Executive Summary

Background

North Carolina is renowned for its 326 miles of ocean shoreline, barrier islands and 19 active inlet complexes. North Carolina beaches and inlets have tremendous economic value and serve as important habitat for fish and wildlife resources. Beaches and inlets support millions of recreational visitors every year, provide billions of dollars in economic value through business and tourism, provide ocean access for commercial and recreational fishermen, and are an integral part of the state's history, culture, identity, and way of life.

However, without effective planning and management, the future of the state's coastal communities and a significant part of the state's economic base could be adversely affected by storms, sea-level rise, shifting shorelines, and erosion. The North Carolina Department of Environment and Natural Resources (DENR) is committed to the long-term conservation and management of the state's beaches and inlets. As part of this commitment, the Beach and Inlet Management Plan (BIMP) was developed by the Division of Water Resources (DWR) and the Division of Coastal Management (DCM) in order to provide the necessary information to address the natural resources, funding mechanisms and strategies for the comprehensive management of the state's ocean and inlet shorelines. The BIMP is the first statewide compilation of data and issues related to managing the beaches and inlets.

The framework for development of the BIMP is the culmination of past efforts, legislative actions, studies and recommendations. The most pertinent action was House Bill 1840 (Session Law 2000-67), passed in 2000. The Bill required DENR to develop a state beach management and restoration strategy that could also be used for local government planning purposes. The Bill declared that it is a necessary governmental responsibility to properly manage and protect North Carolina's beaches from erosion and that good planning is needed to assure a cost-effective and equitable approach to beach management and restoration. The Bill also states that as part of a comprehensive response to beach erosion, sound policies are needed to facilitate the ability of landowners to move threatened structures and to allow public acquisition of appropriate parcels of land for public beach access. A BIMP was specifically recommended in the N.C. Coastal Habitat Protection Plan (CHPP) completed in 2005. With the overall intent of preserving and enhancing recreational and commercial fisheries, the CHPP recommended that the state "[p]repare and implement a comprehensive beach and inlet management plan that addresses ecologically based guidelines, socio-economic concerns, and fish habitat."

BIMP Development Process

With funding from the General Assembly in 2007, the engineering firm of Moffatt & Nichol assisted the state with: 1) data identification and acquisition of existing datasets, 2) determination of beach and inlet management regions, 3) scheduling and facilitation of stakeholder meetings, 4) development of draft beach and inlet management strategies, and 5) preparation of a final report. In addition, two groups were established to guide the BIMP development: a BIMP Advisory Committee and a DENR technical work group. The Advisory Committee was composed of representatives from federal and state agencies, local governments, academic institutions, and non-profit organizations. The technical work group was comprised of DENR division representatives.

Stakeholder Process

Given the statewide importance of the BIMP, a broad stakeholder process was used to incorporate stakeholder expertise, local knowledge, concerns, and passion for North Carolina's coastal resources and to offer insight into each part of the BIMP. The public was engaged, informed, and consulted throughout the process by means of press releases, a project website, comment solicitation, questionnaires and public input meetings that were held in four coastal regions and in Raleigh.

Data Identification and Acquisition

The identification and collection of pertinent data is critical in the understanding of any natural system. The nature of the beaches and inlets along the coast are influenced by a wide array of factors that include geology, sediment characteristics, waves, currents, water levels, and storms. Other datasets integral to comprehensive management of the beaches and inlets also include ecological and socioeconomic factors. In order to develop appropriate management regions and properly develop and assess management strategies, relevant coastal data was gathered, compiled and reviewed.

A literature review was conducted by the Division of Coastal Management (DCM) to identify states and other entities that have addressed statewide or local beach and inlet management plans, as well as to review the various approaches studied and adopted. Some states have developed plans for managing beaches and inlets focusing on individual inlet management plans (*e.g.* AL, DE), while others have concentrated their efforts on regional sediment management (*e.g.* CA, SC). There have also been cases where particular aspects of the beach, such as erosion or dunes (*e.g.* MD, VA) have been the focus.

The data presented in the BIMP is intended to serve as a resource, common reference, and starting point for beach and inlet projects and strategy discussions among stakeholders. During the data collection efforts, several data gaps were identified that would greatly aid future updates to the BIMP as well as beach and inlet management

projects and environmental monitoring. Data sets that were acquired or identified for development of the BIMP include:

- an overview of the state's coastal geology,
- an assessment of waves and climate,
- water levels, including tides and tide stations,
- storm surge and coastal flooding, beach profile data,
- an assessment of sea level rise,
- tropical storm and hurricane history and probabilities,
- availability of digital orthophotography,
- historical shorelines and erosion rates,
- geological framework of islands/inlets,
- assessments of potential sand resources,
- beach fill and dredging history,
- inlet channel realignment/relocation,
- use and location of erosion control structures
- data gaps

Environmental Considerations

As stated earlier, the development of a BIMP was a key recommendation of the North Carolina Coastal Habitat Protection Plan (CHPP). A BIMP was seen as a way to protect the primary coastal habitats that are vital to the health and function of coastal ecosystems and fisheries from the potential impacts of beach fill and dredging activities. In that regard, the BIMP relies heavily on the CHPP as a data source pertaining to these critical habitat types. Detailed discussions of the environmental considerations at a local level can be found in the individual region sections of this report.

Socio-Economic Values of N.C. Beaches and Inlets

North Carolina beaches and inlets have tremendous economic importance to the state, providing billions of dollars in economic value through business and tourism, residential and commercial property value, water access for commercial and recreational fishermen, and the marina and boat building industries. Beaches and inlets generate $3 billion in revenue and directly support 39,000 jobs in coastal communities. When multipliers (total business sales supported and total jobs supported) are added, these numbers rise to $4.9 billion and 62,100 jobs. The developed portions of the ocean shoreline also represent a considerable investment. The value of coastal property at risk for three of the most

developed oceanfront counties (New Hanover, Carteret, and Dare) is $2.8 billion. The recreational consumer surplus resulting from beaches and inlets is over $400 million.

Development of Beach and Inlet Management Regions

Sustainable management of the state's beaches and inlets requires regional approaches that consider related segments of the coast rather than merely a project-focused approach. By adopting a regional approach to beach and inlet management projects, the entire coastal environment is taken into account, including natural processes as well as the effect of human activities. In addition, planning projects on a regional scale balances environmental and economic needs while facilitating collaboration and pooling of local resources. To this end, the BIMP divides the North Carolina coast into four main beach and inlet management regions and five subregions

A similar effort to manage beach and inlet systems more holistically, balancing between social, economic and environmental needs, is being taken by the U.S. Army Corps of Engineers. Their Regional Sediment Management Program (RSM) is a strategy based on the principle that sediment should be managed and conserved within discrete sediment transport regions, or littoral cells. The assertion is that the traditional method of minimizing the cost of individual projects does not always benefit nearshore systems, nor does it minimize long-term costs for the USACE.

Delineation of Regions and Subregions

The delineation of the regions and subregions included consideration of the geologic framework, the physical processes (wave exposure, sediment transport, etc.), geography, sand sources and natural resources, and common sociopolitical concerns.

The four primary regional delineations are defined by N.C.'s geological framework and cape features. The configuration of the coastline reflects major differences in the underlying geological framework and the local hydrodynamic regime. Cape Lookout separates the North Carolina coastal system into two large-scale coastal geologic provinces, to the north and to the south. Each province has a unique geologic framework that results in distinctive coastal features. The Northern Province extends from Cape Lookout northward and is characterized by lower, flatter beach slopes, and large shallow sounds having few inlets. This region is underlain primarily by unconsolidated sediments. The low-lying coastal area that evolved consists of wide shallow bays and sounds fronted by long, narrow barrier islands. The Southern Province, by contrast, has many inlets and smaller, narrower sounds with higher, steeper beach slopes. This region is underlain by rock with only a thin and highly variable veneer of sediments. The capes and associated cape shoals (Diamond Shoals off Cape Hatteras, Lookout Shoals off Cape Lookout, and Frying Pan Shoals off Cape Fear) are significant natural features in the coastal geomorphology and the sediment transport processes along the coast, and thus provide natural delineation points for the four main regions.

Further subdivision of the four main regions into five localized subregions was defined by:

- Local geologic features
- Developed/undeveloped shoreline reaches
- Erosion/accretion patterns and rates
- Potential sediment transport (sediment budgets and transport directions)
- Potential sand sources
- Dredging considerations
- Sociopolitical boundaries

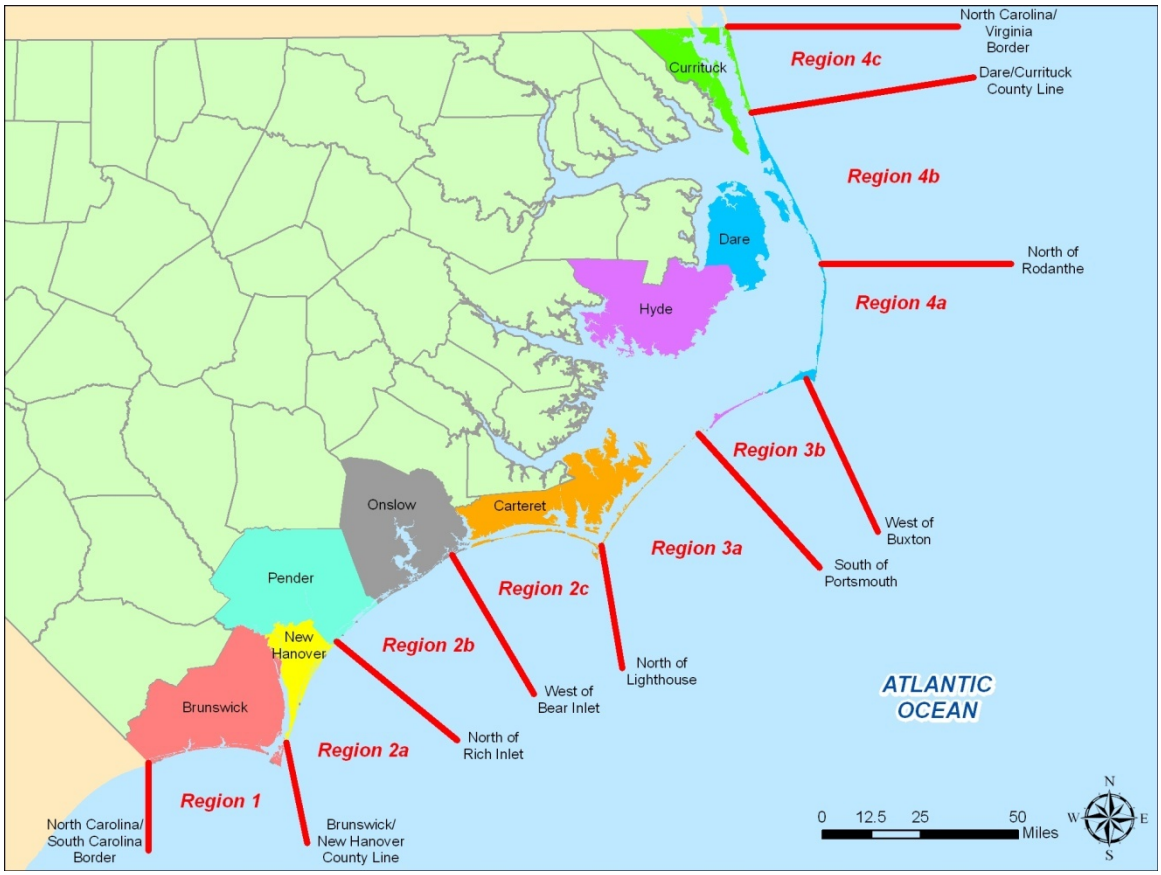

Figure ES-1: BIMP Management Regions and Subregions

USACE Regional Sediment Management Initiatives and Integration of the BIMP

Several USACE districts are applying and adapting their Regional Sediment Management approach to programs, projects, and activities through the Corps Regional Sediment Management National Demonstration Program. During the last decade, the USACE began to recognize the need for regional sediment management, and the Wilmington

District continues to receive funding for numerous regional sediment management projects in N.C.

The state and USACE recognize the importance of a cooperative relationship for successful implementation of the BIMP and federal regional sediment management initiatives. The re-authorization of the federal Water Resources Development Act (WRDA 2007) gave the USACE authority to implement regional sediment management within its programs and operating framework.

In 2008, regional sediment management demonstration funds derived from the national program were allocated to the USACE-Wilmington District for gathering a detailed sediment transport and sediment budget for Brunswick County, and hydrographic surveys at inlets in the Bogue Banks (Carteret County) region. In 2009, the USACE-Wilmington District continued development of a detailed sediment budget from Cape Fear to the Bogue Banks region of Cape Lookout, by quantifying inlet sediment budgets, and conducting coastal process modeling and data analyses. In addition, a final data mining effort to capture remaining survey data from 2000 to 2005 will be completed in the near future.

Development of Beach and Inlet Management Strategies

Strategy Development and Potential Costs

State law and development policies are intended to provide a management strategy for ocean hazard areas that eliminates unreasonable danger to life and property and balances between the financial, safety, and social aspects of hazard area development. To that end, these policies seek to preserve the protective characteristics of natural beach and dune systems. Beach and inlet management strategies consistent with this objective include beach nourishment, inlet dredging/bypassing, inlet channel realignment/relocation, temporary erosion control structures (sandbags), and structure relocation. Many of those management strategies are interrelated – for example, sediment dredged from inlets is used as a source of sand for beach nourishment. The BIMP reflects these strategies as well as the use of development regulations, such as oceanfront building setbacks and hazard mitigation approaches to development adjacent to the dynamic inlet areas.

In order to determine the potential costs for each region and subregion, preliminary estimates of short- and long-term costs for beach nourishment for the developed portion of the coast were compiled. This initial base-level funding assumes that beach nourishment, would be the initial strategy that all the regions could support with local cost-share. While a dedicated fund should consider additional strategies such as relocation and conservation easements, this first estimate, combined with a regional approach, provides a financial starting point for a more cost-effective and environmentally sound management program. Detailed information on costs can also be found in the individual chapters that summarize the regions.

The BIMP identified approximately 112 miles of developed oceanfront shoreline that either 1) have received public funding for past beach fill projects or for current USACE beach fill projects (storm protection, habitat restoration, beneficial use of dredged material placement); or 2) are actively involved in a USACE-sponsored investigation to study the viability of a long-term beach fill project. The BIMP adjusts projected beach fill sand volumes and related placement cost to reflect ten-year cycles. In this decadal approach, the costs reflect maintenance on a three-, four-, or five-year cycle, with the ten-year period representing at least two maintenance efforts.

The projected costs associated with future federal beach protection projects uses the current cost-share ratio employed by the USACE, wherein the federal government pays 65 percent and the remaining 35 percent is shared by the state and local governments. The state has historically paid 75 percent of the 35 percent share (26.25 percent), and the local government is responsible for the remaining 8.75 percent. For a non-federal beach protection project, the state can fund up to 75 percent of the project cost, although the actual state contribution has historically ranged between 25 and 30 percent of the total cost.

Costs estimates are based on the assumption that projects would be implemented regionally to achieve cost-savings in mobilization and demobilization (dredging, berm construction, etc.). Costs are shown below based on groups of adjacent communities that correspond to the BIMP regions. In this way, beach fill projections consider beach fill maintenance on a five-year schedule rather than a per year cost (currently, no community in the state receives beach fill every year but, rather, on a maintenance cycle of between three and five years). While storm impacts and other coastal processes may require more frequent beach fill maintenance over the life of the project, the five subregion clusters are assumed to receive beach fill maintenance once every five years.

Beach Nourishment Needs by BIMP Region and Costs by Project Partner

Community	Managed Shoreline length	Beach fill volume	*Total Cost Per decade*	Federal Share millions	State Share *millions*	Local Share *millions*
REGION 1	***31.2***	***5,641,214***	***$54,713,132***	***$29.4***	***$14.2***	***$11.1***
Ocean Isle Beach	5.6	459,720	$4,445,470			
Holden Beach	8.2	1,897,470	$18,633,120			
Oak Island	9.3	745,730	$10,820,520			
Caswell Beach	3.6	440,990	$3,616,150			
Bald Head Island	4.5	2,097,304	$17,197,872			
REGION 2a	***17.3***	***3,886,729***	***$33,022,839***	***$18.9***	***$8.2***	***$5.9***
Kure Beach	3.4	381,393	$5,137,423			
Carolina Beach	2.7	2,428,236	$19,741,556			
Wrightsville Beach	4.1	895,610	$6,555,840			
Figure Eight Island	5.1	181,490	$1,588,020			
REGION 2b	***22.3***	***2,370,627***	***$24,655,778***	***$11.0***	***$6.4***	***$7.2***
Topsail Beach	5.1	604,070	$4,911,050			
Surf City	6.1	623,770	$8,202,570			
North Topsail Beach	11.1	1,142,787	$11,542,158			
REGION 2c	***23.8***	***3,773,368***	***$48,052,803***	***$38.4***	***$7.2***	***$2.5***
Emerald Isle	10.3	981,968	$13,747,573			
Indian Beach / Salter Path	2.6	353,780	$4,952,970			
Pine Knoll Shores	4.8	545,000	$7,771,740			
Atlantic Beach (includes Ft. Macon)	6.1	1,892,620	$21,580,520			
REGION 4b	***19.6***	***2,745,080***	***$30,694,980***	***$15.3***	***$8.0***	***$7.4***
Nags Head	11.3	1,859,230	$21,325,380			
Kill Devil Hills	4.8	327,520	$3,579,760			
Kitty Hawk	3.5	558,330	$5,789,840			
TOTAL (all regions)	***112.2***	***18,417,018***	***$191,139,532***	***$113.0***	***$44.0***	***$34.1***
Total per/yr Avg.		***1,841,702***	***$19,113,953.2***	***$11.3***	***$4.4***	***$3.4***

Accounting for storm impacts and other areas of the coast that may require management in the future, there is an estimated coast-wide need of approximately 1.8 million cubic yards of beach nourishment to be completed annually (may fluctuate due to storms) at a combined average cost of $19.1 million per year. It must be noted that beach fill and dredging projects may not occur every year or in any given year. The average annual project cost ($19.1M) is intended as a planning number for gauging the annual outlay for beach and inlet projects over the decadal cycle illustrated in the above table. The annual

costs could also be affected by the extent to which the state pursues the regional approach and the resulting grouping of projects.

Dredging Needs by BIMP Region and Costs by Project Partner

REGION	Shallow Draft Inlet Dredging *(total cost per decade)**	Deep Draft Inlet Dredging *(total cost per decade)**	*TOTAL Inlet Dredging (cost per decade)**
1	$9 million	$51 million	$60 million
2a	$10 million	$0	$10 million
2b	$20 million	$0	$20 million
2c	$20 million	$17 million	$37 million
3a	$5 million	$0	$5 million
3b	$10 million	$0	$10 million
4a	$0 million	$0	$0 million
4b	$25 million	$0	$25 million
4c	$65 million	$0	$65 million
TOTAL *(per decade)*	**$164 million**	**$68 million**	**$232 million**
TOTAL Cost Share	*90% federal cost share* **$147.6 million** *10% state cost share* **$16.4 million**	*75% federal cost share* **$51 million** *25% state cost share* **$17.0 million**	(total federal share) **$198.6 million** (total state share) **$33.4 million**
TOTAL Cost Share *(per-yr avg)*	*federal cost share* **$14.76 million**	*federal cost share* **$5.1 million**	(total federal share) **$19.86 million**
	state cost share **$1.64 million**	*state cost share* **$1.7 million**	*(total state share)* **$3.34 million**

*Values are from 1997-2007, adjusted for inflation (2009 dollars), and Cost share data for dredging provided by Division of Water Resources

Assuming the current federal cost share for navigational dredging of the state's deep- and shallow-draft inlets continues into the future, the total state cost share for dredging is projected to be $33.4 million per decade ($3.3 million per year) with a federal cost share of $198.6 million ($19.9 million per year). There are no records of local cost sharing that has occurred for inlet navigation projects.

Adding existing inlet dredging costs for shallow and deep draft inlets ($23.2 million per year) increases the overall total to $42.3 million per year. This total cost includes federal, state, and local participation in current beach and inlet projects. While this estimate includes the AIWW inlet crossings, the AIWW as a whole is not.

Finally, under the current federal cost-sharing models for both beach fill and inlet dredging, the total state funding required for these projects per decade is projected to be $77.4 million ($7.7 million per year). This projection is based on a projection of $44 million for beach nourishment and $33.4 million for dredging.

Funding and Prioritization Strategies for Beach and Inlet Projects

Establishment of Regional Authorities and a Dedicated Fund

Beach and inlet projects can be expensive, technically challenging, and full of complex legal and regulatory issues. It is difficult for an individual local government to undertake an effort to plan, authorize and fund a beach project. The BIMP identifies two changes that could support more cost-effective and environmentally sound management of the state's beaches and inlets: 1) Expanded use of regional planning for beach and inlet management projects; and 2) A dedicated state fund to support regional projects.

These two changes would place North Carolina at the forefront of coastal states seeking to improve the comprehensive management, restoration and preservation of their beaches and inlets.

The regional planning model could provide coordinated project planning and management within a region, maximizing efficiency and cost-saving opportunities such as area-wide sand search investigations, comprehensive shoreline monitoring for all projects in the region, and coordinated environmental investigations and studies.

Regional project planning could also simplify coordination between state and local government. Rather than coordinating activities with multiple municipalities, the state could work with a regional planning entity, authority or project coordinator.

In the form of a regional beach and inlet management authority, local partners could develop a project financing structure that uses funding options that are most appropriate for the cooperating local governments. Creation of a state dedicated fund for beach and inlet management project would make state project contributions more predictable and give local governments a better foundation for local financing plans.

A dedicated state fund could create a more manageable and predictable level of state expenditures, allowing for better planning for coastal needs with less stress on the limited general revenues. The fund would also reduce financial uncertainties at the local level that often contribute to project delays, increase costs, and disrupt local planning efforts. A reliable and predictable state funding source would allow coastal communities to make informed decisions about allocation of new or existing sales or property tax revenues to coastal projects, knowing the state was committed to sharing the costs. With project uncertainties reduced, the dredging industry could better anticipate upcoming work, increasing competition and potentially reducing project costs. A dedicated source of state

funding could also lead to the development of innovative technologies by the dredging industry, which could also result in cost savings. With greater financial predictability, uncertainty can be reduced at all phases of implementation.

Increased state involvement in administration of a dedicated fund may require additional staff resources in both the Division of Water Resources and Division of Coastal Management to assist with fund administration and permitting. In the interim, existing staff could be utilized, and given the current economic downturn, it may be necessary to phase in the program over a number of years.

Future Updates

This initial BIMP is the first step in the development of recommendations for regionalization, strategy development, and potential funding and prioritization options.

Future updates to the BIMP should focus on filling the data gaps identified in the plan, formalization of funding mechanisms, and modifications of strategy options.