33.65)	(90.62)
Fripp Island	68.70	2.12	70.82
Hilton Head	236.96	(85.28)	151.68
Daufuskie Island	41.95	(27.68)	14.27
Total Municipal/Resort Beaches	326.09	(171.88)	154.21
Other Beaches	(131.51)	(94.66)	(226.17)
Jasper County	19.41	(41.36)	(21.95)
Statewide Totals	436.92	(1,000.98)	(564.06)
Total Municipal/Resort Beaches	1,332.64	(429.59)	903.05
Other Beaches	(895.72)	(571.39)	(1,467.11)

Table 19. Beach Nourishment Projects along the South Carolina Coast

Beach Location	Primary Funding Source				Total Cost	Vol. (cu.yds)
	Federal	State	Local	Private	Post-BFM	
Daufuskie				\$ 6,000,000	\$ 6,000,000	1,400,000
Debordieu				\$ 8,100,000	\$ 8,100,000	1,050,000
Edisto Beach		\$ 5,950,000	\$ 3,500,000		\$ 9,450,000	1,050,000
Folly Beach	\$ 30,850,000	\$ 3,600,000	\$ 1,000,000		\$ 35,450,000	5,623,000
Grand Strand	\$ 46,571,250	\$ 13,800,000	\$ 40,800,000		\$ 101,171,250	10,391,039
Hilton Head		\$ 6,500,000	\$ 34,400,000		\$ 40,900,000	8,621,000
Hunting Island		\$ 9,735,800			\$ 9,735,800	1,557,825
Isle of Palms (a)		\$ 700,000	\$ 2,800,000	\$ 7,100,000	\$ 10,600,000	885,000
Kiawah Island			\$ 2,700,000	\$ 900,000	\$ 3,600,000	550,000
Pawleys Island (b)	\$ 6,460,000	\$ 2,870,000	\$ 1,570,000		\$ 11,326,912	510,000
Seabrook Island (c)				\$ 2,309,000	\$ 2,309,000	908,100
Sullivans Island		\$ 230,000			\$ 230,000	35,000
Statewide Estimates	Federal	State	Local	Private (c)	Total Cost (b,d)	Vol. (cu.yds)
Post-Beachfront Management Act	\$ 83,881,250	\$ 43,685,800	\$ 86,770,000	\$ 24,409,000	\$ 238,872,962	32,580,964
Pre-Beachfront Management Act	\$ 5,607,919		\$ 4,500,000	\$ 1,475,000	\$ 12,682,919	13,323,390
Total Renourishment Costs	\$ 89,403,303	\$ 43,685,800	\$ 91,270,000	\$ 25,884,000	\$ 251,555,881	45,904,354

(a) Estimated. (b) Total includes \$426,912 in unallocated funds. (c) Private includes some local funds.

(d) Pre-BFM total includes \$1.1 million in unallocated funds.

Note: Dollar amounts are actual expenditures/nominal dollars and are not adjusted for inflation. Adjusted for inflation, total renourishment expenditures in 2008 constant dollars are estimated to be \$325,204,898.

Figure 10 shows a generalized map of major renourishment projects along the South Carolina coast. The earliest projects date to 1954 at Edisto Beach and to 1968 at Hunting Island and 1969 at Hilton Head, although information is somewhat limited for early projects. The greatest share of activity began in the early 1990s with major projects at Folly Beach, Hilton Head, Hunting Island, and along the Grand Strand. Projects have continued at each of those locations over the past decade with other major projects at Daufuskie, Debordieu, Edisto Beach, Isle of Palms, Kiawah, Pawleys Island, and Seabrook. These levels of activity suggest that while institutional controls were implemented through beachfront management, significant beach stabilization efforts took place using both public and private resources to maintain beaches at least in beachfront municipalities and resort beaches.

As indicated in Table 20, the Federal share of beach nourishment projects has declined from 44.2 percent of project expenditures in the pre-BFM period to the post-BFM mix of 35.1 percent Federal and 36.3 percent local funding. State and private funding now

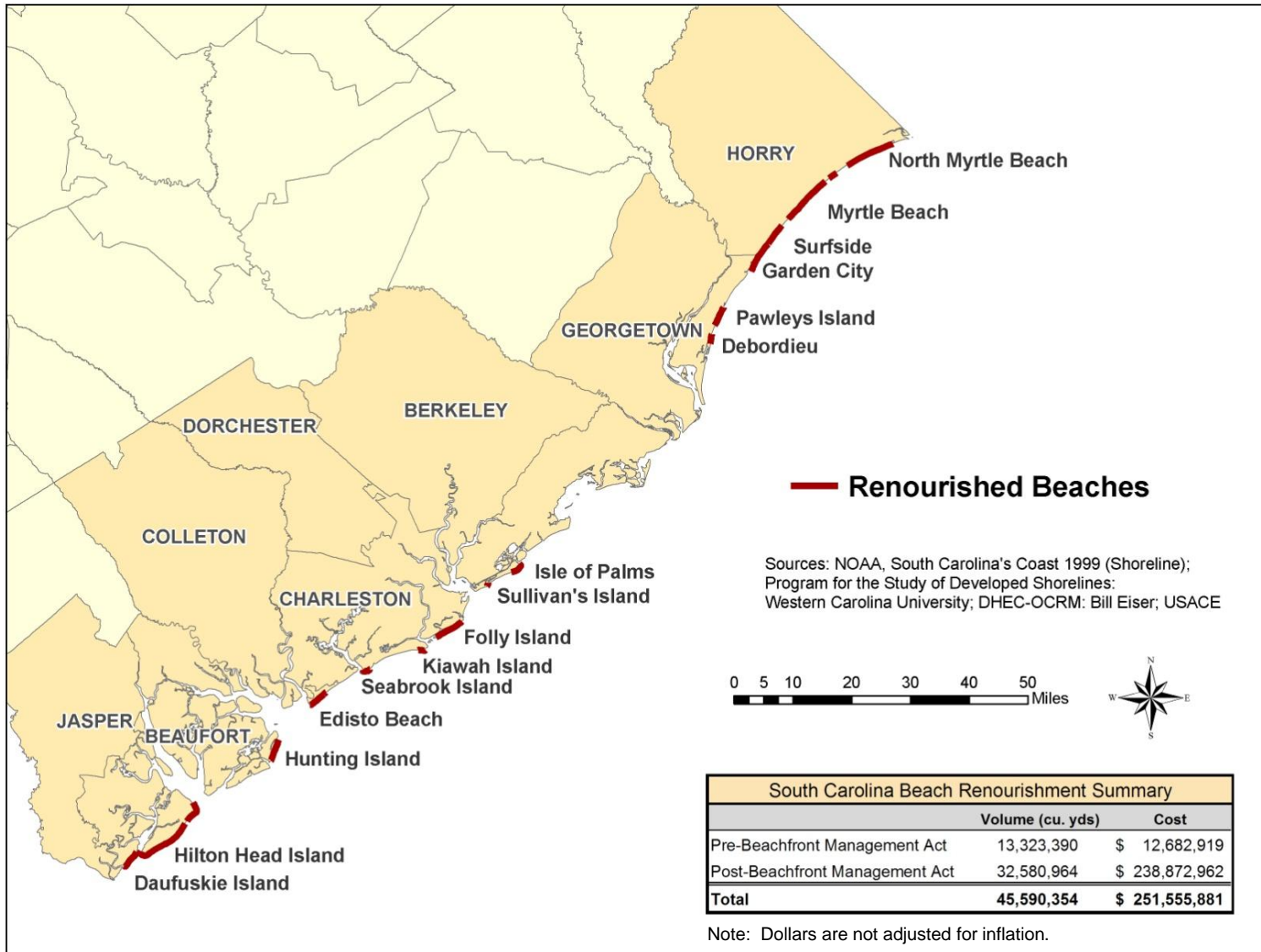


Figure 10. South Carolina Beach Renourishment Projects

represent 18.2 and 10.2 percent of project costs, respectively. Large Federal commitments have been made along the Grand Strand and at Folly Beach, while large local expenditures have occurred along the Grand Strand and at Hilton Head. Because of the large scale tourism activity, the Grand Strand and Hilton Head are best able to generate local revenue sources for beach stabilization. State expenditures have been highest along the Grand Strand and at Hunting Island, Hilton Head and Edisto. A part of those expenditures are for cost sharing while the Hunting Island expenditures have been used primarily to save the beach at Hunting Island State Park. Substantial private expenditures have occurred at the private resort communities at Debordieu, Isle of Palms, Daufuskie, Seabrook and Kiawah.

Table 20. Source of Revenues for Beach Nourishment Projects along the South Carolina Coast

Timing	Federal	State	Local	Private (a)
Pre-Beachfront Management Act	44.22%	0.00%	35.48%	11.63%
Post Beachfront Management Act	35.12%	18.16%	36.32%	10.22%

(a) Private includes small amount of local revenue.

Note: Shares based on current dollar expenditures.

Case Studies

Given the amount of aggregate activity along the coast, the following section focuses in greater detail on two beachfront communities. The town of Hilton Head has evolved over the past 50 years into a premier resort island with extensive commercial as well as residential development. On the other hand, the town of Pawleys Island, dating from the 18th century, is much smaller in scale along the lines of the traditional family beach community. Each of the two communities is examined to assess shoreline change and development activity that has occurred over the past 20 years.

Hilton Head

Hilton Head Island is the second largest barrier island along the East Coast, second only to Long Island. From a sparsely populated island inhabited largely by descendents of freed black slaves, the island began to emerge as a resort island in the 1960s with the development of Sea Pines Plantation. The collection of individual resort plantations was incorporated into the town of Hilton Head in 1983 (Figure 11). As of the 2000 Census, the island had a year round population of 33,862 residents with a peak summer population of 275,000 and annual tourism of 2.1 million visitors. ,

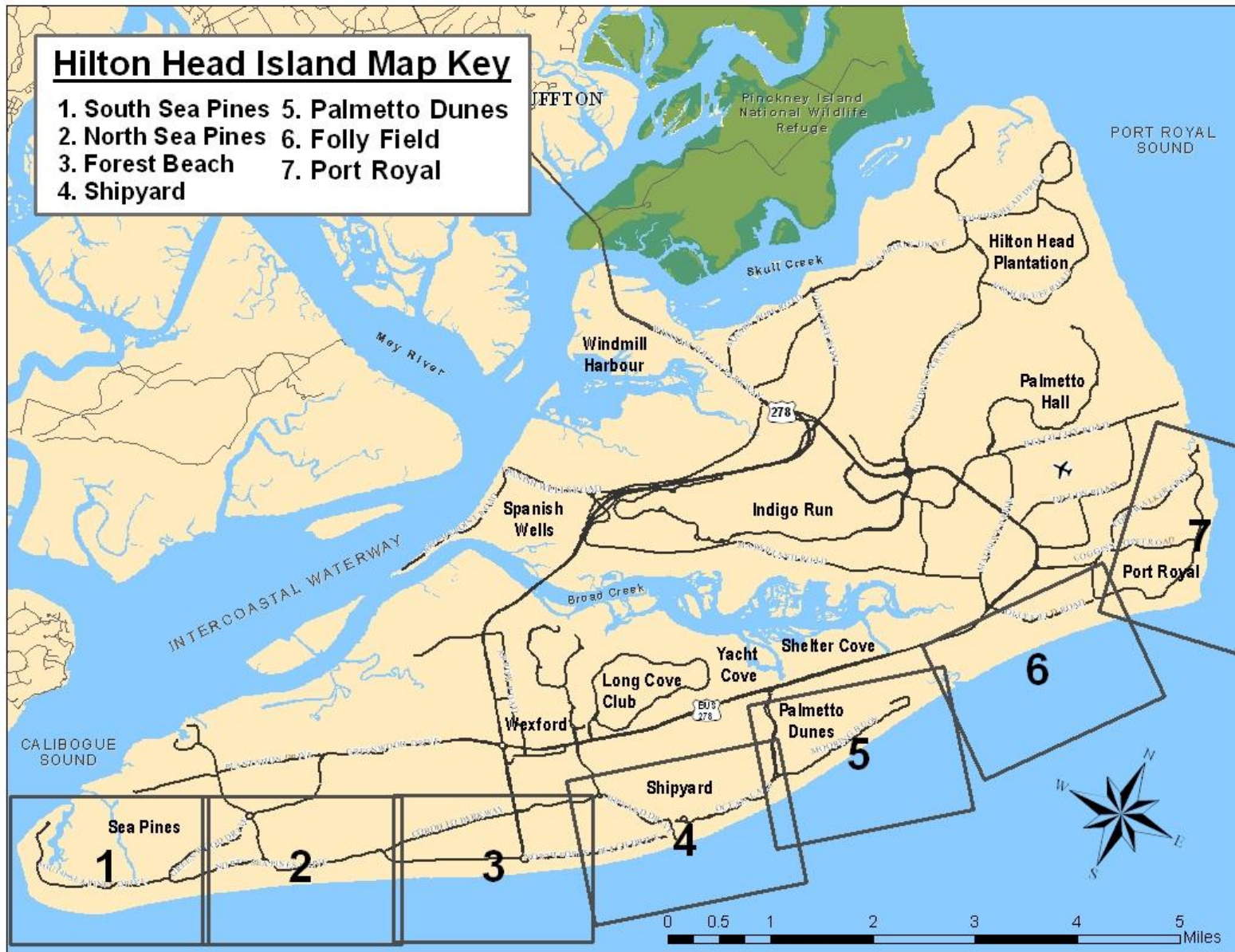


Figure 11. Hilton Head Island

Historical shorelines for individual beach sections for Hilton Head are shown in Appendices 2-8. The maps depict shorelines at mean high water for the years 1850, 1920, 1960 as well as recent shoreline configurations for the periods 1984-87, 1999 and 2006. Like most barrier islands, Hilton Head has experienced shoreline movement as evidenced in the historical record. The south end of the island along Calibogue Sound gained land area through accretion of nearly a half mile in width over the period of record beginning in the mid-1800s. Much of the rest of the island was erosional including mid-island stretches at Shipyard (600 feet) and Palmetto Dunes (nearly 1000 feet) over the same time period. As indicated earlier, the shoreline has been stabilized in recent years with nine beach nourishment projects beginning with projects at both Sea Pines and Palmetto Dunes in 1969. Collectively, Post-BFM nourishment projects on Hilton Head have provided 8.6 million cubic yards of sand at a cost of \$40.9 million. On balance, those projects have added 151.7 acres along the beachfront. Stabilization has occurred throughout most of the island with particular gains at South Sea Pines, Palmetto Dunes and Port Royal although some of the earlier gains have been lost over the past decade.

Only 39 of the island's 17,582 property listings were on the county tax rolls before 1950. Development on the island began with earnest in the 1960s peaking in the 1980s when 5,022 parcels were developed with a current appraised value of \$4.2 billion. Over the past four decades, 95.7 percent of parcels and 95.0 percent of property value at a current appraisal of \$12.7 billion have been developed (Table 21). Since Beachfront Management was adopted in 1988, 51.7 percent of current listings representing the same 51.7 percent of appraised value have been developed.

Among beachfront properties, the development patterns are similar as newer plantation development came on line over the years. None of the current beachfront inventory dates prior to 1950. Although a higher percentage of property along the beachfront relative to the entire housing stock was developed in the 1950s and 1960s at 12.9 percent of the total, that figure would be higher were it not for redevelopment that has occurred along parts of the oceanfront. Still the bulk of beachfront activity has occurred in the past four decades accounting for 87.4 percent of properties and 87.1 percent of appraised value. (Table 22) Since Beachfront Management, 47.1 percent of beachfront property accounting for 44.9 percent of appraised value has been developed.

Currently there are 21,911 parcels and 18,634 buildings registered on the tax rolls in Hilton Head with a total appraised value of \$13.57 billion (Tables 23 and 24). Of those listings, 923 parcels and 763 parcels with structures are beachfront properties with an appraised value of \$1.98 billion. Average property values are \$637,021 for all property and \$2,225,291 for beachfront property. A total of 266 structures are encroaching on the

2000 setback accounting for 34.9 percent of all beachfront structures (Appendices 9-15). Of those structures, 47.7 percent have been built since 1988 when the Beachfront Management Act was adopted. Those properties are currently appraised at \$348.2 million. The average size of single family structures built within the setback since 1988 is 7,314 square feet, a figure above the 5,000 square foot cap for structures built seaward of the setback line.

Table 21. Development History at Hilton Head

Year	Developed Parcels	Appraised Building Value	Appraised Land Value	Total Appraised Value
Before 1950	39	\$ 3,864,000	\$ 20,658,700	\$ 15,200,500
1950s	96	\$ 9,043,100	\$ 53,576,500	\$ 63,033,700
1960s	533	\$ 106,985,400	\$ 432,180,300	\$ 543,028,400
1970s	2,832	\$ 694,439,200	\$ 1,004,452,300	\$ 1,816,764,800
1980s	5,022	\$ 1,675,465,700	\$ 1,892,443,400	\$ 4,263,779,500
1990s	4,119	\$ 1,521,675,500	\$ 1,355,495,200	\$ 3,090,013,700
2000-	2,863	\$ 1,469,099,700	\$ 960,393,100	\$ 2,525,943,700
N/A or undeveloped	2,078	\$ 5,635,400	\$ 378,756,814	\$ 393,358,000
Summary	17,582	\$ 5,486,208,000	\$ 6,097,956,314	\$ 12,711,122,300
1988-2007	8,011	\$ 337,699,400	\$ 2,668,695,200	\$ 6,362,160,400

Source: Beaufort County Tax Assessor's Office, 2007.

Note: Dollar amounts are actual appraisals/nominal dollars and are not adjusted for inflation.

Table 22. Development History of Hilton Head: Beachfront Properties

Year	Developed Parcels	Appraised Building Value	Appraised Land Value	Total Appraised Value
Before 1950		\$ -	\$ -	\$ -
1950s	15	\$ 2,225,300	\$ 27,116,000	\$ 29,424,800
1960s	66	\$ 19,086,300	\$ 181,875,500	\$ 201,774,500
1970s	94	\$ 90,393,700	\$ 202,953,300	\$ 300,086,300
1980s	187	\$ 148,686,400	\$ 365,387,000	\$ 516,078,600
1990s	149	\$ 95,622,700	\$ 264,637,500	\$ 363,827,300
2000-	130	\$ 119,626,000	\$ 258,915,300	\$ 381,700,100
N/A	89	\$ -	\$ 76,870,500	\$ 79,062,100
Undeveloped	193	\$ -	\$ 106,263,300	\$ 13,005,500
Summary	923	\$ 475,640,400	\$ 1,484,018,400	\$ 1,984,959,200
1988-2007	302	\$ 228,817,100	\$ 569,497,800	\$ 805,375,700

Source: Beaufort County Tax Assessor's Office, 2007.

Note: Dollar amounts are actual appraisals/nominal dollars and are not adjusted for inflation.

Table 23. Development History of Hilton Head: Parcels with Structures Intersecting or Seaward of the Setback Line

Year	Developed Parcels	Appraised Building Value	Appraised Land Value	Total Appraised Value	Over 5,000 Sq. Ft.	Residential over 5,000 Sq. Ft.
Before 1950	0	\$ -	\$ -	\$ -	0	0
1950s	4	\$ 270,900	\$ 849,600	\$ 8,800,800	0	0
1960s	10	\$ 2,421,300	\$ 19,750,000	\$ 22,268,100	3	3
1970s	21	\$ 62,023,500	\$ 5,450,500	\$ 116,905,600	9	8
1980s	72	\$ 48,850,100	\$ 148,585,000	\$ 198,326,000	26	26
1990s	52	\$ 40,339,400	\$ 103,770,500	\$ 144,933,200	41	41
2000-	66	\$ 60,438,200	\$ 121,215,300	\$ 183,211,400	63	61
N/A	25	\$ -	\$ 16,981,300	\$ 17,336,500	0	0
Summary	250	\$ 214,343,400	\$ 416,602,200	\$ 691,781,600	142	139
1980-1987	64	\$ 44,449,300	\$ 132,995,000	\$ 178,205,700	23	23
1988-2007	126	\$ 105,178,400	\$ 240,575,800	\$ 348,264,900	107	105

Source: Beaufort County Tax Assessor's Office, 2007.

Note: These are parcels with structures intersecting or seaward of the setback. All of these parcels are developed, but 25 are missing year built information and building information.

Note: Dollar amounts are actual appraisals/nominal dollars and are not adjusted for inflation.

With beach nourishment, the shoreline along most of the beachfront has remained fairly stable in recent years with accretion along some stretches. The town of Hilton Head has identified the accreted land as a buffer zone. The Critical Storm Protection and Dune Accretion Area restricts all development with the exception of wooden walkways and decks, emergency access and soft beach stabilization measures to provide viable dune systems (Town of Hilton Head, 2006). A secondary Transition Area allows for ancillary activity including pools, decks, and picnic areas but no building to limit conflicts should beach stretches become erosional at a later date.

The town has been proactive in other aspects of its beach management efforts. A two percent accommodation tax generates approximately \$4.4 million annually that funds scientific and technical studies as well as beach nourishment projects. In addition, locally generated revenues have allowed the town to purchase \$20 million of beachfront land for conservation and public use. Those efforts show foresight and allow for resiliency in addressing long-term shoreline change.

Table 24. Hilton Head Development Summary

Hilton Head Island Development Summary									
	Tax Rate	Parcels	Structures	Avg. Year Built	Total Building Value	Total Land Value	Total Appraised Value	Percent of Total Value	Avg. Total Value
Total Island	Single Family	16,820	14,514	1988	\$ 4,327,949,800	\$ 5,402,608,800	\$ 9,807,255,600	72.28%	\$ 583,140
	All Other Uses	5,091	4,120	1984	\$ 1,159,100,800	\$ 1,461,248,600	\$ 3,761,310,300	27.72%	\$ 801,643
	4 % Tax	8,564	8,603	1989	\$ 2,525,264,000	\$ 2,268,377,000	\$ 4,829,397,000	35.59%	\$ 563,918
	6 % Tax	12,948	10,007	1986	\$ 2,961,786,600	\$ 4,595,480,400	\$ 8,739,168,900	64.41%	\$ 686,178
	Total	21,911	18,634		\$ 5,487,050,600	\$ 6,863,857,400	\$ 13,568,565,900	100.00%	\$ 637,021
Beachfront Properties	Single Family	686	576	1986	\$ 319,638,000	\$ 1,354,558,100	\$ 1,682,545,100	12.40%	\$ 2,452,690
	All Other Uses	237	187	1989	\$ 156,002,400	\$ 129,460,300	\$ 302,414,100	2.23%	\$ 1,468,030
	4 % Tax	160	161	1987	\$ 86,475,400	\$ 332,684,000	\$ 421,101,700	3.10%	\$ 2,631,886
	6 % Tax	747	602	1986	\$ 389,165,000	\$ 1,151,334,400	\$ 1,563,857,500	11.53%	\$ 2,136,417
	Total	923	763		\$ 475,640,400	\$ 1,484,018,400	\$ 1,984,959,200	14.63%	\$ 2,225,291
Parcels in Setback	Single Family	476	385	1988	\$ 229,471,900	\$ 874,103,600	\$ 1,109,596,200	8.18%	\$ 2,331,084
	All Other Uses	147	131	1986	\$ 140,592,600	\$ 104,713,800	\$ 260,053,400	1.92%	\$ 2,185,323
	4 % Tax	103	97	1988	\$ 57,836,200	\$ 212,295,000	\$ 271,508,900	2.00%	\$ 2,636,009
	6 % Tax	505	419	1987	\$ 312,228,300	\$ 766,522,400	\$ 1,098,140,700	8.09%	\$ 2,231,993
	Total	623	516		\$ 370,064,500	\$ 978,817,400	\$ 1,369,649,600	10.09%	\$ 2,198,474

Table 24 cont. Hilton Head Development Summary

Development Within 2000 Setback									
	Tax Rate	Parcels	Structures	Avg. Year Built	Total Building Value	Total Land Value	Total Appraised Value	Percent of Total Value	Avg. Total Value
Parcels w/ Structures Seaward of Setback	Single Family	216	218	1990	\$ 136,284,100	\$ 438,496,500	\$ 578,300,600	4.26%	\$ 2,677,318
	All Other Uses	34	48	1988	\$ 78,059,300	\$ 34,807,100	\$ 113,481,500	0.84%	\$ 4,364,673
	4 % Tax	55	56	1988	\$ 33,258,900	\$ 105,640,000	\$ 139,634,700	1.03%	\$ 2,538,813
	6 % Tax	195	110	1990	\$ 181,084,500	\$ 367,663,600	\$ 552,147,400	4.07%	\$ 2,952,660
	Total	250	266		\$ 214,343,400	\$ 473,303,600	\$ 691,782,100	5.10%	\$ 2,858,604
Seaward of Setback Since 1988	Single Family	119	119	1999	\$ 102,375,000	\$ 236,390,000	\$ 341,140,800	2.51%	\$ 2,866,729
	All Other Uses	7	8	1995	\$ 2,803,400	\$ 4,185,800	\$ 7,124,100	0.05%	\$ 1,017,729
	4 % Tax	28	28	1999	\$ 23,836,300	\$ 55,140,000	\$ 79,466,500	0.59%	\$ 2,838,089
	6 % Tax	98	99	1999	\$ 81,342,100	\$ 185,435,800	\$ 268,798,400	1.98%	\$ 2,742,841
	Total	126	127		\$ 105,178,400	\$ 240,575,800	\$ 348,264,900	2.57%	\$ 2,764,007

Notes: 1) Parcel information only includes total square footage information, not square footage for every building. All single family properties built within the setback zone since 1988 only had one structure on them. 2) Some recreational facilities have very low land values. 3) In some cases, the land value + the building value did not equal the total appraised value. This is seen throughout the GIS tables provided by Beaufort County.

Pawleys Island

Pawleys Island is a barrier island in Georgetown County with development activity dating to the colonial period where beachfront cottages helped plantation families escape the summer fever common along the rice fields of the Waccamaw Neck. The island has continued as a very traditional summer beach community. With a permanent population of 138, the town grows considerably during the summer months when its 485 unit housing stock approaches capacity.

Like other barrier islands, the shoreline of Pawleys has shifted over time. Figure 12 indicates the seven beach stretches for which shoreline configurations over time are depicted (Appendices 16-22). Significant movement has occurred along Pawleys Inlet on the south end of the island and Midway Inlet on the north end of the island where the historic inlet changes suggest that these locations will continue to be vulnerable to shifting shoreline configurations. The center of the island particularly sections along the upper end of North Myrtle Avenue have been extremely stable over the years.

Currently, 24.6 percent of the housing stock and 21.4 percent of beachfront housing stock dates from before 1950 (Table 25). Along the beachfront, another 41.2 percent of housing units were added through new construction or redevelopment between 1950 and 1990 (Table 26). The upswing in the 1990s is due primarily to redevelopment following Hurricane Hugo in 1989 accounting for 25.9 percent of parcels and 28.1 percent of building value. Along the beachfront, 30.3 percent of parcels were built or substantially rebuilt after Hurricane Hugo accounting for 31.5 percent of the appraised value of beachfront property on the island.

Currently, 52.3 percent of developed parcels on Pawleys Island are beachfront accounting for 65.0 percent of property value. Of the beachfront properties, 30.3 percent have been developed since 1988 accounting for 36.8 percent of building value (Table 26). Of developed parcels, 56 parcels have structures within the 2000 setback line with a total appraised value of \$79.3 million. Twenty-two of those structures were completed since 1988 with a value of \$35.9 million (Tables 27 and 28). All but seven of the 56 structures within the setback line are on the narrow spit on the south end of the beach along Springs Avenue where damage from Hurricane Hugo was particularly heavy given the narrow lot depths and limited dune system in place (Figure 13 and Appendices 23-29). Square footage figures were not available for the Pawleys Island assessment.

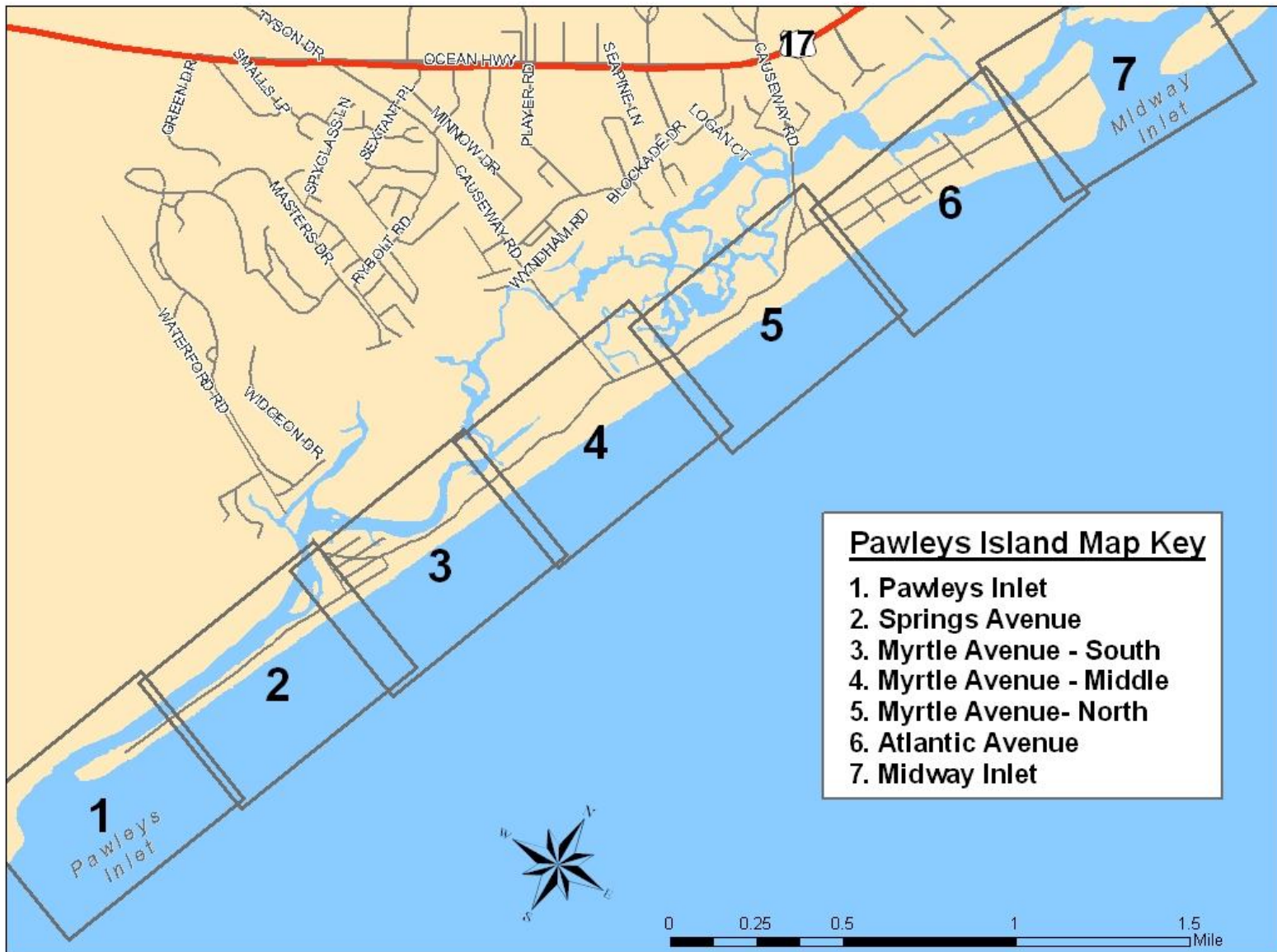


Figure 12. Pawleys Island

Table 25. Pawleys Island Development History

Year	Developed Parcels	Appraised Building Value	Appraised Land Value	Total Appraised Value
Before 1950	112	\$ 18,801,600	\$ 114,684,600	\$ 133,568,200
1950s	51	\$ 8,377,600	\$ 57,008,000	\$ 65,419,600
1960s	50	\$ 9,406,400	\$ 54,420,900	\$ 63,842,100
1970s	40	\$ 7,278,100	\$ 35,723,200	\$ 43,056,700
1980s	50	\$ 12,500,000	\$ 52,244,700	\$ 64,779,100
1990s	108	\$ 31,652,700	\$ 117,796,100	\$ 149,480,600
2000-	44	\$ 20,147,200	\$ 46,679,800	\$ 66,931,000
N/A	85	\$ 19,800	\$ 4,639,300	\$ 32,195,350
Total	540	\$ 108,183,400	\$ 483,196,600	\$ 619,272,650
1988-present	118	\$ 34,568,000	\$ 130,123,600	\$ 164,723,400

Source: Georgetown County Tax Assessor's Office, 2007.

Table 26. Pawleys Island Development History: Beachfront Properties

Year	Developed Parcels	Appraised Building Value	Appraised Land Value	Total Appraised Value
Before 1950	51	\$ 9,037,100	\$ 69,563,300	\$ 78,659,800
1950s	31	\$ 5,476,300	\$ 41,298,500	\$ 46,785,300
1960s	27	\$ 5,918,300	\$ 38,324,700	\$ 44,248,500
1970s	17	\$ 2,779,800	\$ 17,982,900	\$ 20,799,200
1980s	23	\$ 6,617,500	\$ 31,973,600	\$ 38,612,300
1990s	65	\$ 20,772,500	\$ 87,187,800	\$ 107,989,100
2000-	24	\$ 12,086,100	\$ 32,394,100	\$ 44,535,600
N/A	34		\$ 4,050,000	\$ 25,431,400
Total	272	\$ 62,687,600	\$ 322,774,900	\$ 407,061,200
1988-present	72	\$ 23,073,800	\$ 97,157,900	\$ 120,260,500

Source: Georgetown County Tax Assessor's Office, 2007.

Although the island incurred considerable damage from Hurricane Hugo, the beach has been stabilized on balance due in large part to beach nourishment activity in 1989 and 1998 that collectively pumped 470,000 cubic yards onto the beach. On balance, Pawleys gained 4.9 acres as a result of the two previous nourishment projects. Pawleys has requested federal funding for a major nourishment project at a cost of \$9 million with a 65 percent Federal share to provide additional stabilization. The proposed beach nourishment project would provide immediate assistance. In addition to beach

nourishment, Pawleys Island has maintained its groin field that may be stabilizing the mid-section of the beachfront. The challenges at Pawleys Island will continue to be shifting shoreline conditions along Midway and Pawleys Inlets and the need to periodically stabilize vulnerable beach stretches.

Table 27. Development History of Pawleys Island: Parcels with Structures Intersecting or Seaward of the Setback Line

Year	Developed Parcels	Appraised Building Value	Appraised Land Value	Total Appraised Value
Before 1950	1	\$ 61,600	\$ -	\$ 61,600
1950s	18	\$ 2,809,400	\$ 22,862,000	\$ 25,671,400
1960s	6	\$ 1,080,800	\$ 7,831,200	\$ 8,912,000
1970s	4	\$ 625,200	\$ 4,527,000	\$ 5,152,200
1980s	4	\$ 1,140,100	\$ 5,652,000	\$ 6,797,300
1990s	19	\$ 5,394,300	\$ 23,734,400	\$ 29,129,400
2000-	1	\$ 1,050,000	\$ 2,500,000	\$ 3,550,000
N/A	3			
Total	56	\$ 12,161,400	\$ 67,106,600	\$ 79,273,900
1988-2000	21	\$ 5,917,900	\$ 26,386,400	\$ 32,305,000

Source: Georgetown County Tax Assessor's Office, 2007.

Note: These are parcels with structures intersecting or seaward of the setback. All of these parcels are developed, but 3 are missing year built information and building information.

Note: Dollar amounts are actual appraisals/nominal dollars and are not adjusted for inflation.

Table 28. Development Activity on Pawleys Island

Pawleys Island Development Summary											
	Tax Rate	Parcels	Structures	Avg. Year Built	Total Building Value	Total Land Value	Total Appraised Value	Percent of Total Value	Avg. Bldg Value	Avg. Land Value	Avg. Total Value
Total Island	4 % Tax	80	75	1972	\$ 20,100,000	80,883,000.00	\$ 101,531,250	16.40%	\$ 26,462	\$ 1,064,250	\$ 1,269,141
	6 % Tax	424	404	1969	\$ 87,368,000	\$ 400,512,500	\$ 515,235,300	83.20%	\$ 229,312	\$ 1,068,033	\$ 1,229,679
	N/A	36	6	NA	\$ 705,000	\$ 1,801,100	\$ 2,506,100	0.40%	NA	NA	NA
	Total	540	485		\$ 108,183,400	\$ 483,196,600	\$ 619,272,650	100.00%	\$ 235,694	\$ 1,069,019	\$ 1,236,073
Beachfront Properties	4 % Tax	37	36	1976	\$ 10,184,100	\$ 49,087,300	\$ 59,661,100	9.63%	\$ 290,974	\$ 1,402,494	\$ 1,612,462
	6 % Tax	220	223	1970	\$ 51,803,500	\$ 50,843,000	\$ 344,900,100	55.69%	\$ 256,453	\$ 262,077	\$ 1,567,728
	N/A	15	6	NA	\$ 700,000	\$ 1,800,000	\$ 2,500,000	0.40%	NA	NA	NA
	Total	272	265		\$ 62,687,600	\$ 322,774,900	\$ 407,061,200	65.73%	\$ 230,469	\$ 1,186,672	\$ 1,496,549
Parcels in Setback	4 % Tax	32	32	1974	\$ 8,322,500	\$ 41,759,800	\$ 50,465,100	8.15%	\$ 277,417	\$ 1,391,993	\$ 1,577,034
	6 % Tax	198	201	1971	\$ 47,327,000	\$ 242,594,100	\$ 289,062,100	46.68%	\$ 262,928	\$ 142,278.03	\$ 1,670,879
	N/A	12	3	NA	\$ 700,000	\$ 1,800,000	\$ 2,500,000	0.40%	NA	NA	NA
	Total	242	236		\$ 56,349,500	\$ 286,153,900	\$ 362,821,100	58.59%	\$ 267,059	\$ 1,409,625	\$ 1,584,372
Development Within 2000 Setback											
Parcels w/ Structures Seaward of Setback	4 % Tax	5	5	1987	\$ 2,064,600	\$ 7,806,400	\$ 9,871,000	1.59%	\$ 412,920	\$ 1,561,280	\$ 1,974,200
	6 % Tax	48	48	1971	\$ 10,096,800	\$ 59,300,200	\$ 69,402,900	11.21%	\$ 210,350	\$ 1,261,706	\$ 1,445,894
	N/A	3	3	NA	NA	NA	NA	NA	NA	NA	NA
	Total	56	56		\$ 12,161,400	\$ 67,106,600	\$ 79,273,900	12.80%	\$ 229,460	\$ 1,290,512	\$ 1,495,734
Seaward of Setback Since 1988	4 % Tax	4	4	1996	\$ 1,921,500	\$ 6,480,400	\$ 8,401,900	1.36%	\$ 480,375	\$ 1,620,100	\$ 2,100,475
	6 % Tax	18	18	1991	\$ 5,046,400	\$ 22,406,000	\$ 27,453,100	4.43%	\$ 280,356	\$ 1,244,778	\$ 1,525,172
	N/A	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	Total	22	22		\$ 6,967,900	\$ 28,886,400	\$ 35,855,000	5.79%	\$ 316,723	\$ 1,313,018	\$ 1,629,773

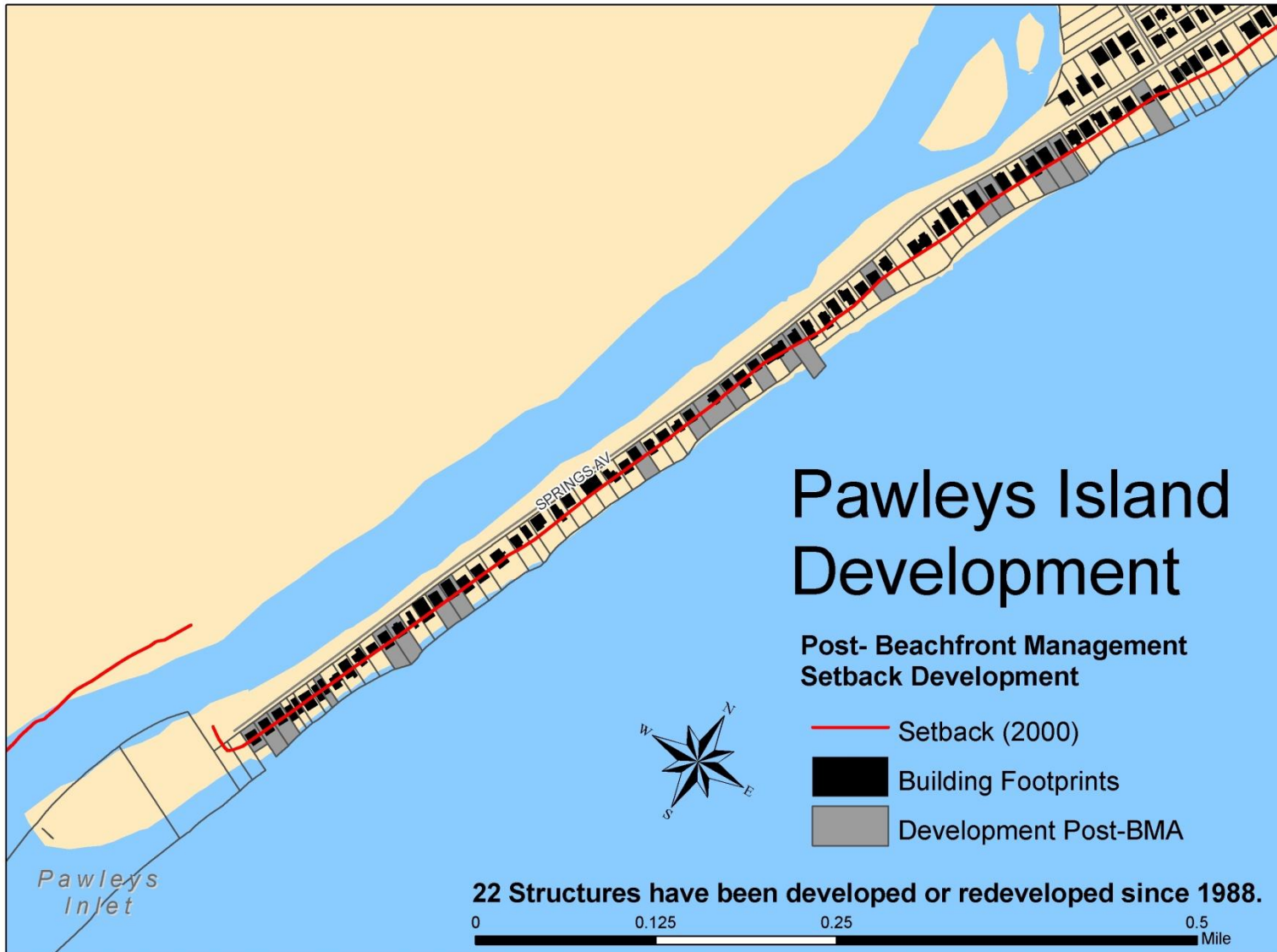


Figure 13. Development within the Setback Line of Pawleys Island

Part III: Focus Group Meetings

The final part of the study incorporated public input from focus groups along the coast. Focus group meetings were held in Charleston, Myrtle Beach and Hilton Head in late October 2008. Attendance amounting to 48 participants was less than expected due in part to problems in getting out advance publicity and the inherent problem of getting people out to evening meetings unless there is an imminent crisis at hand. Still, the mix of property owners and local government officials provided for a good sounding of issues important to the public and public officials along the coast. Transcripts from the focus group meetings appear in Appendix 32. A summary of content from those focus group meetings appears as Table 29.

A primary concern on the part of focus group participants was the negative effect of shoreline change on private property. That concern was expressed in the strongest terms by residents living on Sullivans Island along Breach Inlet and on Hilton Head along Port Royal Sound. In both cases, the north ends of the two barrier islands are shifting and putting property at risk. As a result, property owners were asking for interventions to protect their property. At Sullivans Island, property owners were requesting relief with structural solutions – either temporary relief with sandbags or longer term relief with hard structures. At Hilton Head, the emphasis is on beach nourishment along the sound at Port Royal Plantation. At Pawleys Island, the island's groin field was credited with stabilization particularly along the mid-section of the beach. Although less vocal, some felt that in general beachfront management was working to protect property.

In terms of management tools, beach nourishment was most frequently cited as an appropriate tool for beach stabilization. Successful beach nourishment projects were cited at Myrtle Beach where the beach profile has largely been maintained and at Pawleys Island with a major project scheduled for this spring. Hilton Head also has had a series of beach nourishment projects that have stabilized the beach although the issue of shoreline loss along Port Royal Sound is of current concern. There was some sentiment that maintained setbacks were working, although areas where setbacks are working best are often areas that have had beach nourishment projects. On Hilton Head, at issue is the town's critical protection area that provides a wider no-build zone than the state setback line. Land acquisition was mentioned although with less enthusiasm and as a last resort option where beach stabilization is not feasible. The strongest sentiment heard in terms of management options was that retreat strategies were not a viable option for developed areas along the coast.

One of the points made most often especially by public officials but by the public as well was that one size does not fit all. In other words, what might be appropriate at Myrtle Beach or Hilton Head might not be appropriate at Pawleys Island, Sullivans Island or Folly Beach. In terms of influence along the coast, insurance companies were identified most often as influencing activity along the shoreline. State government (OCRM) was identified half as often with local government following. When asked who should have the most influence, local government and property owners were the most cited parties followed by shared responsibilities between local, state and federal governments. As to who should pay, a shared responsibility was indicated most frequently followed by property owners. While the general sentiment was toward more local control, there was at least some realization that local authority might go hand in hand with greater local and private responsibility including bearing a still larger role in beach stabilization costs.

The issue of accelerated sea level rise was deemed inevitable but not of particular concern among most participants. Some indicated that changes in shoreline configuration were evident, but most felt that renourishment and maintained setbacks would address sea level rise even at accelerated rates of change. At the same time, participants felt that local educational programs addressing sea level rise needed to be more easily accessible so that property owners were more aware of changing shoreline conditions.

When the discussion shifted to wetlands and estuarine areas, there was acknowledgement that those areas need protection as well given the value of wetland systems. As with beachfront areas, the issue of one size does not fit all circumstances was raised particularly with regard to existing development and undeveloped areas. For existing development, it was felt that property owners should be able to protect their property from inundation or shoreline retreat, but tighter controls may be appropriate for new development. It was suggested that dealing with shoreline change in estuarine and tidal reaches is an issue that local governments should be addressing.

In the open discussion segment, issues discussed included again the general concern that shoreline management programs not negatively affect private property. A repeated concern was that too much political influence was being injected into beach management decisions including beach nourishment funding. There was at least some sentiment that economic assessments should be used to determine where public monies are being spent to assure that public investments are cost effective and that funds are targeted to highest priority interventions. Finally, the role of local education was addressed again with the thought that better information will lead to more informed private investment decisions.

Summary and Conclusions

Summary

The project examines options for addressing shoreline change as background for the update of the South Carolina Beachfront Management Plan. Part 1 of the project provides a literature review and legal assessment of trends in shoreline management since the implementation of state coastal zone management programs. The larger part of this phase of the study examines current conditions with a survey of state coastal managers in the 30 coastal states including the Great Lakes. Based on 29 responses, the majority of states allow various forms of hard structures ranging from 27 states allowing jetties to 22 states allowing groins. Among soft structures, all of the states had some type of beach nourishment program, while 27 states had an active vegetation program in place and roughly two-thirds of the states (20) allowed bulldozing/scraping. Among development modifications, the most common was land purchase (22) followed by fixed setbacks (20). Other building restrictions employed included post hazard building limits (14) and rolling easements (13). Particularly in the case of rolling easements, variability exists in terms of both definition and implementation policies.

The most frequently cited need was data on which to make good decisions identified by 16 of the respondents. Other information needs mentioned included examples of success in reducing risk/vulnerability and more research and modeling capacity. Funding issues for staff, land acquisition, beach nourishment, and planning were cited as was better coordination. The greatest impediments identified were funding constraints, lack of environmental regulatory support and lack of data. When asked their overall rating of their state's shoreline management plan, two of the respondents rated their state's program a 5 on a 5 point scale with the remainder of the ratings ranging from 2 to 4. The mean rating for all states was 3.46 suggesting that coastal managers felt their programs were at least adequate but that there may be some opportunity for improvement. In terms of sea level rise, 55 percent of states indicated that they addressed sea level rise in their shoreline management plan. Here again, variability exists ranging from the incorporation of historical trends into setback lines to a more proactive incorporation of accelerated sea level projections into shoreline configurations with corresponding adaptation measures such as building restrictions or retreat strategies.

A follow-up survey to compile more detailed information on management tools was conducted for nine states. Those states were deemed innovative states based upon a review of statutes and state plans as well as results from the initial survey. Based on

discussions with coastal managers, it appears that there have been two waves in terms of innovation. The first wave occurred in the late 1970s and early 1980s as states set up their coastal management programs. The second wave appears to have come in the current decade as states deal with development pressure and changing shorelines particularly with the prospect of accelerated sea level rise. In between, concerns over property rights and resultant legal challenges dominated agendas. Intergovernmental relations with both the Federal program and local government participation were mentioned as areas of concern. In both cases, the issues of authority and responsibility were cited.

Five of the nine states are continuing to use fixed setback provisions to reduce conflicts along the coast. In general, it is felt that setbacks have failed to meet initial expectations due to variances at the local level and because 30 or even 40 years is not enough of a buffer. Alternatives to standard setbacks being used in one or more states include designation of erosion hazard areas, delineation of low/high risk zones, banning infrastructure provision in high risk areas, and developing guidelines for local erosion response plans. Rolling easements are being used in some form in six of the nine states. Rhode Island incorporates a rolling easement in deeds, Hawaii uses the public trust, and Texas relies on its Open Beaches Act. Concern exists as to challenges to state programs in the light of heavy losses from coastal storms. Abandonment and relocation are used on a limited basis. The general consensus is that those tools may work in low density areas but in cities like Galveston recovering from Hurricane Ike, the resources are not there for large scale relocations. Land purchase similarly is being used only on a limited basis given the high cost of coastal property. A consistent observation is that programs need to be in place before natural disasters occur.

Part 2 of the study focused on the effectiveness of beachfront management in avoiding losses associated with shoreline change along the state's coastline. To examine shoreline change a composite of the 1984-87 shoreline compiled by NOAA's Coastal Services Center was compared to updates for both 1999 and 2006 compiled by the SC Department of Natural Resources and Dr. Scott Harris at the College of Charleston. It is estimated that the state lost 564 acres of shoreline over the past 20 years with a loss of 1467 acres in unincorporated areas of the state and a gain of 903 acres in beachfront municipalities and resort communities. The primary influence in shoreline retreat/accretion appears to be the amount of beach nourishment along the state's more developed beachfronts. An inventory of beach nourishment activity found that 46,904,364 cubic yards of sand have been applied to the state's shoreline at a cost of \$251,556,981 (at time of construction). The bulk of that activity has occurred since beachfront management – 95.0 percent in terms of expenditures and 71.0 percent in terms of sand volume. The majority of gains occurred in the municipalities of Myrtle

Beach, North Myrtle Beach and Hilton Head along with the resort islands of Kiawah and Seabrook.

Case studies at Hilton Head and Pawleys Island were conducted to compare shoreline change and development patterns. The shoreline at Hilton Head has been relatively stable in recent decades tied in large part to a series of beach nourishment projects beginning in 1969. Over the past two decades, Hilton Head has applied 8.6 million cubic yards of sand to its beaches at a cost of \$40.9 million. Currently, the town of Hilton Head lists 21,911 parcels with an appraised value of \$13.6 billion; beachfront properties account for \$1.98 billion in land and building value. The average property value for single family residences is \$637,021 with an average value of \$2,225,291 for beachfront properties. Structures encroaching on the 2000 setback exist on 240 of those parcels accounting for 34.9 percent of all beachfront structures - 44.0 percent of those structures have been built since 1988. The average size of single family structures built within the setback since 1988 is 7,314 square feet, a figure above the 5,000 square foot cap. That issue is less of a concern in areas of the island that have accreted through beach nourishment. The town of Hilton Head has identified areas of accreted land as the Critical Storm Protection and Dune Accretion Area and restricts permanent structures within that zone. The town has been proactive in other aspects of its beach management efforts. A two percent accommodation tax generates approximately \$4.4 million annually that funds scientific and technical studies as well as beach nourishment projects. In addition, locally generated revenues have allowed the town to purchase \$20 million of beachfront land for conservation and public use.

At Pawleys Island, the shoreline has been maintained due in large part to nourishment activity that pumped 470,000 cubic yards of sand onto the beach between 1989 and 1998. Some loss has occurred over the past decade, but on balance the island has gained 4.9 acres over the past 20 years. A major nourishment project is proposed at a cost of \$9 million. The south and north ends of the island along Pawleys and Midway Inlets remain vulnerable to inlet migration. Currently 54.6 percent of developed parcels are on the beachfront accounting for 65.7 percent of the \$619.3 million in property value on the island. Average property values are \$1,236,073 for the island as a whole and \$1,496,549 for beachfront properties. Of developed parcels, 56 parcels have structures within the 2000 setback line, and all but seven of those structures are on Springs Avenue along the island's narrow south end. Twenty-two of those structures were completed since 1988 with a total value of \$35.9 million. Much of that redevelopment occurred following Hurricane Hugo in 1989 that caused extensive property damage to the island. As with Hilton Head, development along the oceanfront has continued on Pawleys Island with beach nourishment providing shoreline stabilization and preventing major property loss with the exception of the substantial losses from Hurricane Hugo.

The challenges at Pawleys Island will continue to be shifting shoreline conditions along Midway and Pawleys Inlets and the need to periodically stabilize vulnerable beach stretches.

The final part of the study incorporated public input from focus groups along the coast. Focus group meetings were held in Charleston, Myrtle Beach and Hilton Head in late October 2008. Primary concerns expressed by the public with respect to shoreline management related to negative effects on private property particularly regarding restrictions on beach stabilization structures. In terms of management tools, the public seemed to be in favor of beach nourishment, while concern was expressed with respect to retreat as a long range strategy. In terms of who should pay the cost for beach stabilization, the most often cited sources were local communities and property owners. There was a general concern that one size does not fit all. While the general sentiment was toward more local control, there was at least some realization that local authority might go hand in hand with greater local and private responsibility including bearing the bulk of beach stabilization costs.

Conclusions

A primary objective of the state's beachfront management program is to promote good decision-making by both public and private entities. A central theme in discussions with coastal managers was the need for better data bases on coastal processes and shoreline change including simulation models to identify vulnerable areas. Ultimately, the aim is to provide good information at the point of contact of individual decisions along the shoreline where the ultimate responsibility must rest. Information exchange must be targeted to user needs and include the provision of technical assistance to local governments and educational programs for the public.

A significant finding of this study is that the state's shoreline at least in beachfront municipalities and resort communities has been stabilized in recent years due in large part to a series of beach nourishment projects at an estimated cost of \$ 252 million. Beach nourishment is a viable option to stabilize the beachfront, although it is expected that it will be a more costly option with greater frequency of application with sea level rise and additional oversight over sand borrow areas to address rights of access, near shore sand movement, and ecological considerations. In addition, the important question of who pays must be addressed – to not do so would be fiscally irresponsible. Coastal tourism is vital to the state's economy, and adequate revenue options to support healthy beach communities must be in place. It is essential therefore that local governments be given a full menu of revenue sources to address impacts associated with changing shoreline configurations.

Effective shoreline management requires a mix of management tools as no one approach will fully address the implications of change in a dynamic shoreline conditions. Although less of a regulatory impact than originally envisioned, setbacks can and should be used to delineate areas with a high vulnerability and an implied risk as part of both beachfront and estuarine shoreline management plans. State investments should provide leverage to assist local governments to adopt long-term approaches to address shoreline change. Abandonment and relocation while not used extensively should be a larger part of the funding mix as those two options may in some cases be far more cost effective than other management options including shoreline stabilization. Strategic retreat also must be included as part of the management mix. Difficult to implement and not an option of choice in highly developed beachfront communities, retreat may be the only long-term option in some communities where the projected loss does not warrant costly and recurring beach stabilization efforts.

Moving forward, the state will continue to bear a responsibility to protect public trust resources and to provide a baseline regulatory framework. Yet, the new round of beachfront management can and should build on the considerable expansion of local government capacity in South Carolina over the past 30 years since the implementation of the state coastal management program. Although local government entities have the authority to restrict development in high hazard areas, greater proactive involvement on the part of local entities is becoming more common and should be encouraged. At the same time, that added authority comes with greater responsibility to minimize potential development conflicts and to bear costs associated with corrective actions. A new round of local beachfront management plans should be developed reflecting physical characteristics, development patterns, areas of vulnerability, shoreline protection options, and funding strategies. Technical assistance should be provided by the state in developing and implementing those plans.

Once again, a primary role of the state should be to assist individuals and local governments to make more informed decisions. In that capacity, the assemblage and distribution of information is essential with adequate resources necessary to accomplish that task. Individuals as well as government entities must take a long-term view in addressing shoreline change. A series of short-term fixes will lead to costly recurring corrective actions. Intergovernmental coordination often a problem because of overlapping responsibilities should be addressed with information sharing and technical assistance to develop sound local plans to complement and add an additional layer of authority to the state plan. Resources to develop and implement the next round of beachfront management at both the state and local levels must be available. Sound planning at this point in time will result in substantial cost avoidance in the long-run.

Appendices

Appendix 1. Coastal Manager Survey

COASTAL CHARACTERISTICS AND SHORELINE MANAGEMENT TOOLS

1. What is your state's type of shoreline? *(Please identify predominant shoreline types and other types that apply)*

- a. Crystalline bedrock
- b. Eroding bluffs and cliffs
- c. Pocket beaches between headlands
- d. Strandplain beaches
- e. Barrier islands
- f. Coral reef and mangrove
- g. Coastal wetlands
- h. Deltaic coasts

2. How would you describe the degree of development/redevelopment pressure occurring in your community at present? *(Source: Moser & Tribbia; 2007)*

1	2	3	4	5
No	Slight	Moderate	Significant	Extreme
development	development	development	development	development
pressure	pressure	pressure	pressure	pressure

3. What best characterizes the institutional structure of your state's coastal zone management program? *(Please identify appropriate answer)*

- a. **Direct:** a single state agency regulates
- b. **Direct/LCP:** a single state agency regulates but may delegate power to a local government under a local coastal program [LCP]
- c. **Networked:** a single state agency coordinates the activities of other state and local agencies who have regulatory power
- d. **Networked/LCP:** same as Networked with the addition of enforceable LCP
- e. **Networked/Regulatory:** a lead state agency shares regulatory authority with other state agencies

4. Which of the following shoreline management tools are used in your state? *(Please identify all that apply)*

Hard Stabilization

- a. Seawalls
- b. Bulkheads
- c. Jetties
- d. Revetments
- e. Groins

Soft Stabilization

- f. Beach renourishment
- g. Bulldozing/scraping
- h. Increasing sand dune volume
- i. Vegetation

Modification of Development

- j. Post-hazard event reconstruction limits
- k. Building elevation
- l. Low-density development / density restrictions
- m. Utility and service line location
- n. Abandonment
- o. Relocation
- p. Fixed setbacks (Baseline location Setback distance)
- q. Rolling setbacks (Setback distance _____)
- r. Zoning in hazardous areas (including guidelines for new construction)
- s. Land acquisition (Public__ Private__)

Other Tools

Please List:

5. Which of those tools contribute to your state’s retreat policy? Please list below.

6. Rank the ease of implementation of the following shoreline management tools that you identified in Question 4:

1= Difficult 4= Easy
 2= Somewhat Difficult 5= Very Easy
 3= Average N/A= Not applicable

Hard stabilization

<input type="checkbox"/> a. Seawalls	1	2	3	4	5	N/A
<input type="checkbox"/> b. Bulkheads	1	2	3	4	5	N/A
<input type="checkbox"/> c. Jetties	1	2	3	4	5	N/A
<input type="checkbox"/> d. Revetments	1	2	3	4	5	N/A
<input type="checkbox"/> e. Groins	1	2	3	4	5	N/A

Soft stabilization

<input type="checkbox"/> f. Beach renourishment	1	2	3	4	5	N/A
<input type="checkbox"/> g. Bulldozing/scraping	1	2	3	4	5	N/A
<input type="checkbox"/> h. Increasing sand dune volume	1	2	3	4	5	N/A
<input type="checkbox"/> i. Vegetation	1	2	3	4	5	N/A

Modification of development

<input type="checkbox"/> j. Post-hazard event reconstruction limits	1	2	3	4	5	N/A
<input type="checkbox"/> k. Building elevation	1	2	3	4	5	N/A
<input type="checkbox"/> l. Low-density development / density restrictions	1	2	3	4	5	N/A
<input type="checkbox"/> m. Utility and service line location	1	2	3	4	5	N/A
<input type="checkbox"/> n. Abandonment	1	2	3	4	5	N/A
<input type="checkbox"/> o. Relocation	1	2	3	4	5	N/A
<input type="checkbox"/> p. Fixed setbacks	1	2	3	4	5	N/A
<input type="checkbox"/> q. Rolling setbacks	1	2	3	4	5	N/A
<input type="checkbox"/> r. Zoning in hazardous areas (including guidelines for new construction)	1	2	3	4	5	N/A
<input type="checkbox"/> s. Land acquisition	1	2	3	4	5	N/A
<input type="checkbox"/> <u>Other Tools</u> (as indicated)	1	2	3	4	5	N/A

SHORELINE MANAGEMENT PLANNING AND REGULATIONS

Individual state results for questions 7-9 will be aggregated and only disseminated in that format. No state will be identifiable.

7. How would you rate the effectiveness of your state's shoreline management plan in generating the anticipated shoreline protection?

1	2	3	4	5
Ineffective	Somewhat ineffective	Neutral	Effective	Very effective

8. In the context of shoreline management:

a. How stringent are your state regulations?

1	2	3	4	5
Lax	Somewhat lax	Average	Stringent	Very stringent

b. How closely does the shoreline management plan reflect the mandates in the state statutes?

1	2	3	4	5
Unrelated	Somewhat Unrelated	Neutral	Closely Related	Matching

c. How closely does the shoreline management plan reflect the mandates in the state's administrative codes?

1	2	3	4	5
Unrelated	Somewhat Unrelated	Neutral	Closely Related	Matching

9. In attempts to implement shoreline management plans, rank the cooperation received from each of these different institutions:

- 1= Uncooperative
- 2= Somewhat Uncooperative
- 3= Average
- 4= Cooperative
- 5= Very Cooperative

Local government	1	2	3	4	5	N/A
State government	1	2	3	4	5	N/A
Regional government	1	2	3	4	5	N/A
Federal government	1	2	3	4	5	N/A
Private Industry:						
Tourism	1	2	3	4	5	N/A
Realtors/Rental Companies	1	2	3	4	5	N/A
Developers	1	2	3	4	5	N/A

DATA AND FUNDING CONTRIBUTIONS TO SHORELINE MANAGEMENT

10. Data

a. What is the availability of data essential to effective shoreline management?

1	2	3	4	5
Unavailable	Mostly Unavailable	Average	Mostly Available	Available

b. What is the quality of data available for your shoreline management?

1	2	3	4	5
Poor Quality	Somewhat Poor Quality	Average	Good Quality	Excellent Quality

c. What data would improve the efficiency of your state’s shoreline management?

11. Funding

a. What is your current fiscal year budget for coastal management operations? (Please identify appropriate answer)

- Less than \$1 million
- \$1 - \$4,999,999 million
- \$5 - \$9,999,999 million
- \$10 - \$14,999,999 million
- \$15 million or above

b. Please list your approximate average annual spending on the following management strategies:

Beach Nourishment _____

Land Conservation _____

Retreat Policy _____

c. Please list the funding sources and their associated percentages allocated to each source for the following management strategies:

Beach Nourishment _____

Land Conservation _____

Retreat Policy _____

d. If you had more funding available for shoreline management, on what strategies would you spend it?

12. Needs and Impediments

a. Please list the three greatest needs for shoreline management in your state:

- 1. _____
- 2. _____
- 3. _____

b. Please list the three greatest impediments to shoreline management in your state:

- 1. _____
- 2. _____
- 3. _____

13. Innovations

a. Please list any innovations or new approaches to shoreline management strategies in your state, particularly those related to shoreline change:

b. Are these innovations or new approaches currently incorporated into your shoreline management plan?

Yes No

Do you anticipate incorporating them into your plans?

Yes No

If no, why?

14. Are you currently or do you have plans to make accelerated sea level rise an element of your shoreline management plan?

Yes No

If yes, how?

Appendix 2. Innovation Initiatives of Coastal State Management Programs

STATE	Self-Identified Innovation 1	Self-Identified Innovation 2	Self-Identified Innovation 3	Self-Identified Innovation 4	Self-Identified Innovation 5
Alabama	COHIS program with GA—NOAA grant, electronic database as mechanism as a baseline				
Alaska	[none]				
California	[waiting for survey response from the state on local level innovations]				
Connecticut	Surge and inundation modeling for SLR	Cooperative governance, considering population growth and erosion control			
Delaware	Regional sediment management	MD Bay cooperation			
Florida	Coastal construction control line	Pairs reconnaissance sand search with sediment mgmt			
Georgia	Digital representation of all historic shoreline positions	CSC COHIS project with AL	Permitting program that prohibits the creation of fast land		

Appendix 2 continued. Innovation Initiatives of Coastal State Management Programs

STATE	Self-Identified Innovation 1	Self-Identified Innovation 2	Self-Identified Innovation 3	Self-Identified Innovation 4	Self-Identified Innovation 5
Hawaii	Ocean Resources Management Plan (linking ocean and coastal resources + culture etc. (quite new therefore updated and potentially utilized))				
Illinois	[none]				
Indiana	General authorization for beach nourishment that is deposited on State Park or National Lakeshore property				
Louisiana	Multiple lines of dissent for hurricane				
Maine	Technological innovation for efficient and cost-effective field surveys (personal watercraft-based beach profiling; precision RTK-GPS dune edge and storm washover measurements; volunteer teams doing monthly Emery beach profiling)	100-year Erosion Hazard Areas and sea level rise impacts used in siting development along beaches (Coastal Sand Dune Rules)			

Appendix 2 continued. Innovation Initiatives of Coastal State Management Programs

STATE	Self-Identified Innovation 1	Self-Identified Innovation 2	Self-Identified Innovation 3	Self-Identified Innovation 4	Self-Identified Innovation 5
Maryland	MD Committee on Climate Change- 1st charge ASLR	The Living Shorelines program (initializing the use) legislatively supported and now being implemented			
Massachusetts	[none]				
Michigan	Moved from manual (zoom transfer scope) analysis techniques to a soft-copy photogrammetry and GIS approach (including the ability to ortho-rectify aerial imagery in-house and the use of industry standard (e.g. USGS – Digital Shoreline Analysis System) processes to calculate recession rates)				
Minnesota	Alternative shoreline development standards				
Mississippi	Using the living shoreline approach	Moving away from hard structures			
New Hampshire	Salt marsh restoration (focus on estuaries)	Beach management plans on local levels (groups of homeowners)			

Appendix 2 continued. Innovation Initiatives of Coastal State Management Programs

STATE	Self-Identified Innovation 1	Self-Identified Innovation 2	Self-Identified Innovation 3	Self-Identified Innovation 4	Self-Identified Innovation 5
New Jersey	Flood hazard area criteria (50-300 feet depending)	Criteria for coastal bluffs	Wetland buffers	Rules preventing building on dunes or beaches, riparian zone	Recognition and beginnings of incorporation of ASLR without specification (in codes or survey)
New York	Project with the Corps of Engineers to address storm damage reduction along an 80-mile section of the South Shore of Long Island. The state is starting with engineering measures (beach nourishment) and land use measures and over the 50-yr project life, will gradually step down the engineering measures as the land use measures take affect. The final plan will be subject to consistency review.	Individually-tailored coastal plans with public support	Redevelopment in light of ASLR on hardened shores		
North Carolina	Beach and inlet management plan (between Coastal Management and Water Resources)				

Appendix 2 continued. Innovation Initiatives of Coastal State Management Programs

STATE	Self-Identified Innovation 1	Self-Identified Innovation 2	Self-Identified Innovation 3	Self-Identified Innovation 4	Self-Identified Innovation 5
Ohio	Coastal Atlas	Detached breakwaters for creation of recreational beaches, sometimes paired with beach nourishment and revetments	Regional erosion management plan		
Oregon	Dynamic cobble berms	Erosion hazard risk zone studies	Coordination of coastal with the ocean resources plan (as well as land uses)		
Pennsylvania	Purchase of development rights from farmers (for upland authority/control affecting coastal zone)	Introduction of LIDAR in determining bluff setback	Interstate consistency with OH	Technical advisory services	Municipal reference document
Rhode Island	Watershed zoning with water types and upland authority	Ban public infrastructure on barrier islands and zone barriers for development class 3 - 82% no residential or commercial structures	Comprehensive special areas mgmt plans	Rule requiring accommodation of ASLR in coastal mgmt decisions (at least 3 - 5 ft change)	
South Carolina	Estuarine soft stabilization	Post-hazard reconstruction limits	Prohibition of new erosion structures on the beach		

Appendix 2 continued. Innovation Initiatives of Coastal State Management Programs

STATE	Self-Identified Innovation 1	Self-Identified Innovation 2	Self-Identified Innovation 3	Self-Identified Innovation 4	Self-Identified Innovation 5
Texas	Relocation monies				
Virginia	Living shorelines (computer program with erosion shown from the 1930s to 2002)				
Washington	Regional sediment management plans				
Wisconsin	Setbacks on parcel by parcel where there are very different land types				

Appendix 3. Follow-up Coastal Manager Questions

Follow-up Coastal Manager Questions

Your state has been selected because it was determined to be one of the more innovative states in terms of shoreline management policy. As we discussed at the end of the first survey, we'd now like to follow-up and more thoroughly discuss some of your shoreline change management strategies and what you anticipate doing in the next few years.

- I. Innovations
 - a. Who championed the innovation(s)? When? Why?
 - b. Where are they located? (Statutes? Rules and regs? Plans?)
 - c. What were the obstacles to their introduction and/or problems with implementation?

- II. Accelerated Sea Level Rise [*IF APPLICABLE*]
 - a. What has the state done and/or how does the state plan to address accelerated sea level rise?
 - b. Are there any current discussions about accelerated sea level rise?
 - c. What types of information would be useful in helping the public and elected officials to understand the implications of ASLR along the coast?

- III. Specific Management Tools/Adaptive Measures
 - a. Land acquisition
 - i. How long has land acquisition been used as a shoreline management tool in your state?
 - ii. How might the process be changed in the next five years?
 - iii. Does your state use or augment federal disaster mitigation funding to acquire coastal property?
 - iv. Are local measures also being taken to acquire vulnerable coastal properties? If so, how are those acquisitions funded (sales tax, hospitality taxes, property donation)?
 - b. Setback policy
 - i. Currently you are using 30 foot for residential, 60 for commercial. Is that correct?
 1. How long have those setbacks been in place?
 2. Are there any associated successes?
 3. Any associated failures?
 - ii. Are any alternative setback provisions being discussed? If so what?
 - iii. What is the likelihood that those provisions will be enacted in the next 5 years?

- c. Abandonment and relocation
 - i. How does it work?
 - ii. Is there support for or resistance to this tool? If so, by whom?
 - iii. How long has it been in place?
 - iv. Are there any alternatives to it? Please describe.
 - v.
- d. Rolling easements

NOAA's definition: "Rolling easements are a special type of easement placed along the shoreline to prevent property owners from holding back the sea but allow any other type of use and activity on the land. As the sea advances, the easement automatically moves or "rolls" landward. Because shoreline stabilization structures cannot be erected, sediment transport remains undisturbed and wetlands and other important tidal habitat can migrate naturally." (citing to Titus)

- i. Has this tool been discussed in or adopted by your state?
 - ii. If so, how does your state define it?
 - iii. How long has it been in place?
 - iv. Are there any alternatives to a rolling easement under consideration? If so, what?
- e. Redevelopment planning
 - i. Is this conducted and in place for implementation after a crisis?
 - ii. How long has it been in place?
 - iii. How does it vary from your currently-implemented shoreline management policies?
- f. Are there any other tools that you have been using since your survey or are considering to address shoreline change? If so, please describe.

IV. State v. Local Shoreline Management

- a. Is there a difference between shoreline management tool choices at the state-level and those at the local? If so, how and why?
- b. Why isn't modification of development used as often as other tools at the state or local level (e.g. soft stabilization through beach renourishment or vegetation)?
- c. What agencies or policies have the most influence on coastal management and retreat? (Flood insurance? Wind insurance? Other agencies?)

V. Nuanced Data Information

a. Data Itself

i. Data, generally

1. What kind of data do you need? Can you elaborate on your previous response?
2. What information would best be provided from the federal level? What from the state or local entities?

ii. Data Analysis Infrastructure

1. Is data analysis conducted in the office?
 - a. If so, do you have adequate staff?
2. Do you have the proper hardware and software to process data to get the information you need?

iii. Data Availability

1. Have you experienced any data collection impediments?
 - a. If so, from what?

b. Modeling

i. Do you have shoreline change modeling in your management program?

1. If so, who is responsible for the modeling? (is it institutionalized in-house or sent to university research units or consultants)
2. When was the modeling program established?
3. Have there been any methodological updates since establishment?
 - a. If so, how often are they required?
 - b. What new approaches have been added?

VI. Shoreline Management Plans

For this study, a shoreline management plan is defined as an overarching plan to manage all coastal areas of the state in place and available to the public.

- a. What constitutes a formal management plan in your state? When was it introduced? How has the public received it?
- b. If your state does not, why? Are there any intentions and/or demand to generate a formal plan?

VII. Urban/Commercial v. Residential v. Undeveloped Tools

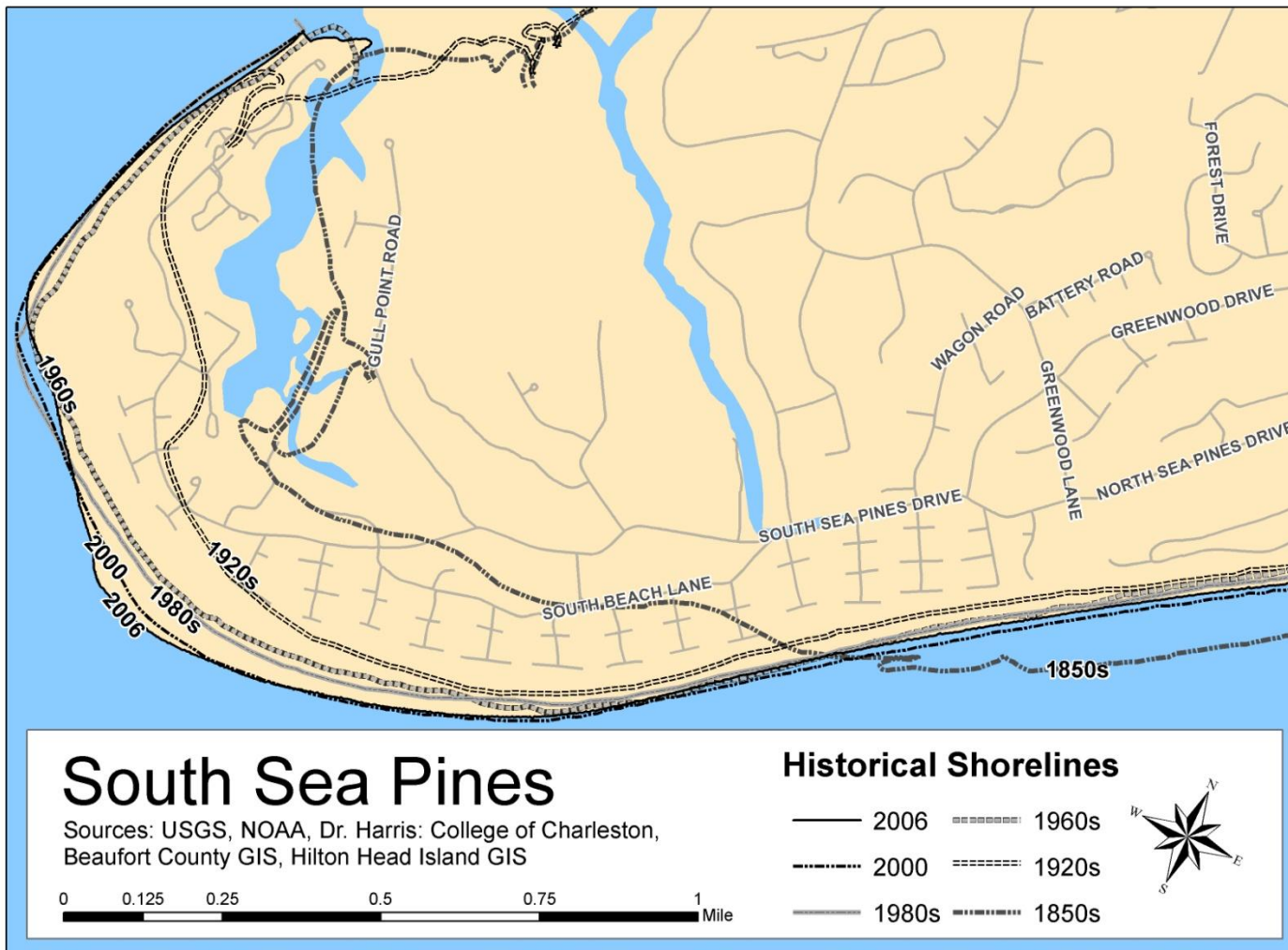
- a. Is there any difference between tools used in urban/commercial areas and those on residential and undeveloped lands?
 1. If so, how? What is used where?

VIII. Sheltered Coastlines

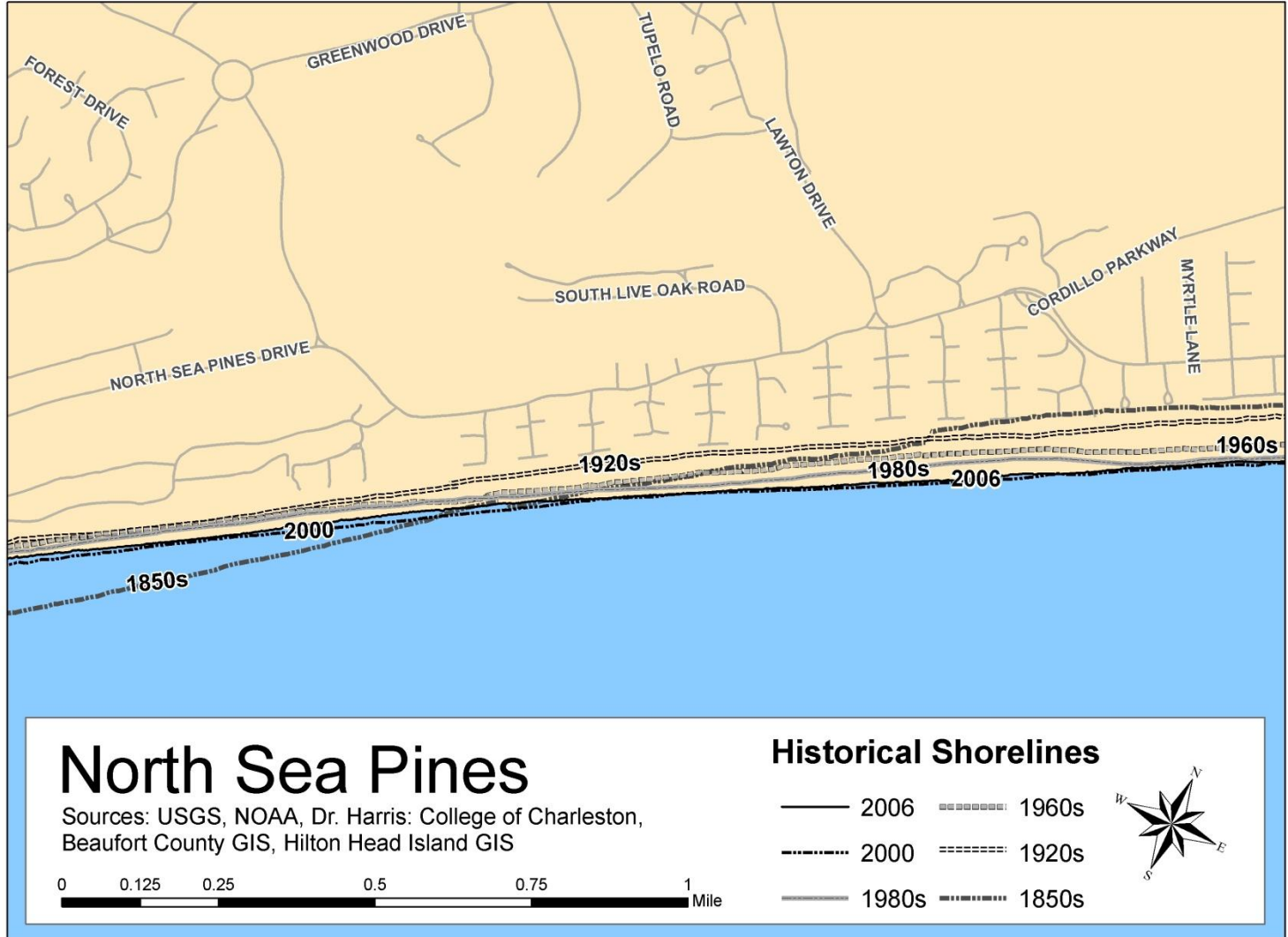
- a. What are the primary differences between shoreline management on estuarine/bay shores and open ocean areas? (In terms of data needs, management tools, the development dichotomy, etc.)
- b. What are the strategies your state is considering for estuarine areas (with respect to SLR, especially)?

- IX. Legal Repercussions of the Tools
 - a. Has your state faced a precedent-setting lawsuit for any of your statutes, rules and regulations/administrative codes or plans?
 - i. If so, for which? (please describe)
 - b. How much has the threat of takings factored into your choice of management strategy? Which strategies are most affected?
 - c. What tools have been constrained because of the takings issue?

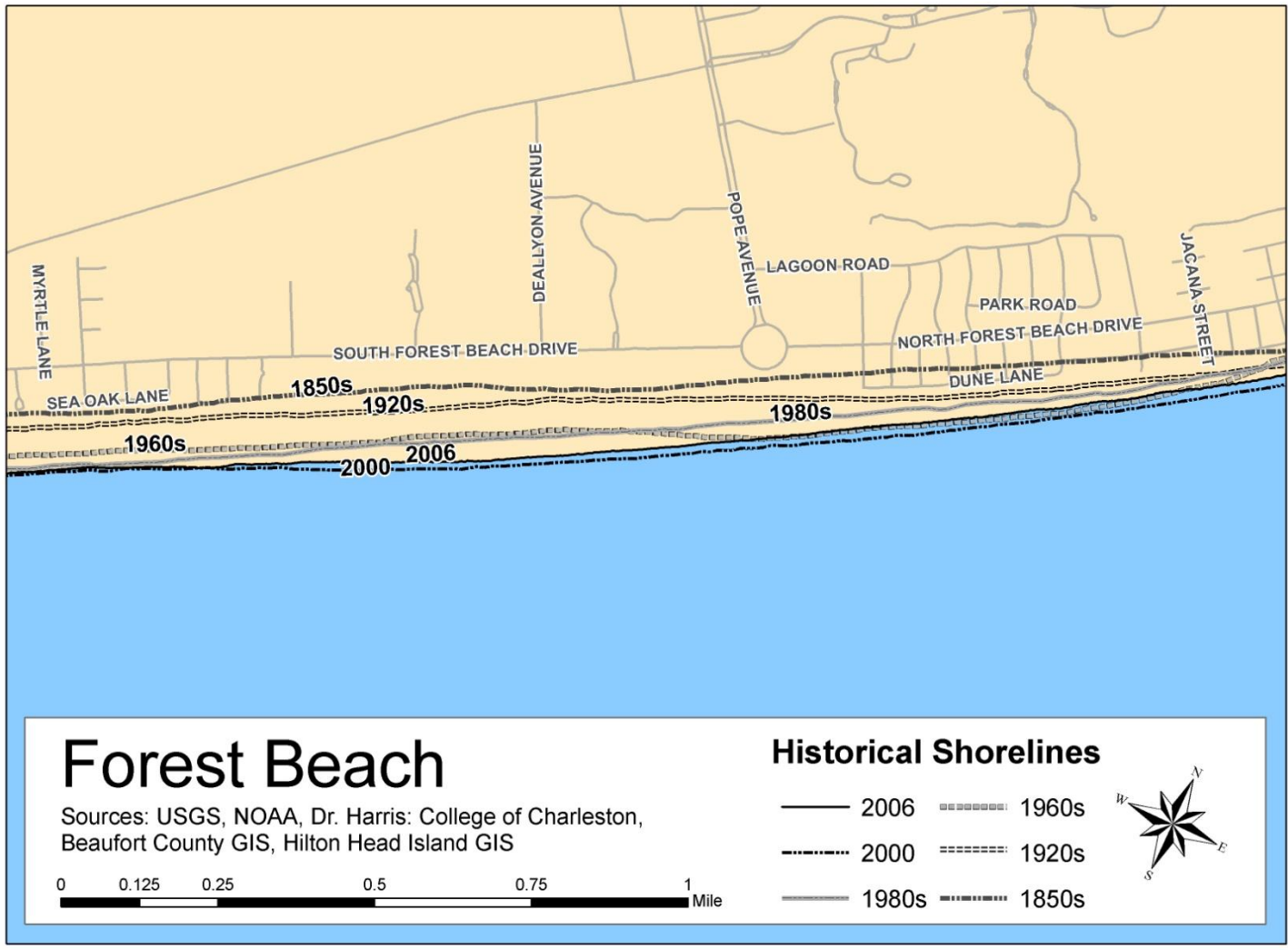
- X. Coastal Management more generally
 - a. Suggested changes to the federal program [ask them to offer]
 - i. Do they need more planning guidance (with Section 306) or will this impede flexibility?



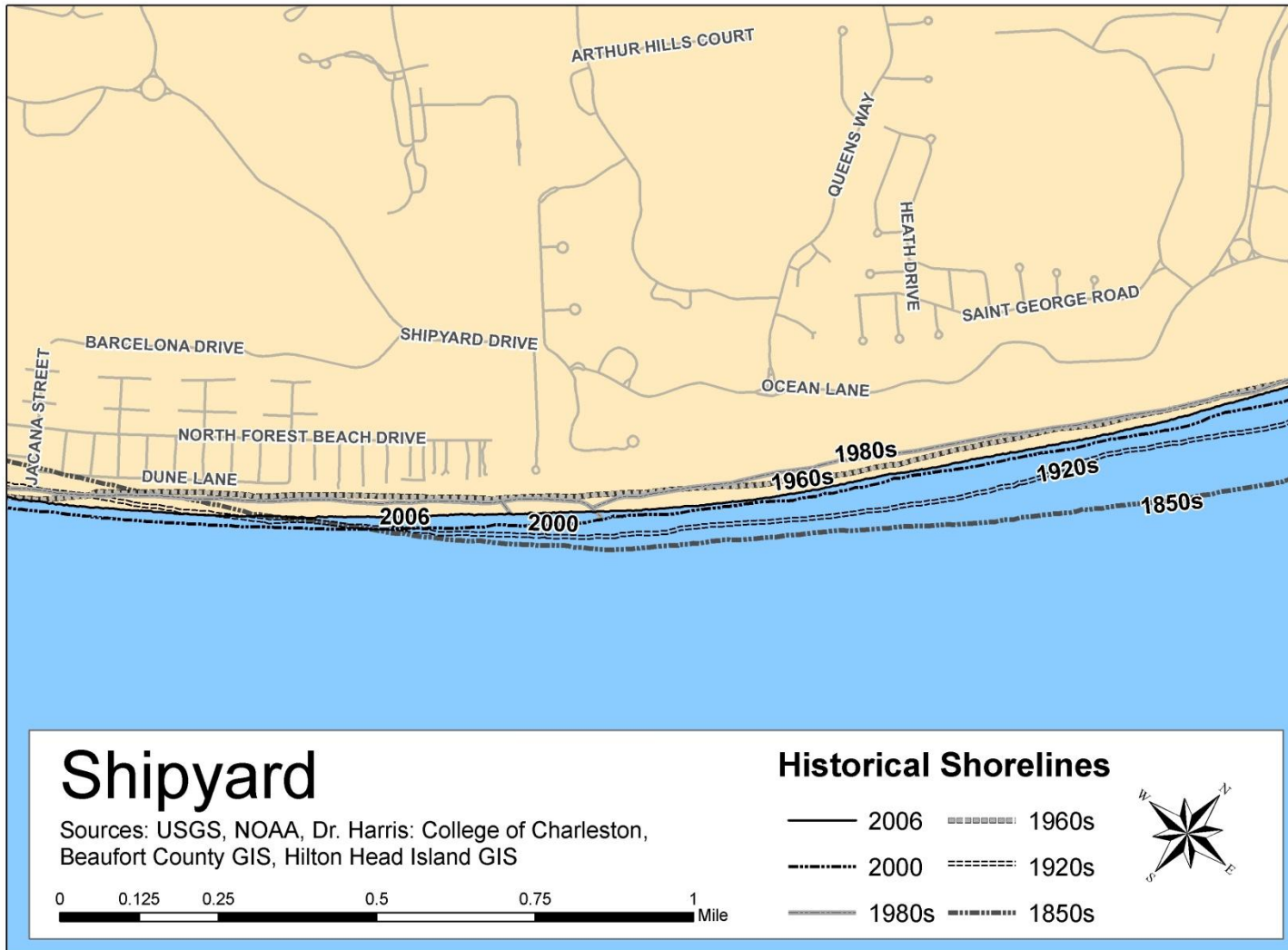
Appendix 4. South Sea Pines Historical Shorelines



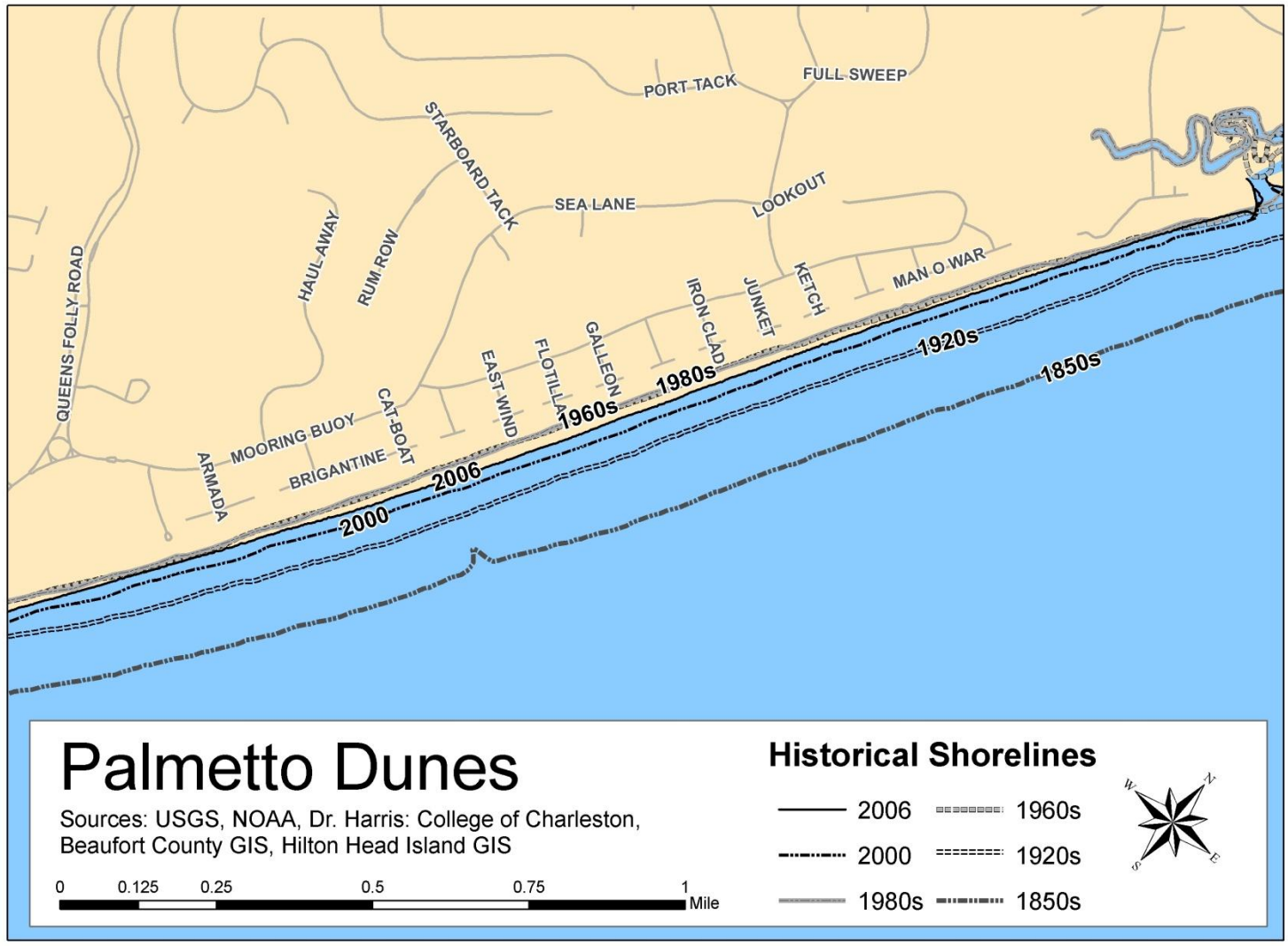
Appendix 5. North Sea Pines Historical Shorelines



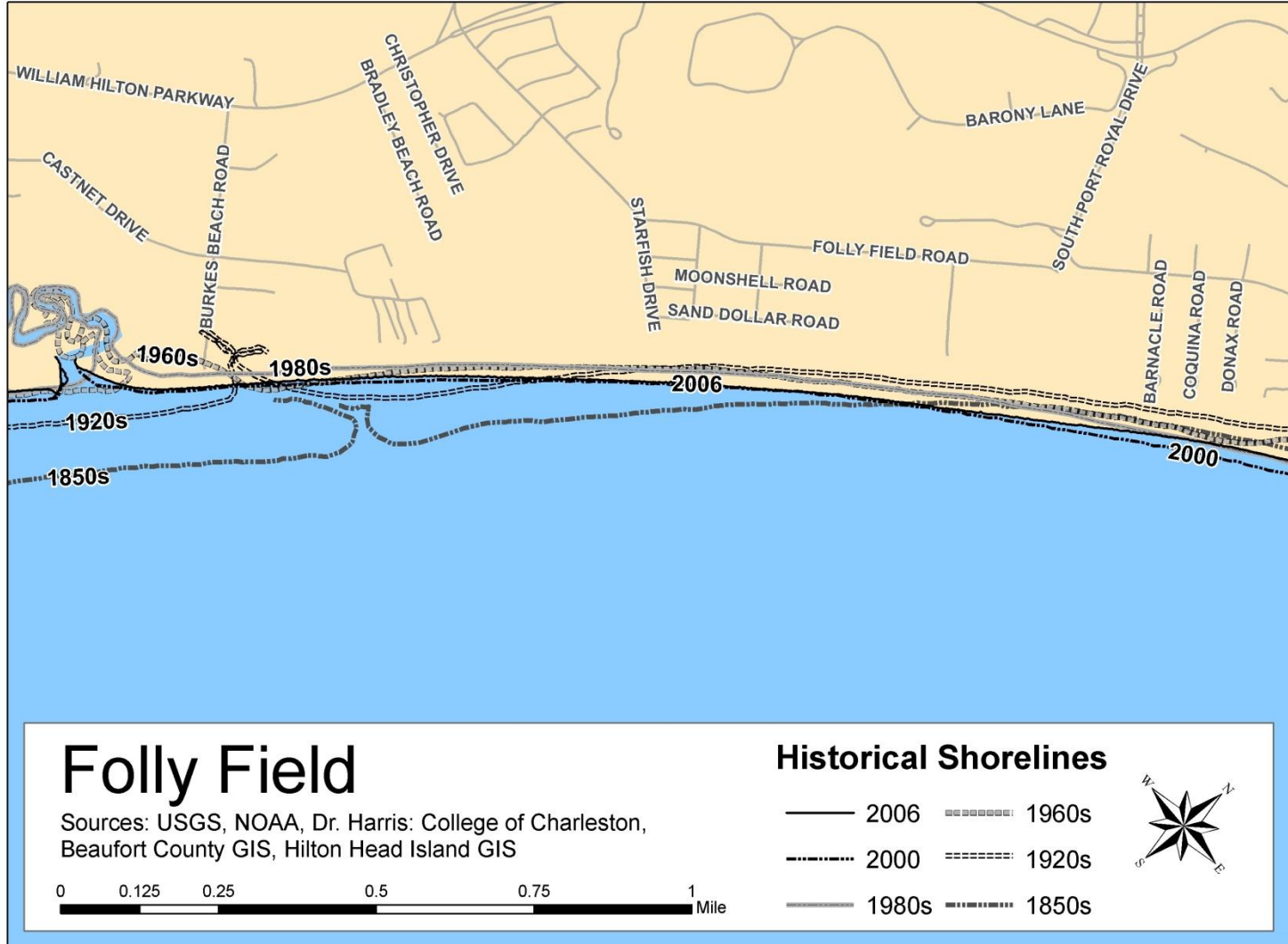
Appendix 6. Forest Beach Historical Shorelines



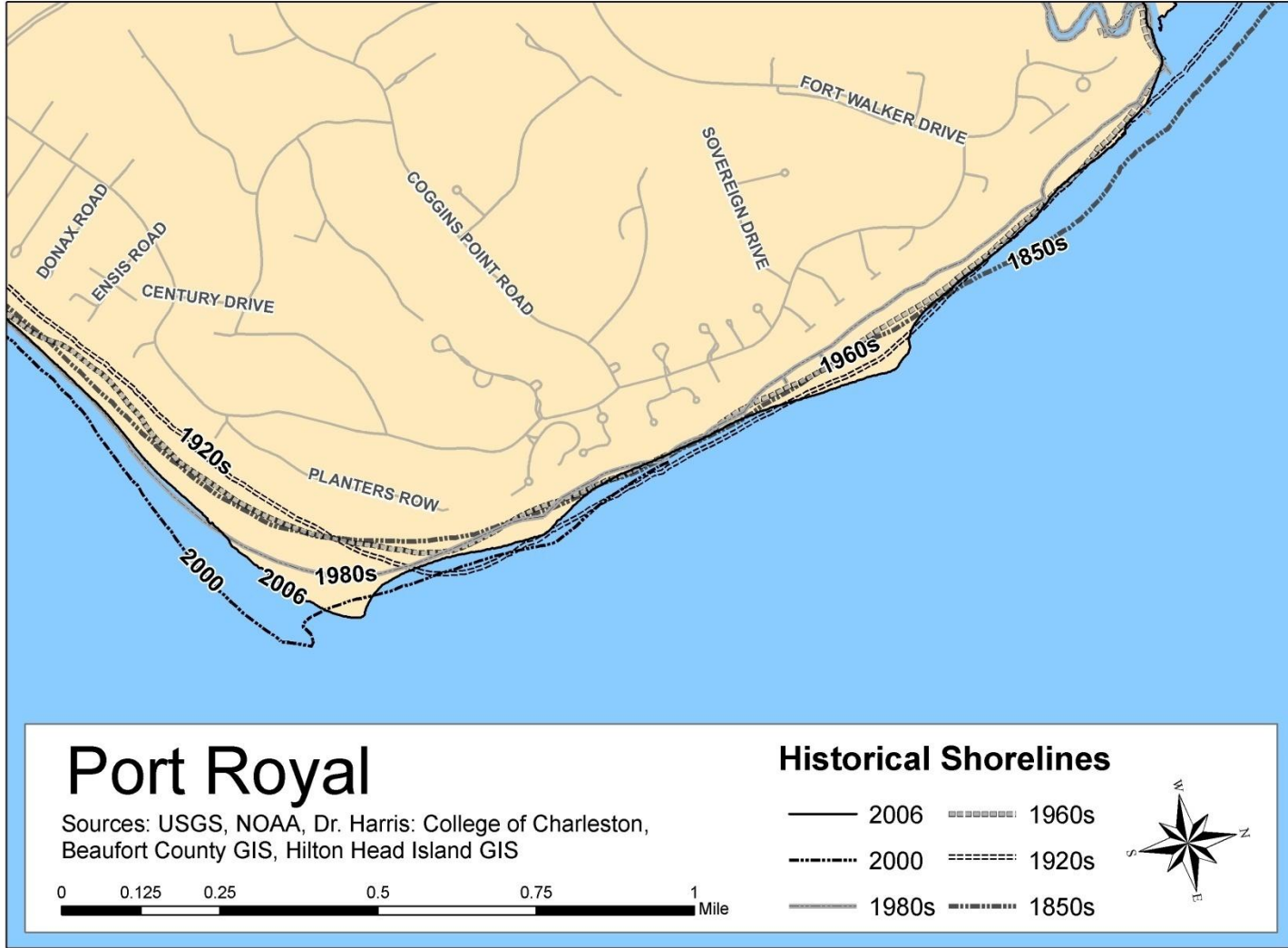
Appendix 7. Shipyard Historical Shorelines



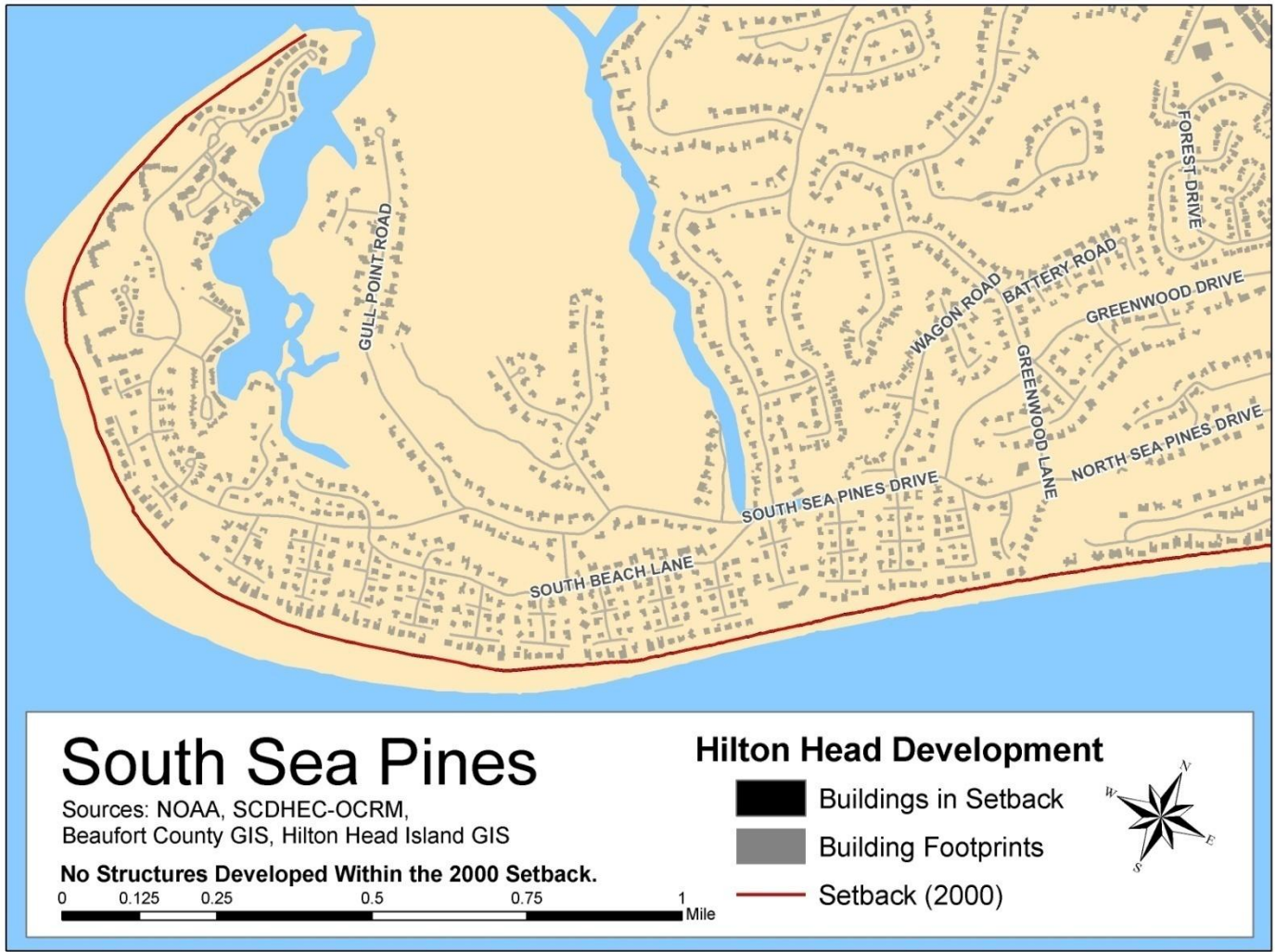
Appendix 8. Palmetto Dunes Historical Shorelines



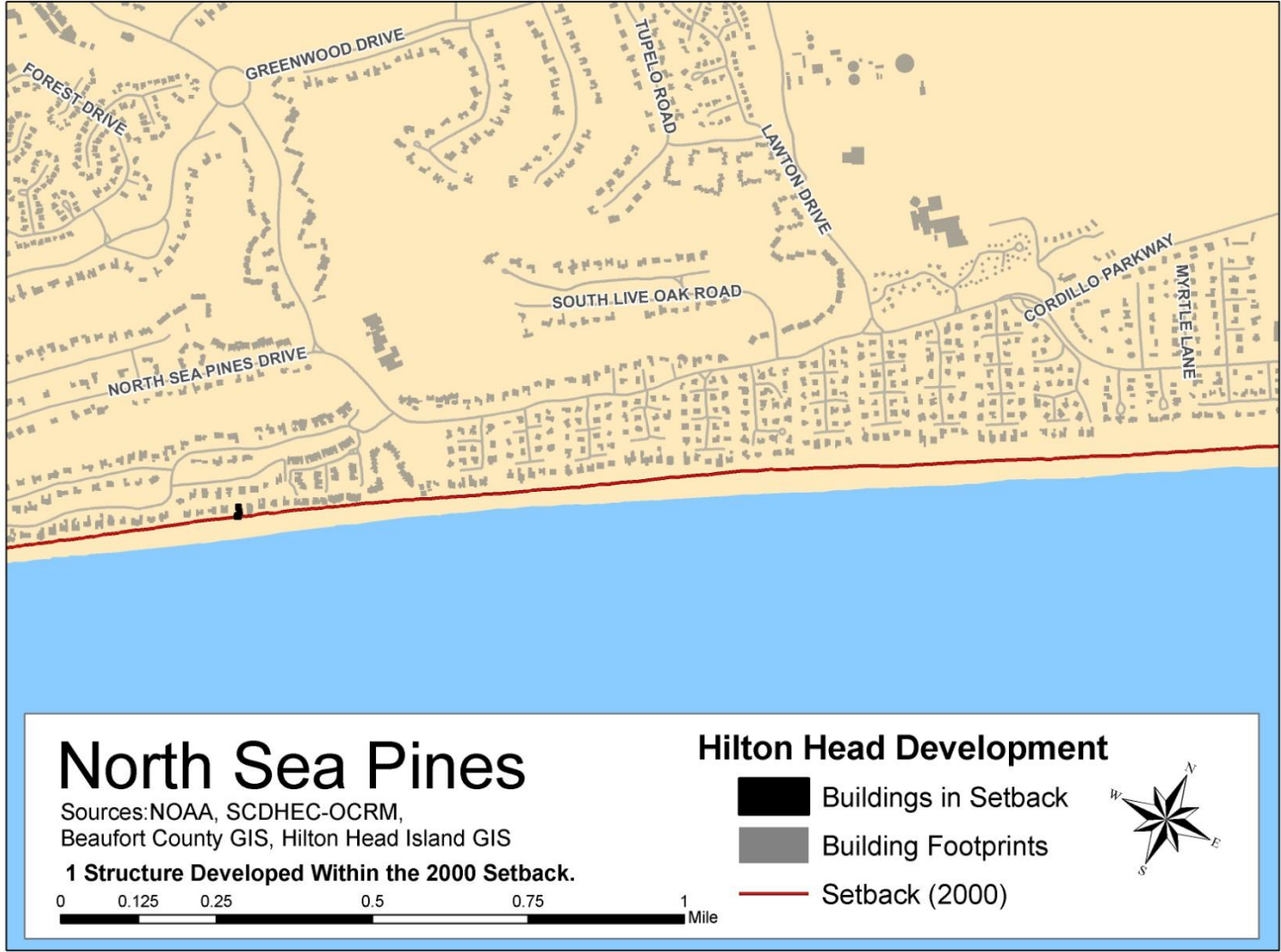
Appendix 9. Folly Field Historical Shorelines



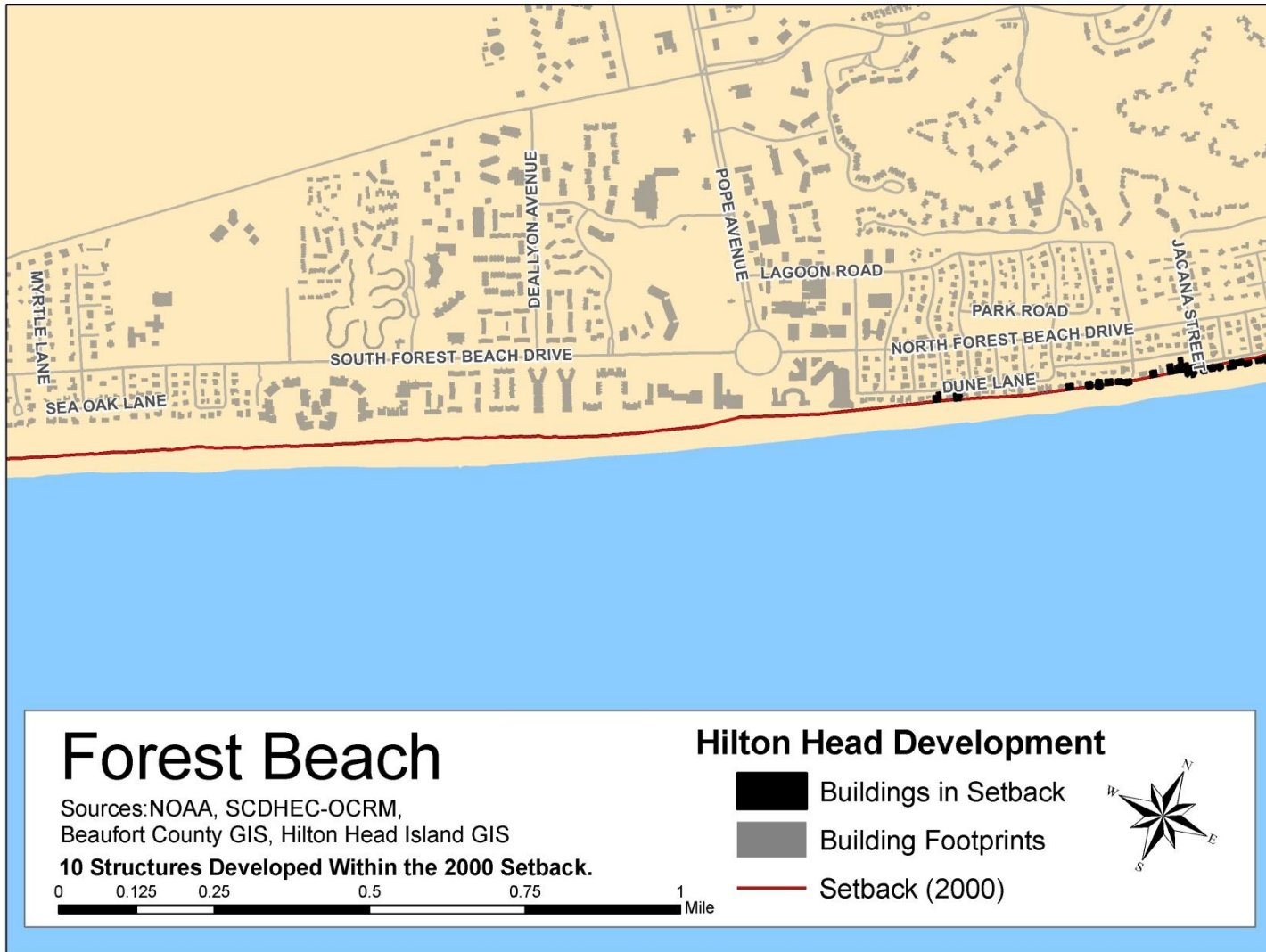
Appendix 10. Port Royal Historical Shorelines



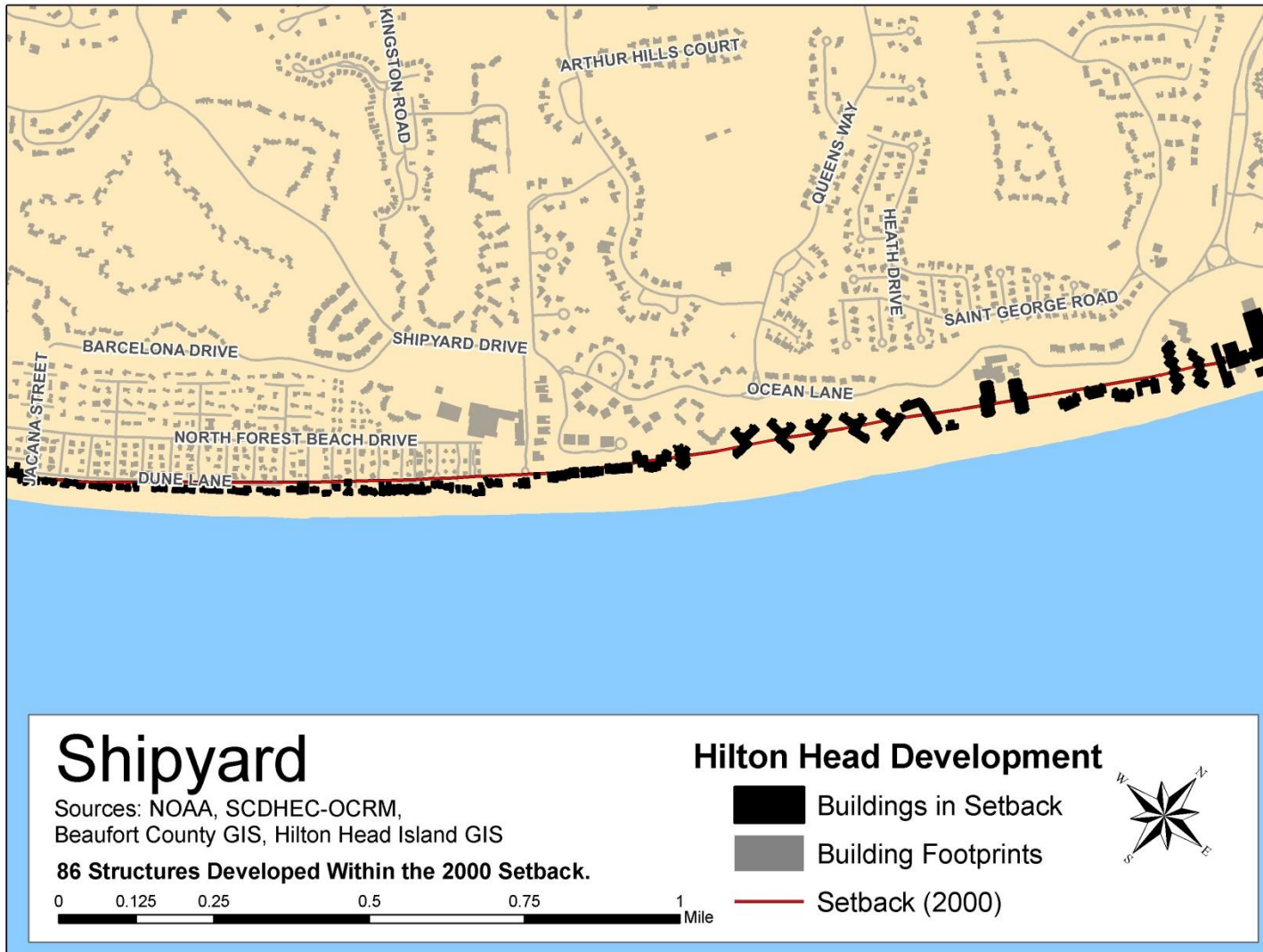
Appendix 11. South Sea Pines Development



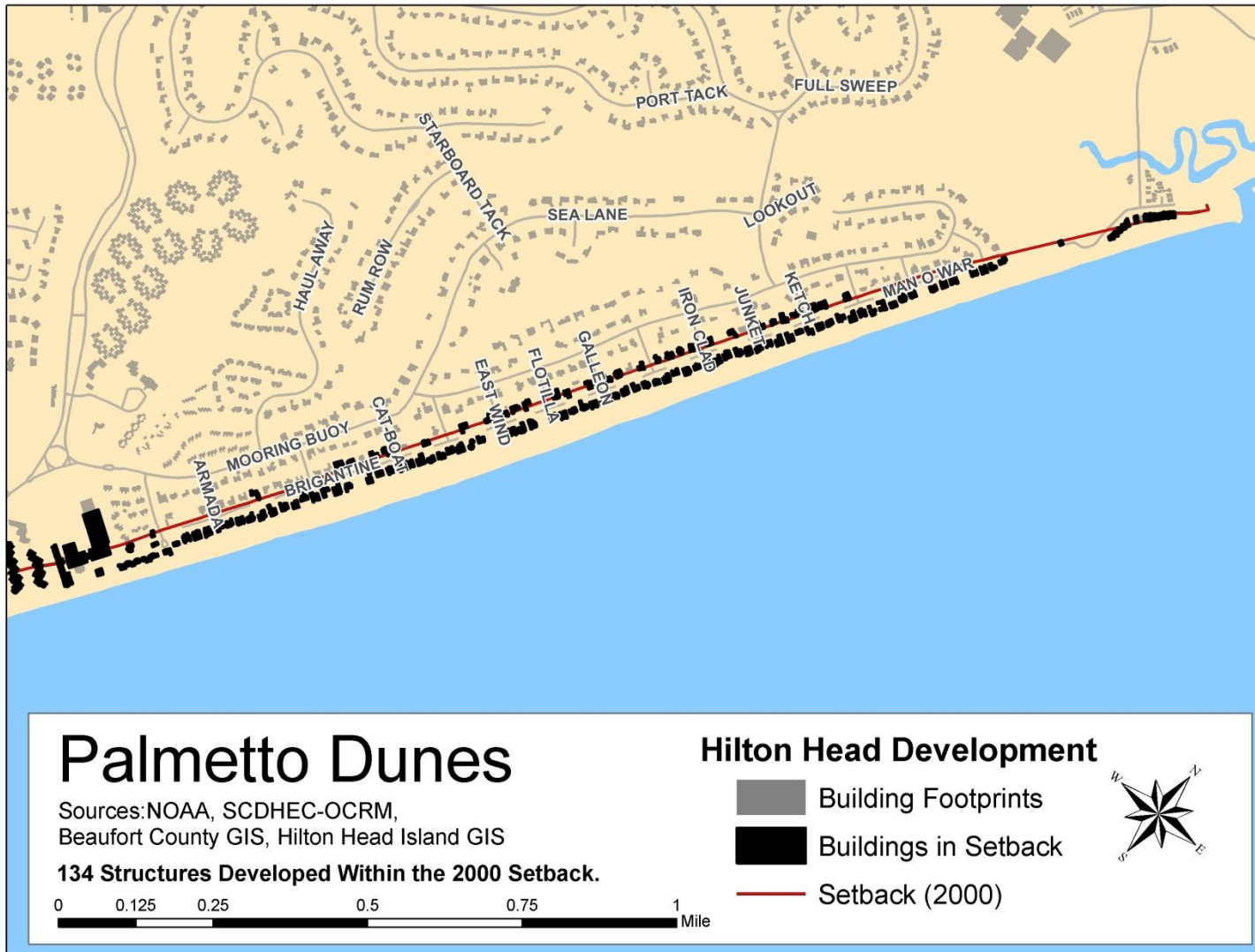
Appendix 12. North Sea Pines Development



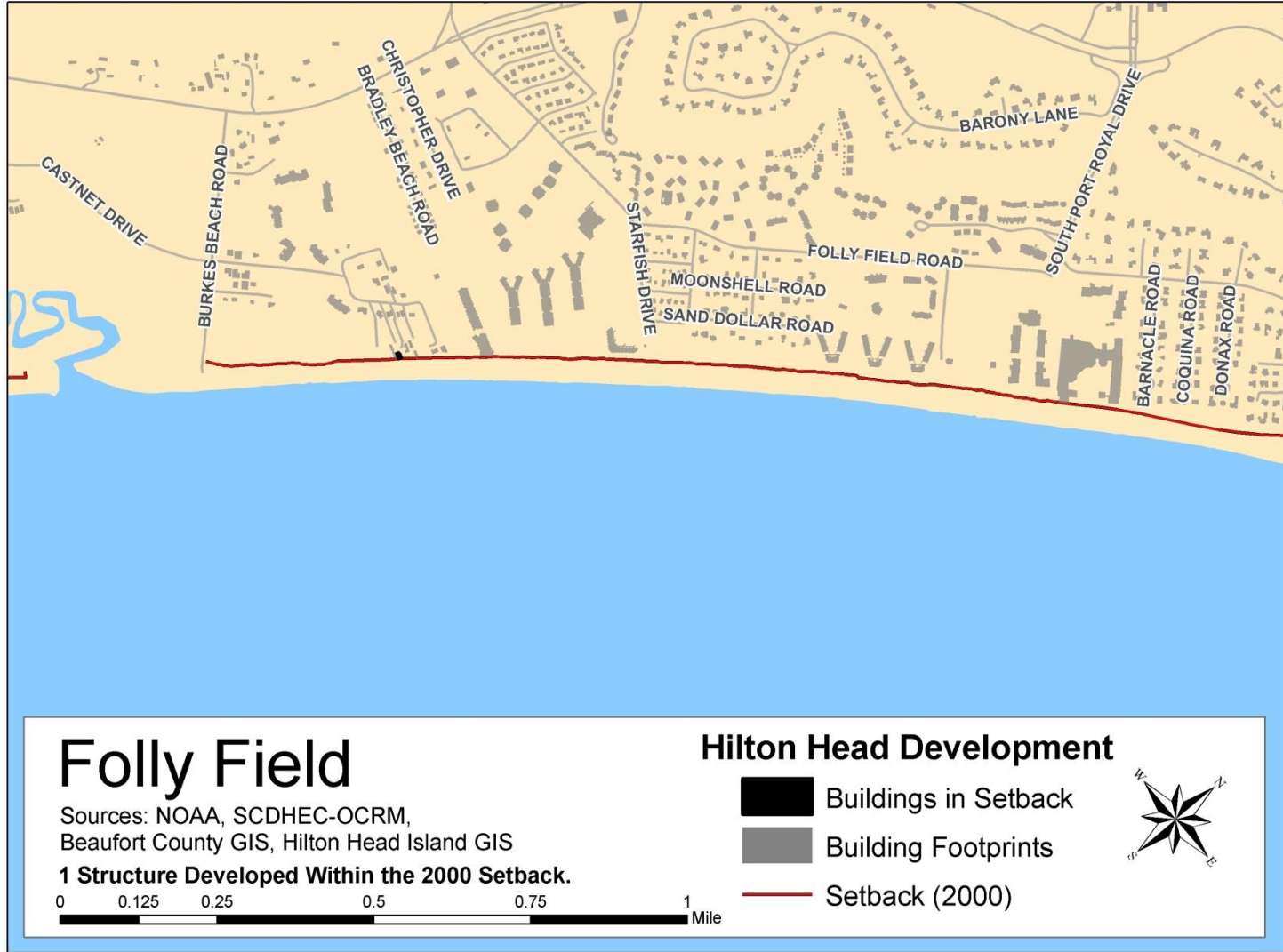
Appendix 13. Forest Beach Development



Appendix 14. Shipyard Development



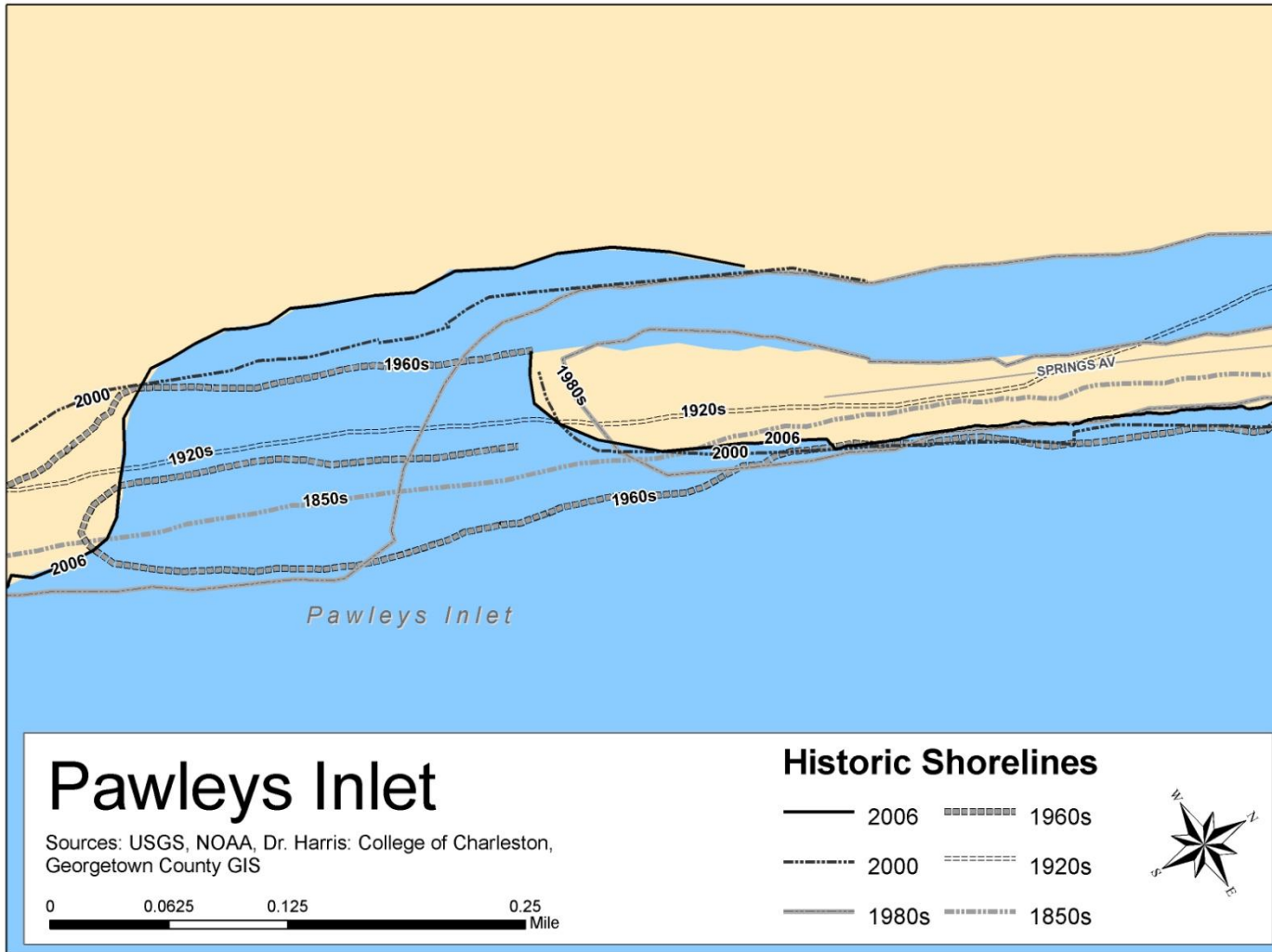
Appendix 15. Palmetto Dunes Development



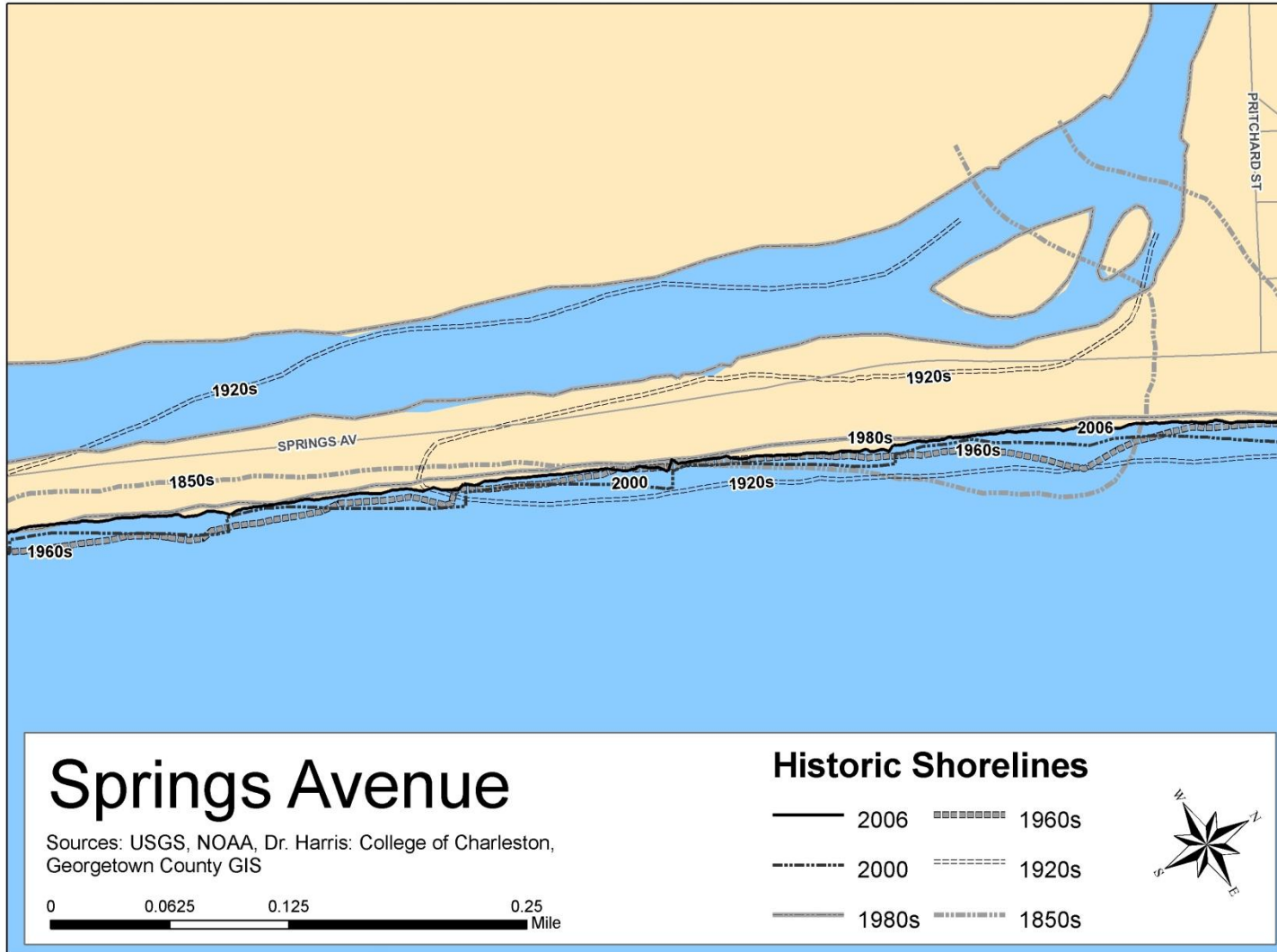
Appendix 16. Folly Field Development



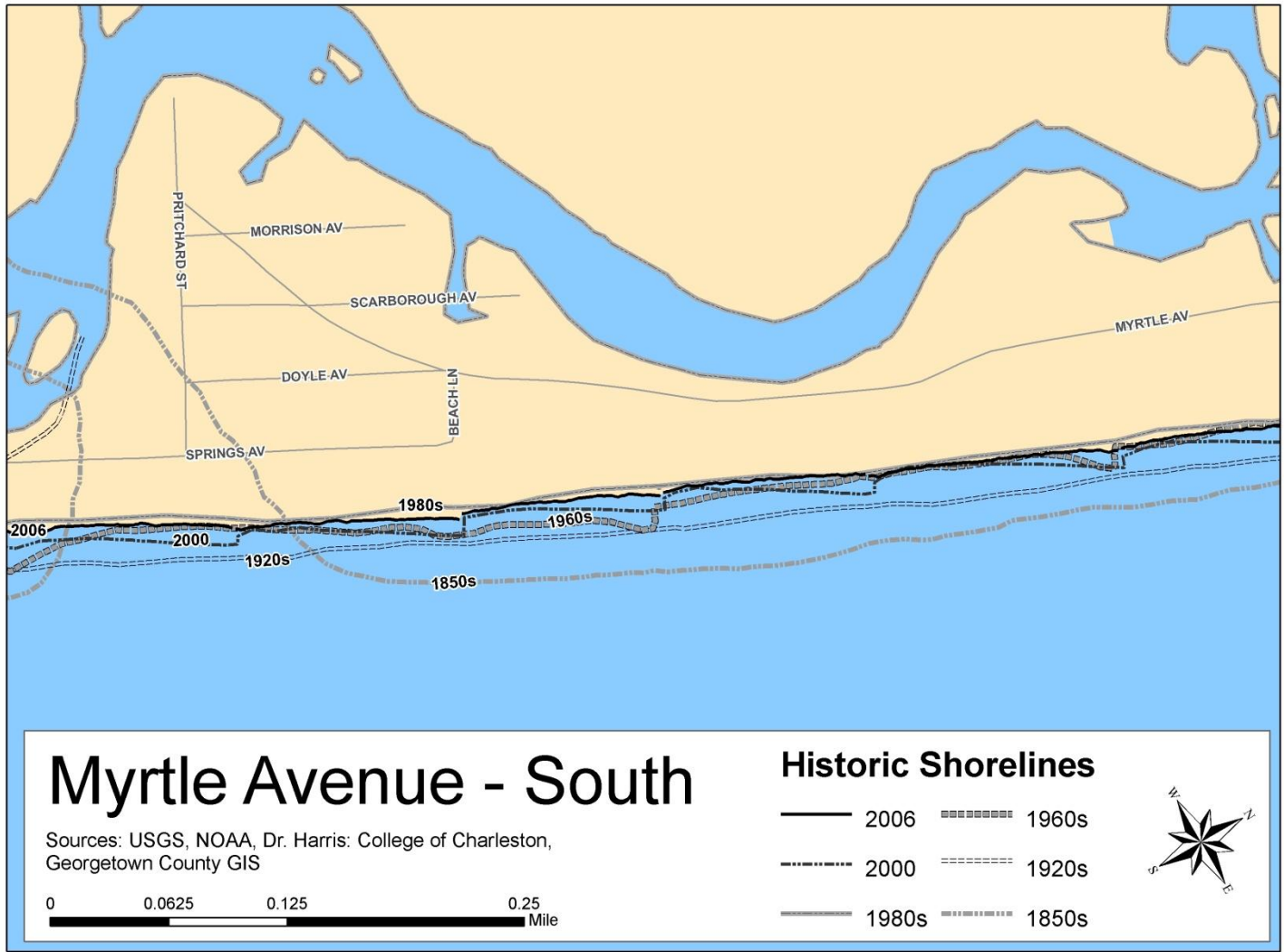
Appendix 17. Port Royal Development



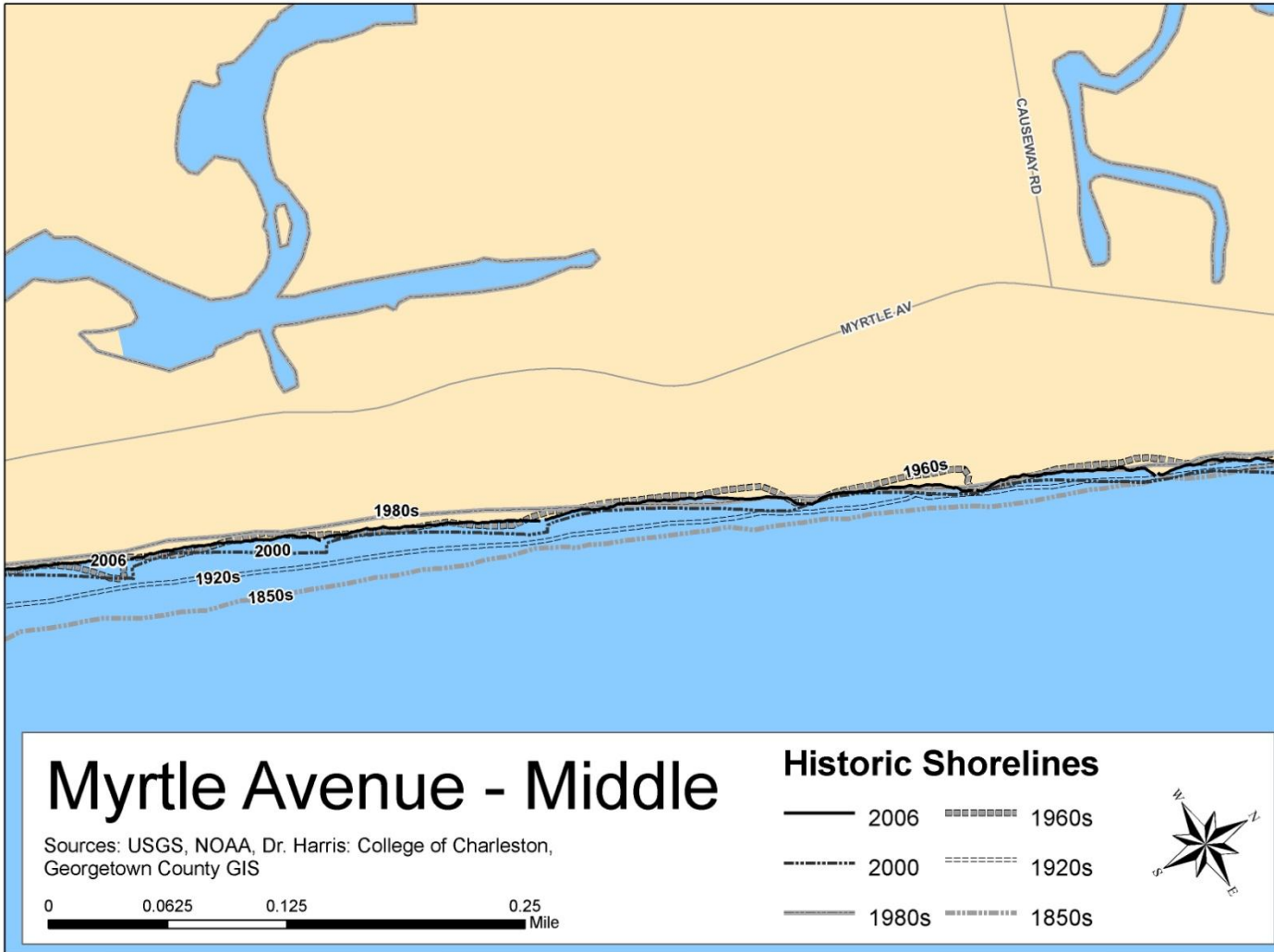
Appendix 18. Pawleys Inlet Historical Shorelines



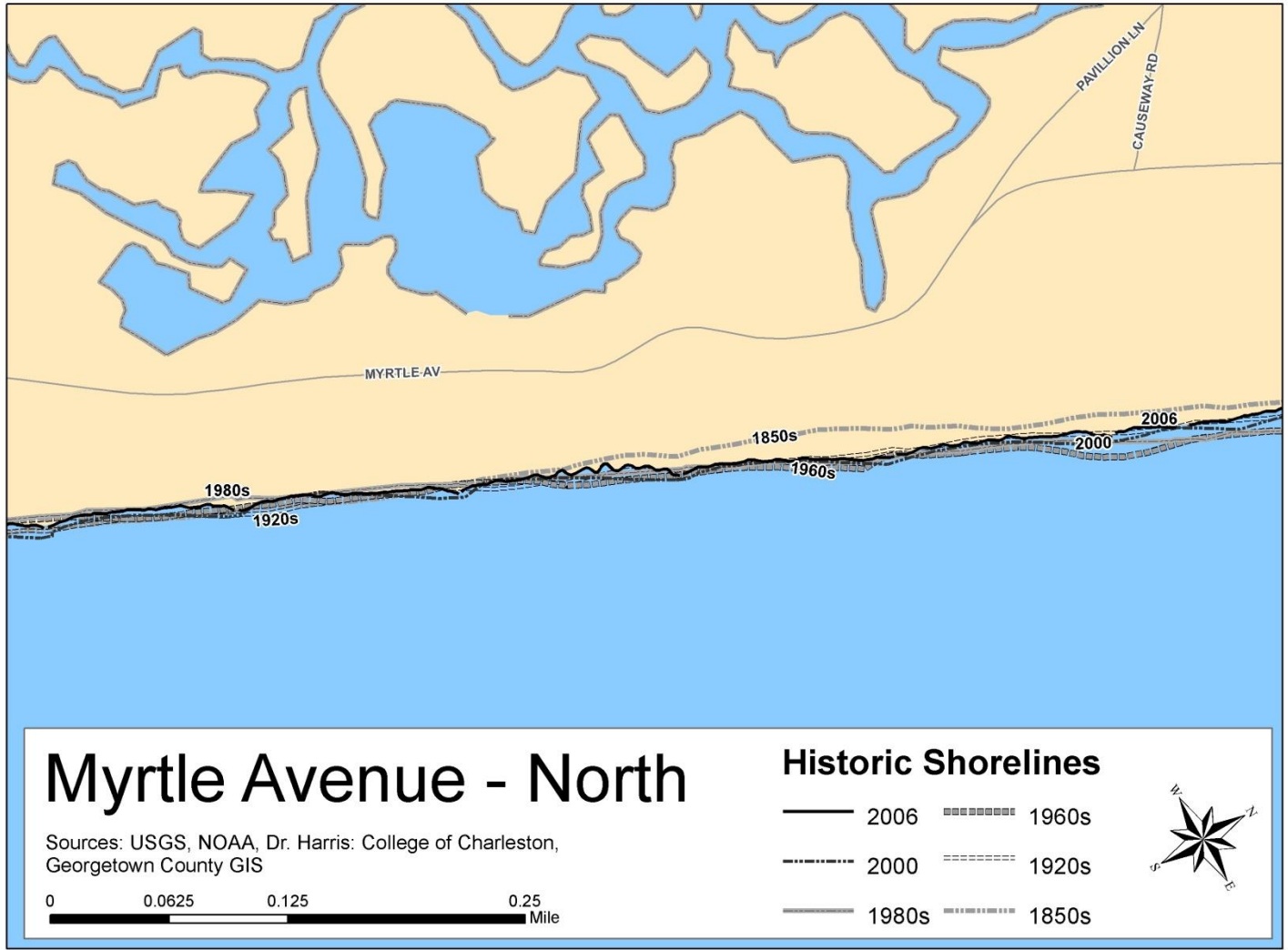
Appendix 19. Springs Avenue Historical Shorelines



Appendix 20. Myrtle Avenue - South Historical Shorelines



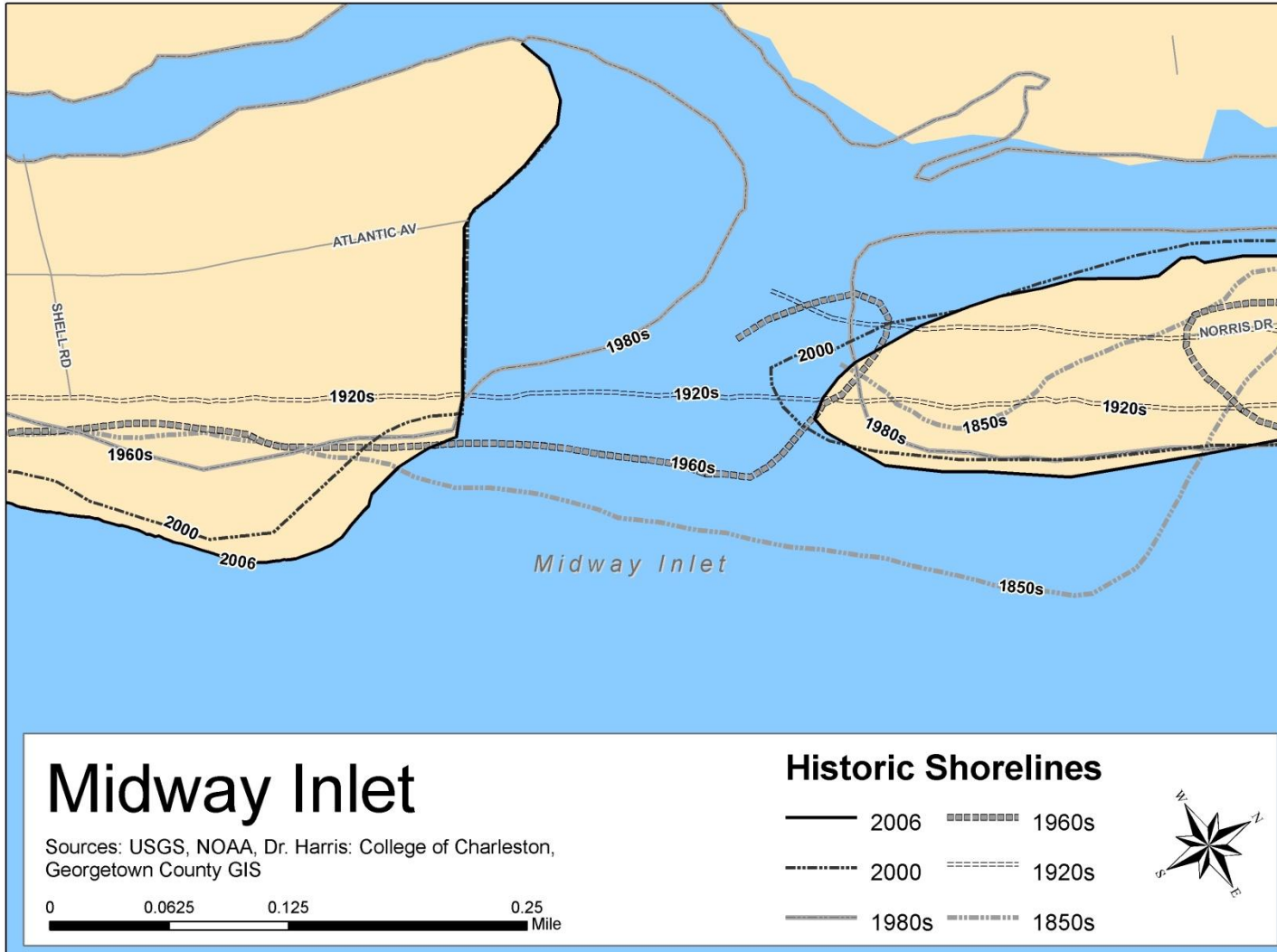
Appendix 21. Myrtle Avenue - Middle Historical Shorelines



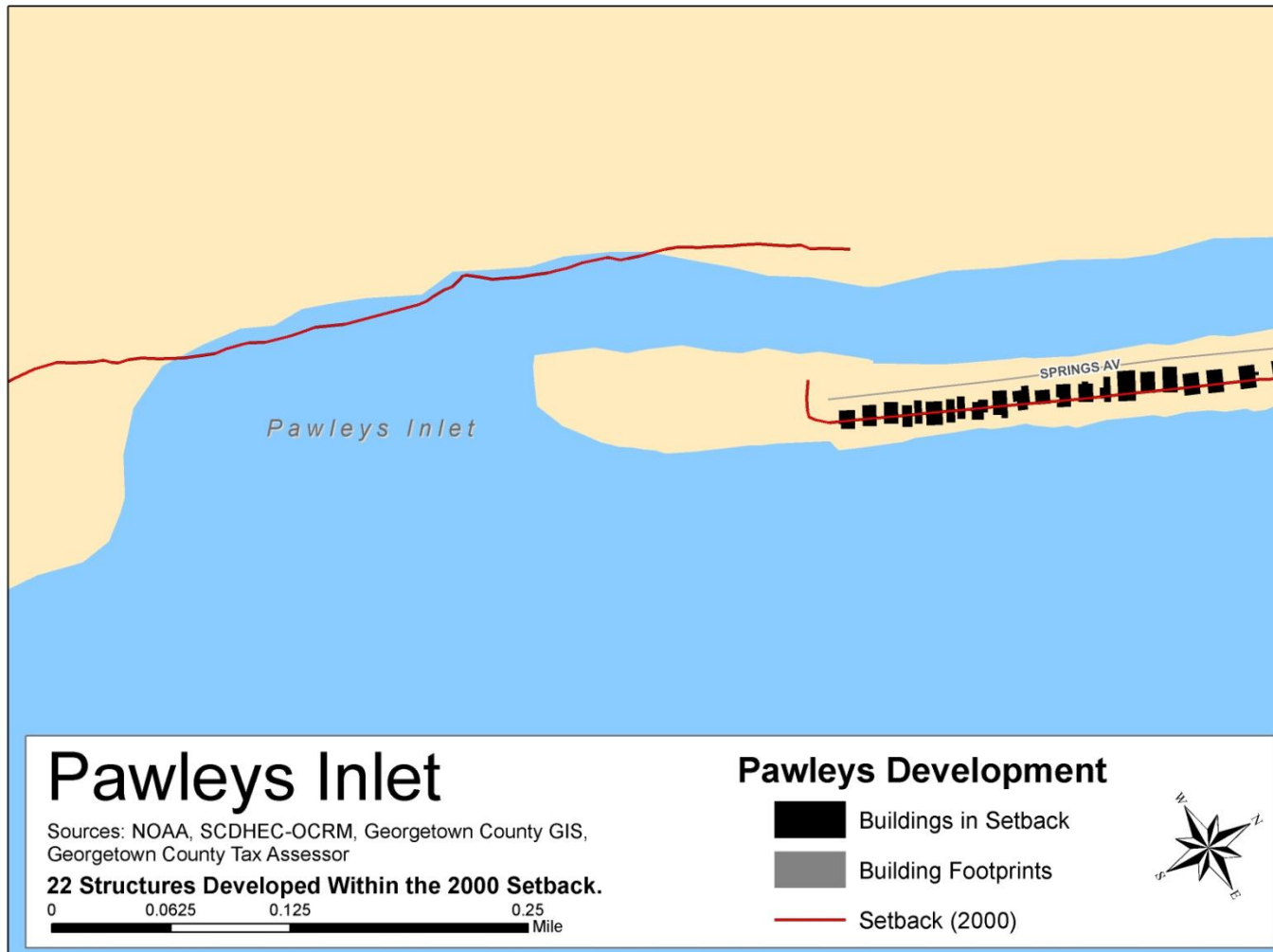
Appendix 22. Myrtle Avenue - North Historical Shorelines



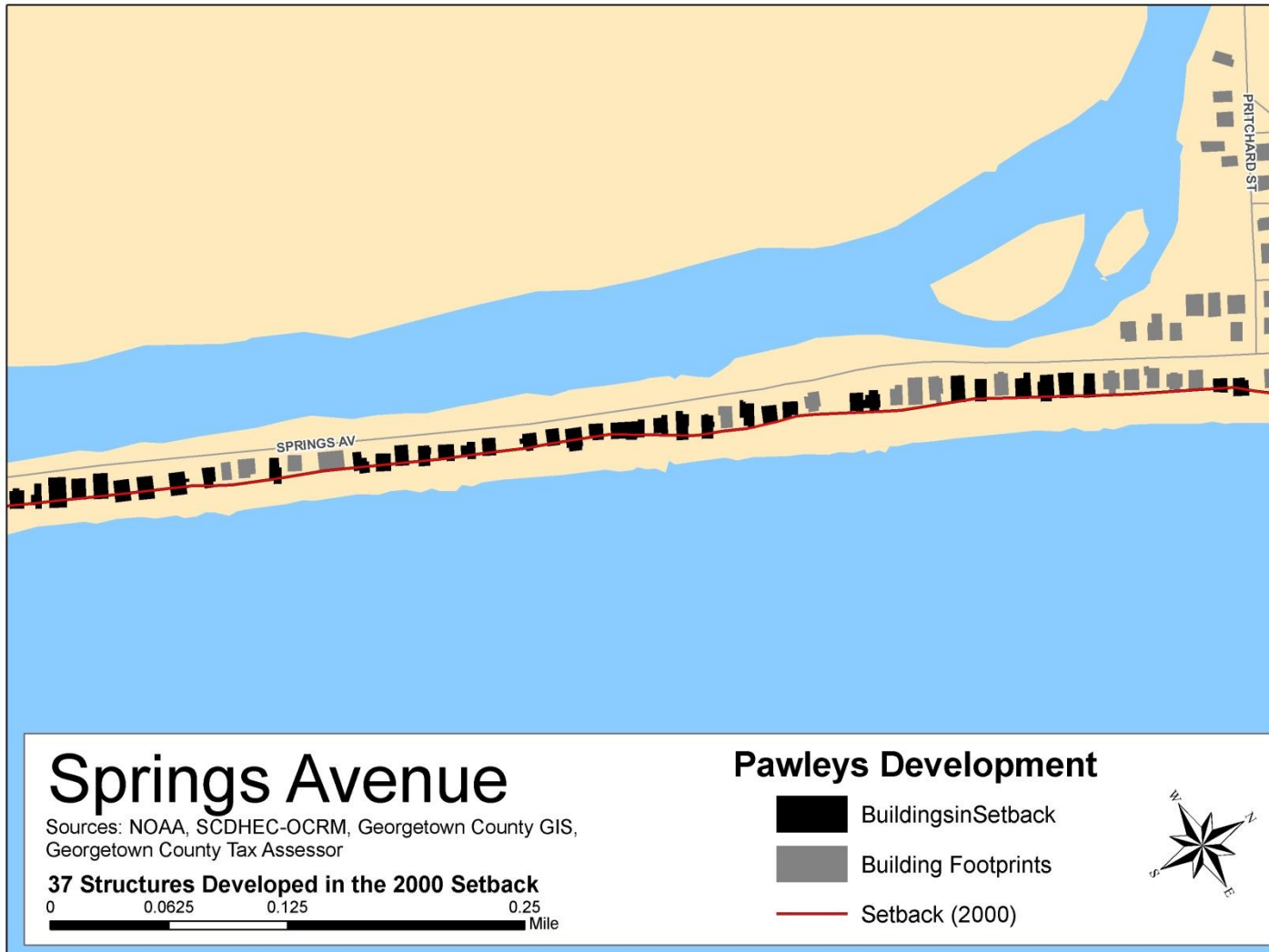
Appendix 23. Atlantic Avenue Historical Shorelines



Appendix 24. Midway Inlet Middle Historical Shorelines



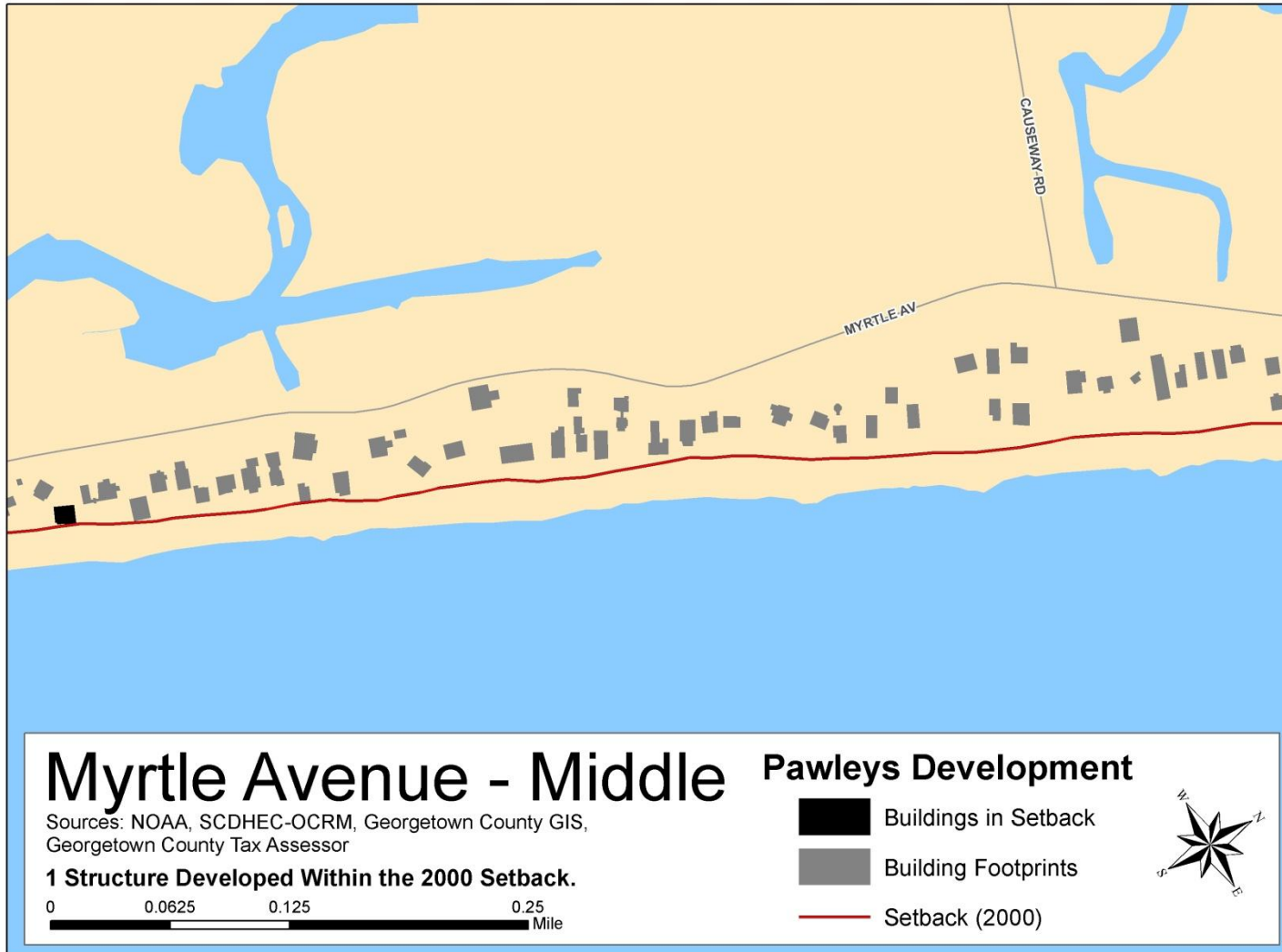
Appendix 25. Pawleys Inlet Development



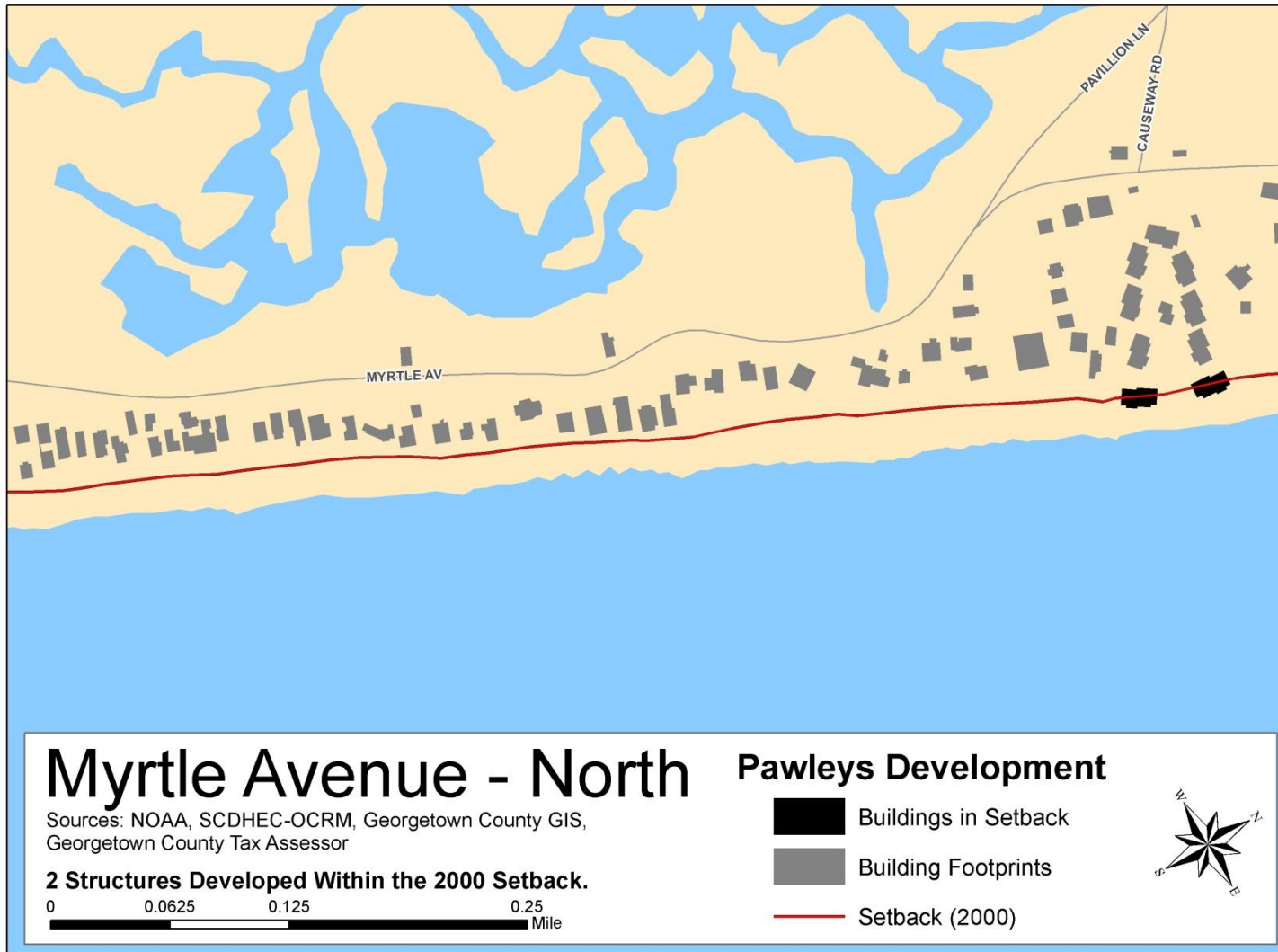
Appendix 26. Springs Avenue Development



Appendix 27. Myrtle Avenue - South Development



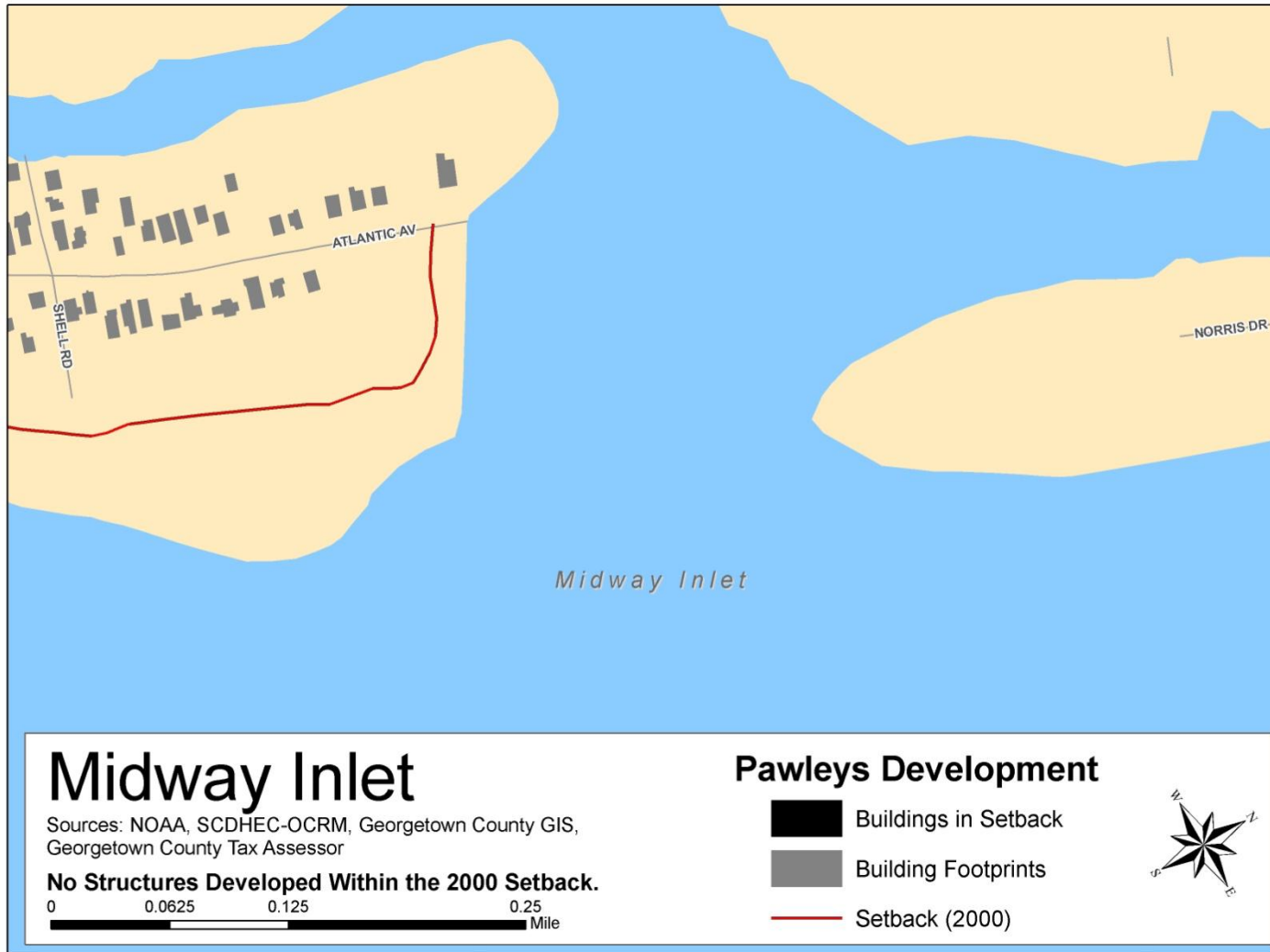
Appendix 28. Myrtle Avenue - Middle Development



Appendix 29. Myrtle Avenue - North Development



Appendix 30. Atlantic Avenue Development



Appendix 31. Midway Inlet Development

Appendix 32. Participant Responses to October 2008 Focus Group Meetings

Focus Group Responses

Mount Pleasant – 10-20-08

How has shoreline change affected SC or locally?

- Shoreline change has taken away my front yard
- The state passed the BMA without telling anyone that they wouldn't be able to build any structure after the law- we would have built something before the act if we had known but we didn't need anything yet
- OCRM says you can use 5 gallon sand bags for erosion management- that's like using ping pong balls- it's a joke. In essence, they have taken my property.
- The law is absolutely ridiculous-"I'm mad as hell." If there was something legal I could do I would do it. I've scraped the sand and pushed it up and I've sand bags but they're useless.
- We need to look forward and I'm amazed that we're still issuing building permits on a sandbar which is sometimes on Kiawah Island and sometimes on Seabrook
- Public beach is up to where high tide comes up- this goes right under my house so people come under my porch and leave trash and play loud music

Tools for shoreline change?

Coast overall:

- Sandbag regulations not effective
- Setback lines and other lines are not realistic and not fair
- Changing areas (spits, etc) should be banned from development

Local:

- State won't allow stabilization of private structures, yet at same time they put boulders around bridges to protect them
- State should allow hard structures on a case by case basis

Setbacks:

- Retroactive setbacks won't work because they don't make fiscal sense.
- Communities need tax revenues from beach residential and commercial areas
- For developed areas need to allow hard structures in combination with beach renourishment
- Land acquisition- state needs to buy land that it doesn't want developed
- When considering groins they need to also add in beach renourishment
- Could inlets be dredged to force sand movement in desired directions?

Who has influence?

- OCRM-state
- Federal
- Locals
- NGO's

Concern over sea level rise?

Inevitable event regardless of human influence

- Have heard very little about the issue- doesn't see it as a problem
- Too often answers to questions tend to focus on single issues when we really need to look at things comprehensively

Adapting to sea level rise

- Listen to stakeholders
- Allow landowners to protect their property
- Seriously take sea level rise into effect for planning purposes and for infrastructure movement and construction

Need to know what the value is for each beach area in order to make decisions on renourishment, rolling easements, etc.

Political influences can change the value of land- e.g. Kiawah was once considered unbuildable, but political decisions changed that

Estuarine Areas

- Sand management issues not as important
 - Already seeing change in areas that once were upland and are now changing to wetland
 - Areas that work as buffers (estuaries) need to be protected (possibly by state purchases of vulnerable areas and land acquisition)
 - Hard structures can protect property
 - Setbacks don't work because they are transient
 - Could flood zones be used to protect wetland areas

Property owners feel like they "know the ocean" and that authorities are often confrontational forcing science and solutions on local people- though these solutions often don't work

- Told we need to follow the rules but there is no one to help you follow them

-No accountability of regulating agencies

Property owners want to be given the option of protecting their property the way they see fit (most property owners know/care more about the beach than agencies)

- Must look at bigger picture and a holistic system
- Estuaries are an important food source breeding ground
- Marshes being filled in by developers at alarming rate
- Must have action at all levels

For shoreline protections need to have commitment from local, state, and federal

Political influence is huge- decisions can be swayed quickly depending on who you know

Need more/better science presented to the public so they can truly understand the issues (e.g. does NEIP really subsidize development)

Argument for more economic studies to see who benefits and who doesn't

Do we also renourish natural areas- have to take whole system into account

Priority items in beachfront management

- Constant renourishment
 - Property owners given more freedom
 - Holistic renourishment system
 - Include economics (because interventions are not free)
 - Preserve sensitive areas
 - Allow hard structures to protect investments
 - Retreat can work as long as it's not wholesale
- Different solutions for different areas

Charleston – 10-21-08

Have you noticed shoreline changes in South Carolina or locally?

- The erosion is worse around my house- built in 1970
- Beach renourishment helps but it is not the only answer and it's going to be hard to get the funding for now. About two or three years ago they got a \$250,000 grant and they

renourished the north side of Sullivan's Island and added rocks to the groins. That helped a lot.

How is the public process working?

- The biggest thing that got us the most upset is with moving baseline and setback line "the line goes right through my house"- older homes should be grandfathered in without more regulation. Now that line won't allow us to do anything protect our property- "like putting a hard structure device around our house- I'm not talking on the public beach just around my house".
- Hurricane Hugo seemed to change physical dynamics of the beach- there hasn't been as much accretion as used to use before Hugo.

Amount of shoreline management you would support (who should be most responsible)?

- Would like to see local government have more control over what you can do, rather than the state but we're probably going to have to have both. Something is going to need to be done, but how you go about doing it I don't know.

Who should bear the cost?

- Property owners need to be responsible for protecting their own property (such as the hard structures around foundations). For beach renourishment I think a combination of private owners and the government.
- Local government will have a hard time paying for things like beach renourishment and now budgets are tight at all levels.
- Sullivan's Island has very little as far as resorts and vacation rentals and other commercial, so it is difficult to tax- won't really add that much money for improvements. Funding is definitely going to be a problem.

Any talk or concern over sea level rise?

- Sea level rise probably has some effect- don't know what to do about it. We have noticed that the sea level has been coming up higher than it has in the past. We're seeing some effects now. But we're not having discussions about that specifically. Either state or federal government should manage accelerated sea level rise.

Concern about wetlands?

- Wetlands and marshes are not as much a concern for me as the shorefront areas, as far as protection and sea level rise goes. Who governs wetlands? Army Corps or OCRM?

Which agencies and policies have the most affect on retreat?

- State is only place I can get wind and hail insurance; if you get water undercutting your house the state will cancel wind and hail.
- Wind and hail insurance costs about \$5000 for \$400,000 house, flood insurance costs about \$2200.
- Wind and hail insurance is the primary limits to people building on the beach.

Other comments?

- My main concern is saving my home and I'm sure others feel the same way. I wish they would just allow you to do something to protect your home and get your insurance back.

Myrtle Beach – 10-22-08

- Two days notice is not enough for a public meeting.

Shoreline change in SC or locally?

- In 1985-1986 the 1st renourishment project occurred in Myrtle Beach- we lost all of that to Hugo. We then fixed that with smaller projects. In 1995 the Corps started with 10-year renourishment cycle and we are currently doing renourishment. After Hugo we got authorization from Congress to have Corps do 10-year cycle.
- Pawleys Island has 23 groins about 500 feet apart. About 11 years ago the groins were rebuilt because they were built in the 1950's and were in decrepit condition. They were rebuilt with rock and concrete and at the time we did some minor renourishment. After this, the middle part of the island built a whole new dune field. As a result probably about 2/3 of the island has rebuilt because of the new building of the groins.
- Feels that groins are effective and has added beach
- A project with the Corps of Engineers determined that 2/3 of Pawley's Island is accretional but south side of island is erosional.
- Myrtle Beach has set a 50-year setback with grandfather clause which can include pools (they may do some restructuring of the pool but they do not take them out).
- We see lots of swimming pools in setback area- thinks they should not be allowed because they act as hard structure. We haven't been tested since Hugo to find out what the ramification of having that kind of structure will be. Enclosed pools are a hot topic with the planning council.
- Issue with enclosed pools (for the winter) being in FEMA flood zones
- Pawleys has set protection zones westward of setback line (in some cases up to several hundred feet). It's basically drawn in front of all of the existing structures. Where I

- live the current base line is on top of the dune that formed from the rebuilding of the groins. There can be no hard structures, pools, just nothing in front of the setback.
 - Prior to BMA could have raised decking on public access points. Now can only have 6 ft. walkway.
 - Should allow for public access points but not for private.
 - A lot of time the public good is not being looked at with the BMA.
 - BMA does not take into account a more physical population in regard to beach renourishment based on number of parking spaces and number of access points.
 - Land acquisition- not feasible in any built up area because of money.
 - Local communities must become more involved in coastal management because they can do more than state government.
 - OCRM must get more involved with CRS program- ratings for flood insurance (every point you drop is a 5% savings for each property owner).
- FEMA insurance has most impact on shoreline management

Coastal Management

- Local government has much better understanding of local beaches
- For example- DOT put storm water pipes in, DHEC gets “in the way’ when Myrtle Beach tries to work on them- shouldn’t need a critical area permit to work on them
- On Pawleys it is very difficult to get permit for sand fences and other erosion control
- If the town wants to get a permit they have to send a registered letter to every property owner on the island
- OCRM has been more attentive in the last year and they are making an effort to get more feedback. DHEC Columbia is also working better recently and working toward more feedback. It is a partnership between all agencies because we’re all working for the public good.
- Doing wholesale “one size fits all” rules makes it very difficult because places like Myrtle Beach and Pawleys are very different.
- Should be sharing of funding because the beach is part of the infrastructure of the tourism industry
- If the Corps is involved in other parts of the country (i.e.- Mississippi River) they should be involved
- OCRM has to be more of a partner with local agencies instead of policing local government. It should be more give and take instead of “you have to do this”. OCRM should develop these policies so that they work in tandem with state and local government laws.

Sea Level Rise

- On Pawleys, sea level rise is not a huge concern

- Myrtle Beach has worked with CCU and other groups to address sea level rise and has put it into their comprehensive plan
- There needs to be better education campaigns for private citizens on sea level rise
- Disclosure on erosion rates are now required at real estate contract signing as opposed to closing
- I don't know what Pawleys can do anyway. We are where we are and the groins are the best we can do.
- Pawleys has added 15 ft buffer to the marsh setback line that is drawn into the plat
- OCRM has done good work on marsh side of issues but need to let local governments decide if they want stricter regulations on marsh side
- For developed property on Pawleys on marsh side there does not need to be movement of property lines in relation to sea level rise
- OCRM needs to do a better job of being flexible as they move from one community to another because issues are different from one place to another.

Hilton Head – 10-30-08

Renourishment proponent's comments at the beginning:

- Town disagrees with the premise that all structures should be removed (including sea walls and groins)- these structures help with beach renourishment
- Science is wrong and it's a philosophical mantra (according to "document")??
- “Committees” suggest that the best group to determine where the renourishment takes place should be in the hands with the university system, not the town
- “Document” suggests that you should not take sand from ebb tidal shoals- most of Hilton Head gets its sand renourishment from the shoals
- Statements made in the document embrace the retreat philosophy. This philosophy was implemented during the 1980's before there were any beach restoration or renourishment programs. Retreat assumes that your beach is eroding when in actuality, in Hilton Head, it is prograding.
- The document indicates that they do not want to advance the line of construction, which we agree with.

How has shoreline affected South Carolina/Hilton Head?

- In as much as our shoreline is moving seaward, we have more visitors and tourists.
- The town has done an outstanding job educating the residents on shoreline change. We have history and facts showing the changing shoreline. It is documented here.
- Shoreline is extending seaward here

- Further down the beach, however, it is eroding
- In the rest of the state there isn't much undeveloped land in places like Folly Beach or Myrtle Beach
- When I came to Hilton Head in the 1980s there wasn't any beach at high tide. The town then implemented a 2% accommodation tax that helps us renourish
- Just in the past 10 years I have noticed that the water level there in high tide tends to come up pretty far. Before the last renourishment project the sand rose very slowly (a slight slope) but when they renourished it the contour was raised, but it was still smooth. With the new development taking place near by you can see a channel in the sand parallel to the ocean.
- At the head of Hilton Head Island you used to be able to throw a rock off the deck and hit the ocean but now there is vegetation and sand, but you can see points where the beach is eroding back.
- The beach is advancing and retreating in different parts of the island. There can't be any confidence with scientific models because it's different everywhere.
- The town of Hilton Head is the only body that has any real idea of what the island is doing
- I've been here 20 years and when we first moved here the water was lapping at the beach house. Now there is a pretty expansive beach in front of us.
- I am livid with concepts when it applies to all areas. There is a big difference between Pawleys Island, Myrtle Beach, and Hilton Head. Policy can only be made at the local level. A statewide policy is asking for a disaster.

Tools for shoreline change?

- Rolling easements will not work here
- A problem with OCRM we're having is that we keep renourishing our beach but now OCRM wants to move the baseline seaward and we don't want people developing towards the ocean
- I like the idea of setback lines being set and maintained with plenty of leeway for either accretion or reduction of shoreline depending on conditions of the year. To change the line could drastically affect how the beach looks- what if mega-mansions build seaward and cause the beach to erode?
- A retreat policy in South Carolina would not work because the state does not have that kind of money
- In 1991 we had a land buying strategy that cost over one million dollars for one thousand acres. We bought up vacant land that would have been used for subdivisions and now the land is for public use.
- We can't have policies based on undeveloped lands and developed lands. The policies need to be in place before development might go in.
- In regards to abandonment and other solutions, has anyone done a financial analysis to figure out how many areas would need to be abandoned versus renourishment?

- Big question over who should pay.
- Issue of public access- what does that mean in terms of state assistance?

What agencies or policies have the most influence on coastal management?

- OCRM has no influence but they have tried some influence but since Lucas they have backed away
 - They are pressed so thin that when we need their help for certain areas- such as to fight development, they can't come help us
- Hilton Head Island has the most influence over beach management
- Insurance is a big factor when considering to live near the water

Accelerated Sea Level Rise?

- Haven't heard anything directly but I have heard conversations over whether or not it's happening
- If the ocean is rising then there is no such thing as accretion
- If sea level is rising then we shouldn't move the setback line closer to the ocean
- No matter how much we do beach renourishment the sea level is still rising at an accelerated rate so we need to factor that in
- Some debate over whether it is really rising at an accelerated rate

How can Hilton Head mitigate around sea level rise?

- Continue to renourish
- Maintain the integrity of the vegetation behind the dune line- the root systems will help stabilize the whole the thing, like a second line of defense.
- Heavy education is needed on the importance of the dune system
- People need to realize that sea oats are protected species

Are there issues in estuaries/tidal wetlands that need protection?

- Absolutely. Everything is a connected ecosystem. Municipal boundaries do not matter in nature. There are tidal rivers that nurture species and balance together to make this place beautiful. If we start to over develop it ruins what makes this place great and it will eventually negatively affect property values.
- The town tries to prevent development on marsh side
- The sea level rise will inundate the wetlands and hard structures will prevent us from having a wetland
- It should be studied how much of the state is marsh and how much we have lost because of development

How has shoreline change affected state of South Carolina?

- The beach here at Hilton Head is better than it was 20 years ago because of renourishment and we are lucky that we can have the financed for the management
- Retreat from the shoreline seems like surrendering
- I'm not impressed with DHEC or OCRM because our rivers and beachfronts are degrading so it's up to local entities to decide how to handle issues.
- The problem with OCRM is that the rules they're working under are dated material. The law says that if the shoreline is accreting then you can move the baseline seaward even though that's not the right thing to do.
- What about natural laws? Different seasons and processes produce accretion or erosion and we should base the laws off of what is naturally occurring.
- You can't just leave Hilton Head up to natural processes because of development- we have to work to fix our mistakes
- Need to protect current no-build line particularly at Hilton Head Plantation. Here we want the state to help with renourishment

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