V. Development of Beach and Inlet Management Regions

A truly statewide approach to managing beaches and inlets requires recognition of both the diversity and common elements of different segments of the shoreline and inlets. As part of the development of a comprehensive statewide plan for managing the beaches and inlets of North Carolina, the BIMP divides the coast into multiple management regions as the 326 miles of ocean shoreline and 19 active inlet complexes are simply too diverse for a single management strategy. 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.

A. Regional Concerns - The Need for a Regional Approach

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. While individual landowners and communities have rightful concerns about "their" beach or inlet, the regional impact of any such projects must also be considered to improve long-term sustainable success. Within a region, the local interests tend to be the driving force, with the local knowledge and concern to make things happen. The goal of a regional approach is to facilitate these local interests working together in areas with common characteristics and concerns to develop regional strategies (*e.g.*, shore protection, inlet management, structure relocation, public access), and pooling talent and resources. The limited availability of sand resources in some regions, the potential down-coast effects of shoreline and inlet projects, and the significant financial costs all support a regional approach. Regional approaches can take advantage of economies of scale, broader permitting efforts, and sharing of resources, such as sand, over a larger area.

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. Many RSM principles are incorporated into the BIMP and the development of management regions and sub-regions.

As the number of people wanting to live and vacation along the coast increases, so has the demand for beach management projects, and with it, sand management issues have become more complex. Issues include resource allocation, sand rights, and cumulative

impacts from repeated use, user conflicts, protection of archaeological sites, and turtle and seabird habitat.

Managing sediment to benefit a region potentially saves money, allows use of natural processes to solve engineering problems, and improves the ability for regulatory agencies to assess the impacts to the environment in a comprehensive fashion. Regional management methods include the entire coastal environment, and account for natural coastal processes and the effect of human activities on sediment budgets while balancing environmental and economic needs.

Regional approaches seek greater effectiveness and efficiency in use of sediment resources and the integration of inlet maintenance dredging with beach nourishment and habitat creation. An underlying goal includes the placement of beach compatible sand associated with dredging on to the beach or back into the nearshore littoral system. In regional management, sediment resources are identified, along with solutions for keeping sediment in the natural system by linking the regional sediment to its uses and coordinating activities with community needs. For example, coordinating dredging to maintain an inlet with beach nourishment or habitat creation can be an effective and efficient use of resources. Cost savings can be achieved from reduced re-handling of sediments and participation in regional projects of larger scale where significant dredge mobilization/demobilization costs can be distributed. Improved agency cooperation and local collaboration also enhance opportunities for innovative options to be brought forward from a permitting and operational perspective.

By identifying regions, common beach and inlet issues and concerns can be defined, as well as associated opportunities and constraints in the development of options and strategies for implementation. The collective nature of regional management provides consistency in approaches, and helps to engage all stakeholders - federal, state and local - in finding mutually beneficial solutions to meeting needs and goals.

B. Developing Regions and Sub-regions

The delineation of the regions and sub-regions 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 (Figure V-1). 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 (Figure V-2). The orientation of the shoreline and consequently the exposure to storms and waves also differs along these regions.

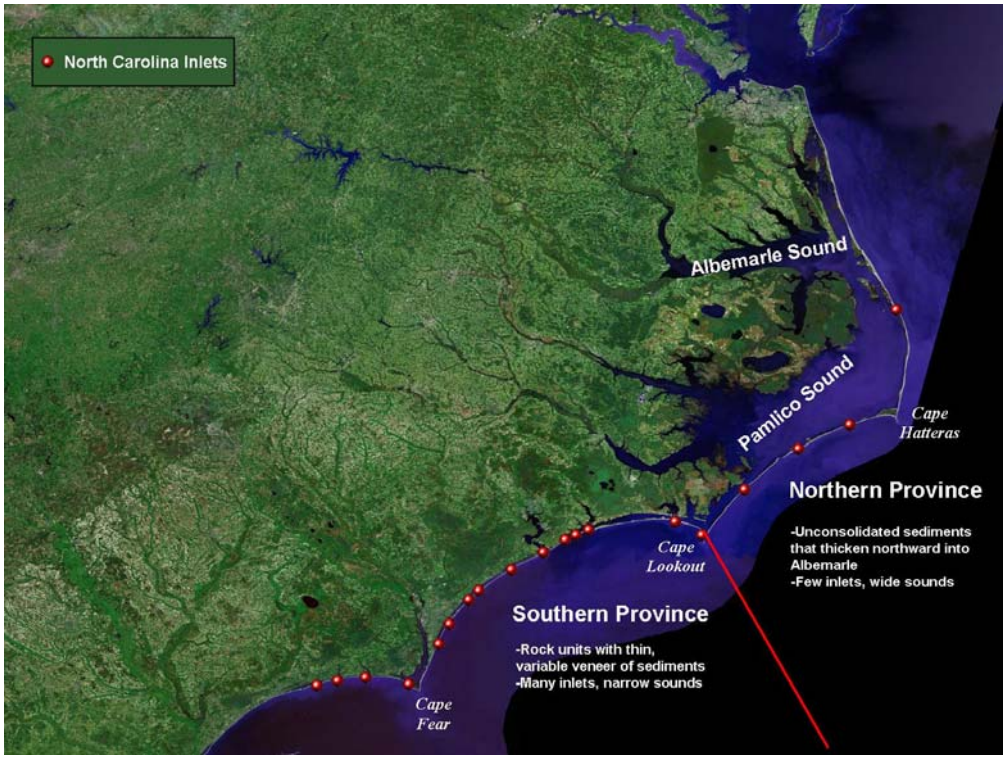


Figure V-1. Coastal Geologic Provinces of North Carolina

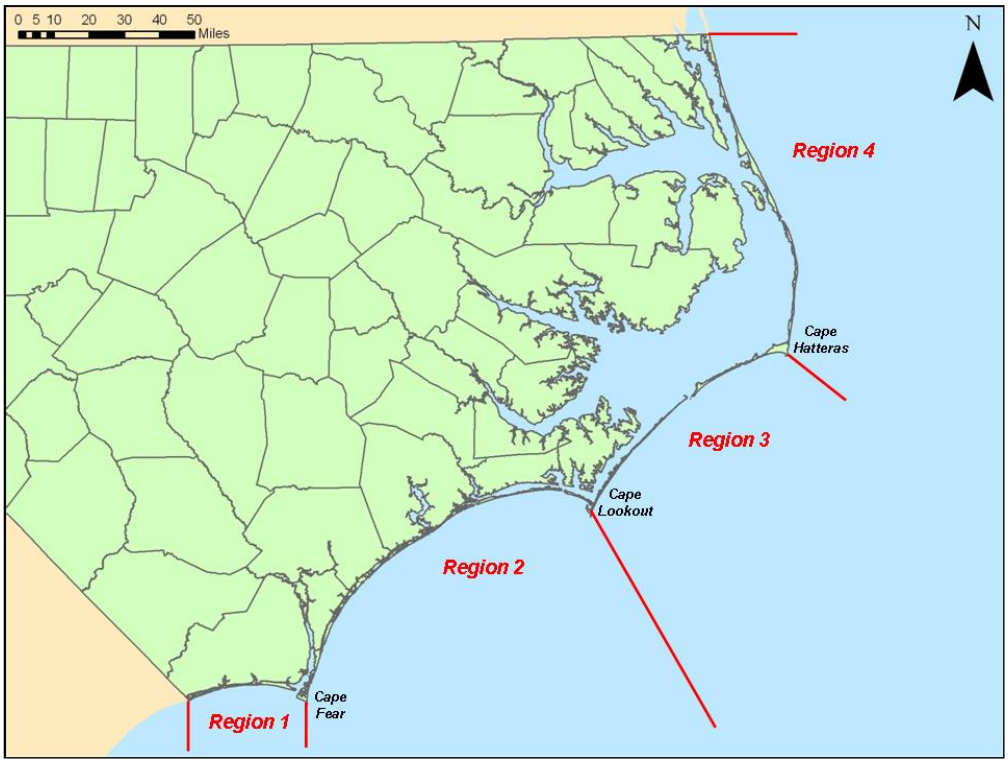


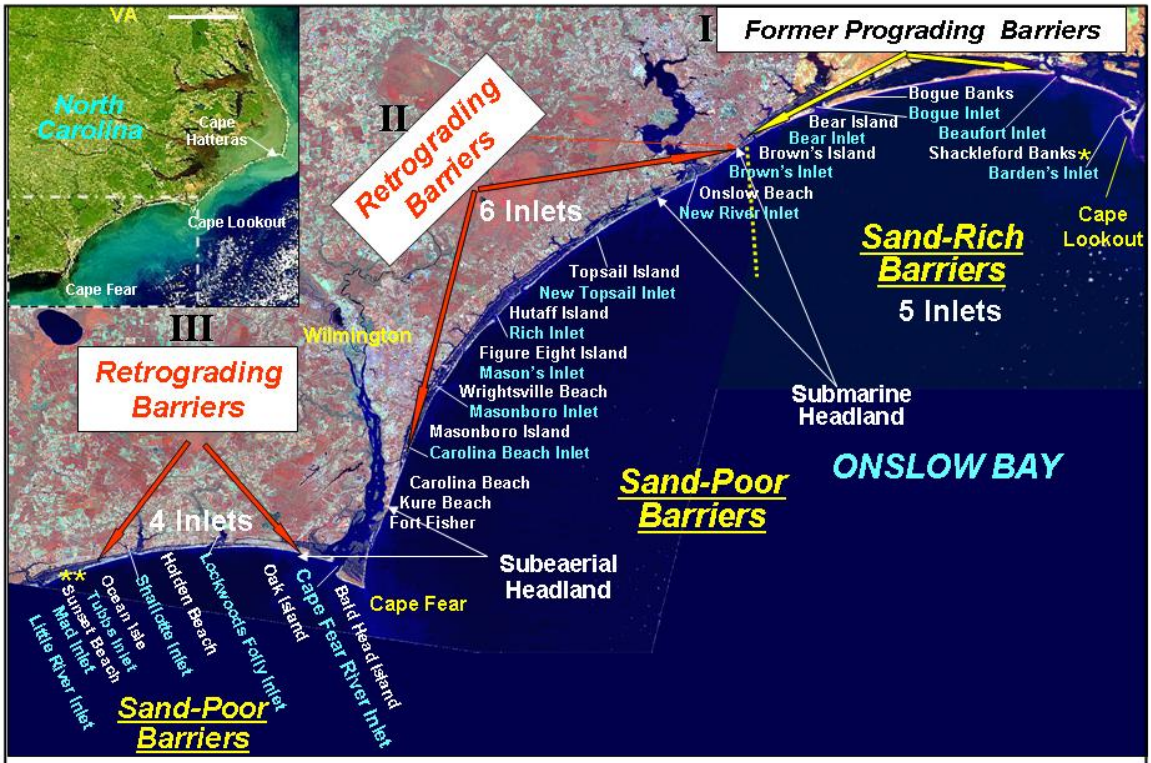
Figure V-2. Four Main Regions and the Capes

Further subdivision of the four main regions into five localized sub-regions 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

1. Geologic Features

Coastlines with limited sand supplies typically have thin barriers resting atop older geologic units that constitute the shoreline. In the southern geologic province, the barrier islands are mostly sand poor retrograding (erosional) shorelines such as Topsail Island. Bogue Banks, however, is sand rich (former progradational or accretional barrier) as shown in Figure V-3. Local geologic features such as the submarine headland offshore of Brown's Island provided a break point between sub-regions (Figure V-4). The change in the underlying geologic formations and transition between regions is illustrated in Figure V-5. Depending upon the composition and geometry, such underlying platforms can strongly influence beach dynamics and sediment composition, as well as the shape of the shoreface. Local rock features along the coast can affect the local sediment patterns and sediment transport.

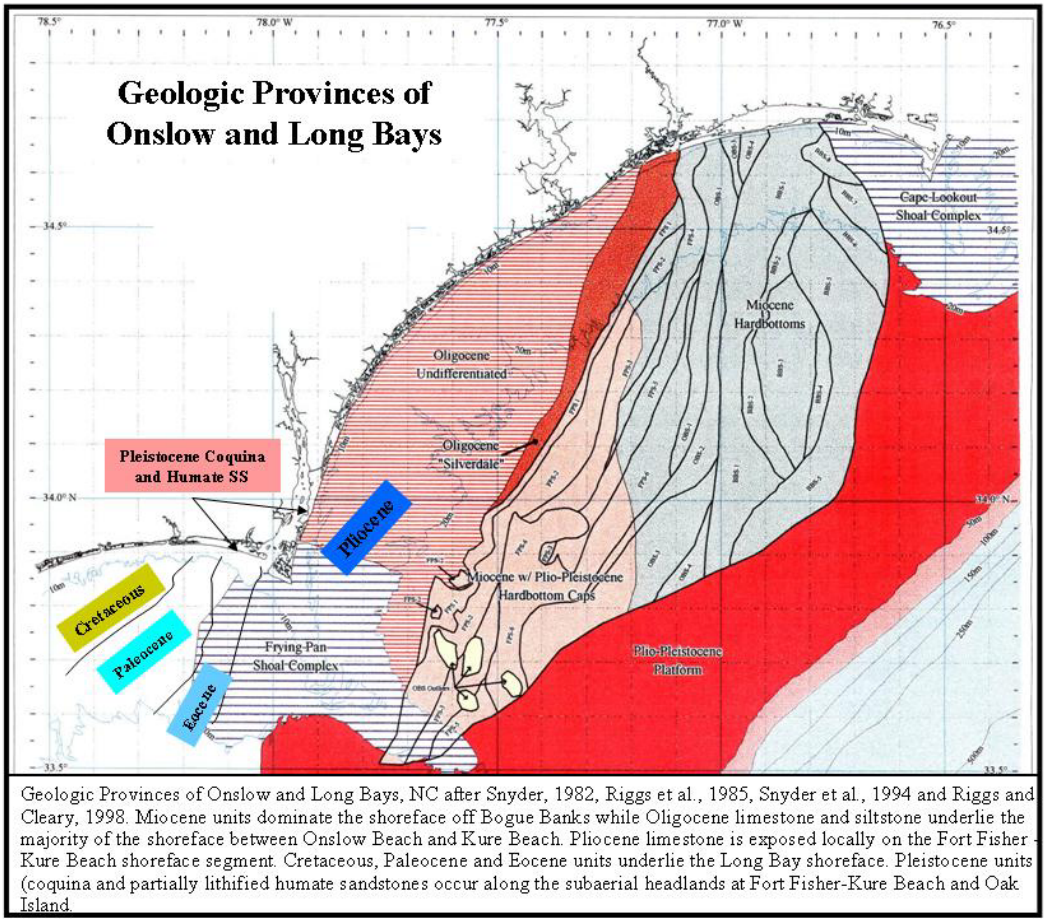


Coastal North Carolina between Cape Lookout and Little River, SC depicting locations of the barriers, mainland beaches, inlets and forelands. Three major oceanfront shoreline subdivisions were indentified base on the history of the Holocene history and the volume of sand comprising the barriers. Several additional subdivisions can be recognized on the basis of headland features.

Figure V-3. Prograding and Retrograding Shorelines (Cleary, 2008)

Coastal North Carolina between Cape Lookout and Little River, SC depicting locations of the barriers, mainland beaches, inlets and forelands. Three major oceanfront shoreline subdivisions were indentified base on the history of the Holocene history and the volume of sand comprising the barriers. Several additional subdivisions can be recognized on the basis of headland features.

Figure V-4. Barrier and Headland Features (Cleary, 2008)



Geologic Provinces of Onslow and Long Bays, NC after Snyder, 1982, Riggs et al., 1985, Snyder et al., 1994 and Riggs and Cleary, 1998. Miocene units dominate the shoreface off Bogue Banks while Oligocene limestone and siltstone underlie the majority of the shoreface between Onslow Beach and Kure Beach. Pliocene limestone is exposed locally on the Fort Fisher - Kure Beach shoreface segment. Cretaceous, Paleocene and Eocene units underlie the Long Bay shoreface. Pleistocene units (coquina and partially lithified humate sandstones occur along the subaerial headlands at Fort Fisher-Kure Beach and Oak Island.

Figure V-5. Geologic Provinces of Onslow and Long Bays (Cleary, 2008)

2. Developed/Undeveloped Shoreline Reaches

The status of shoreline development indicates areas of potential concern with respect to vulnerability to erosion. Erosional areas in close proximity and with limited sand sources require communities to be grouped in the same region to facilitate cooperation for the limited sediment resources. Inlets should not be split between regions in order to coordinate maintenance and/or management of the inlet and neighboring beaches. Developed areas, and undeveloped or never-to-be developed conservation areas, may have different management strategies so these breaks also impact the potential delineation of regions and sub-regions. The undeveloped conservation area reaches provide a natural dividing line for areas that are actively managing their beaches and inlets. Figure V-6 depicts the stretches of developed versus undeveloped reaches of the shoreline.

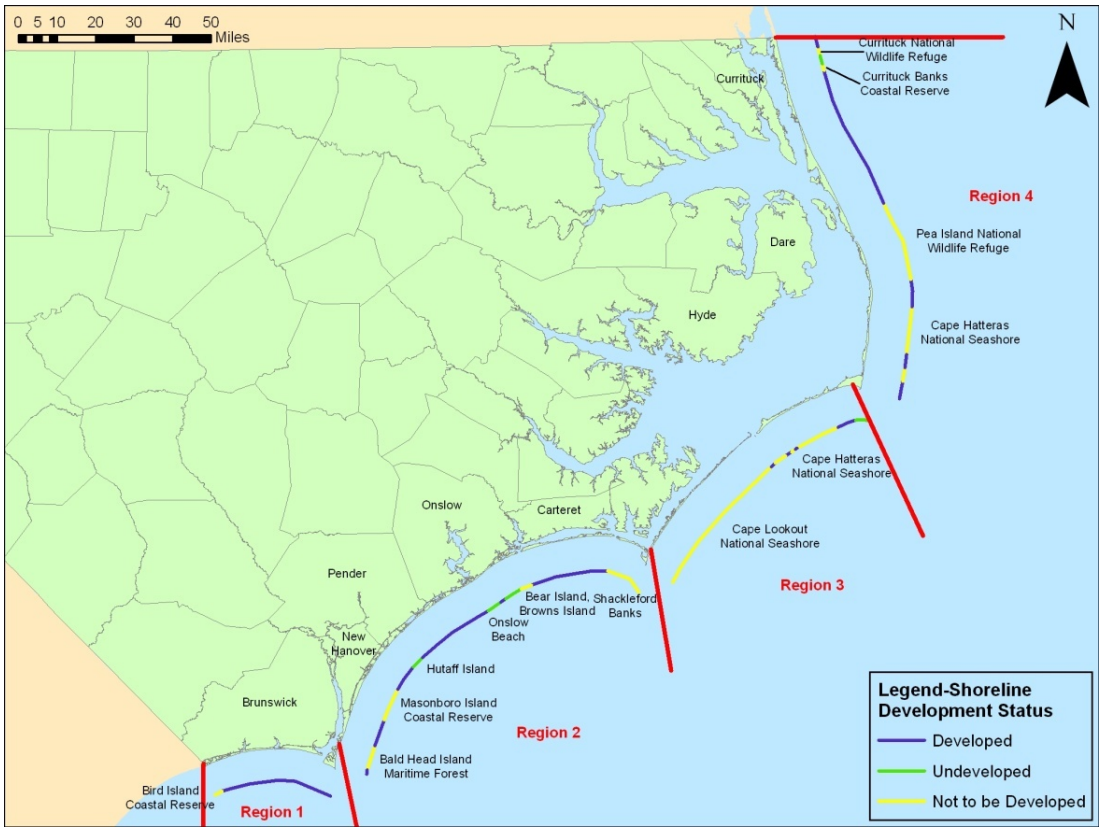


Figure V-6. Shoreline Development Status Along the North Carolina Coast

3. Erosional Patterns/Sediment Resource/Dredging Concerns

The availability of sand, and areas of erosion and accretion, were also key factors in understanding which communities and stretches of the coast would require common strategies, share common resources, or might utilize the same borrow areas for sand. Areas of accretion might serve as natural sub-region break points given that relative shoreline change concerns in these areas might be minimal. Dredging considerations also dictated the furthest distance a potential sand source could be cost-effectively used as roughly 15-20 miles. Therefore, for a given sand source, interested parties may be separated by as much as 30-40 miles. Figures V-7 and V-8 illustrate the erosional and sediment resource issues.

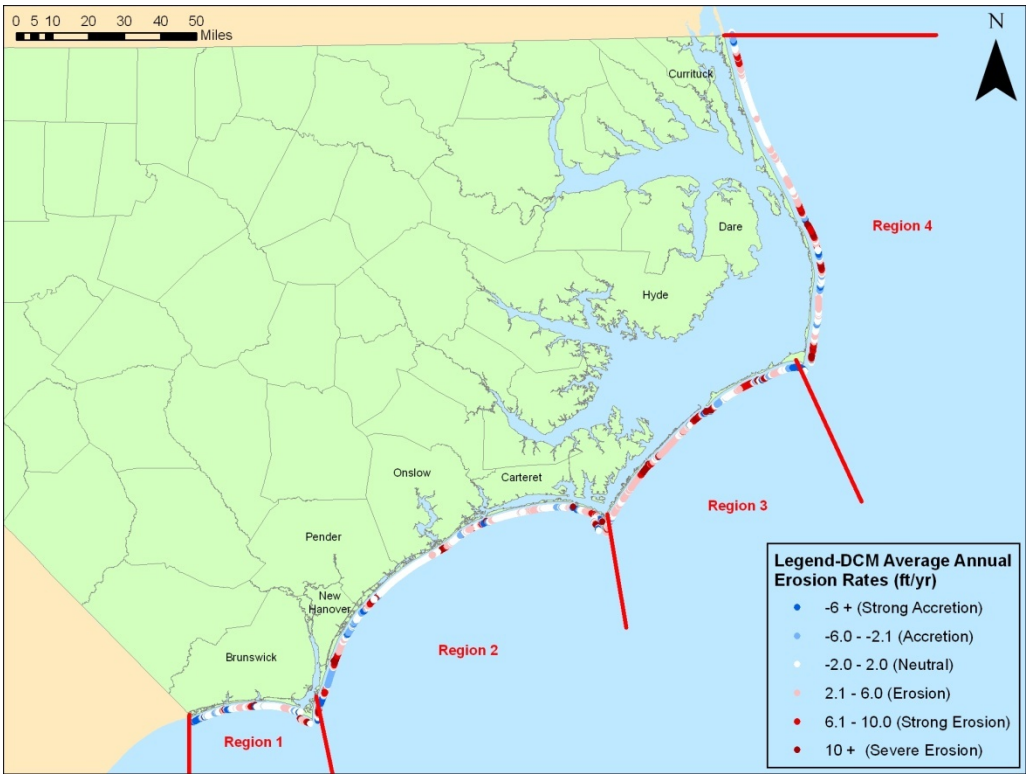


Figure V-7. DCM Long Term Erosion Rates Along the North Carolina Coast

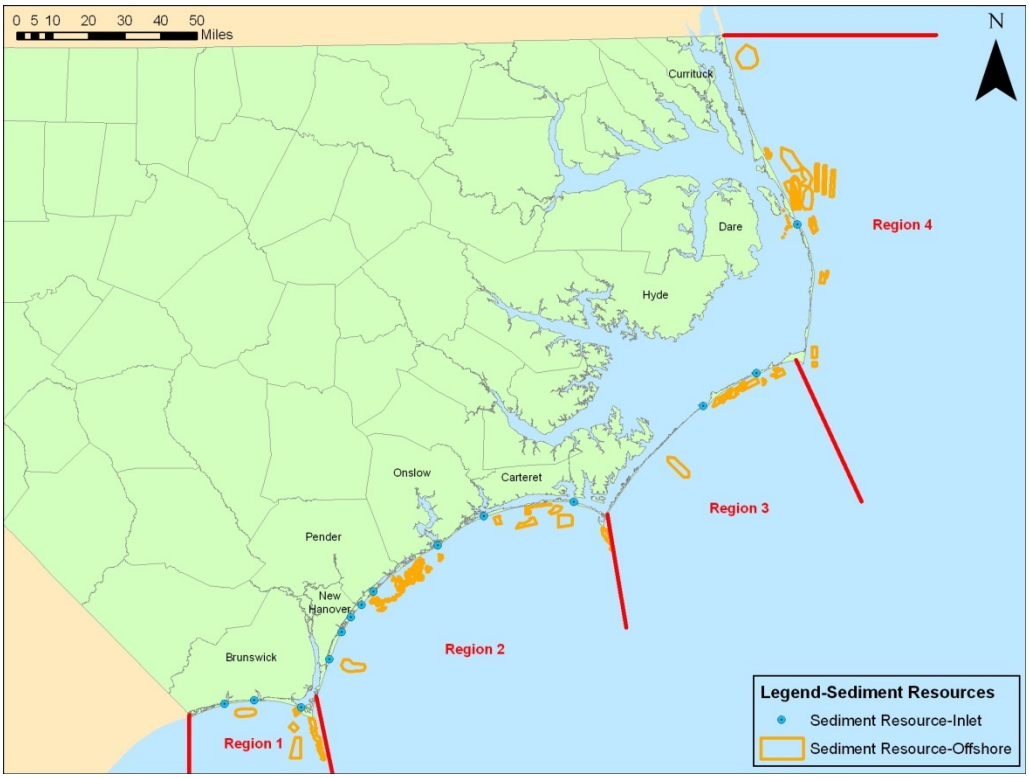


Figure V-8. Known Sediment Resources Along the North Carolina Coast

C. The Beach and Inlet Management Regions

The datasets discussed above as well as the considerations discussed in the previous subsections were used in the determination of management regions and sub-regions for the BIMP as illustrated in Figure V-9.

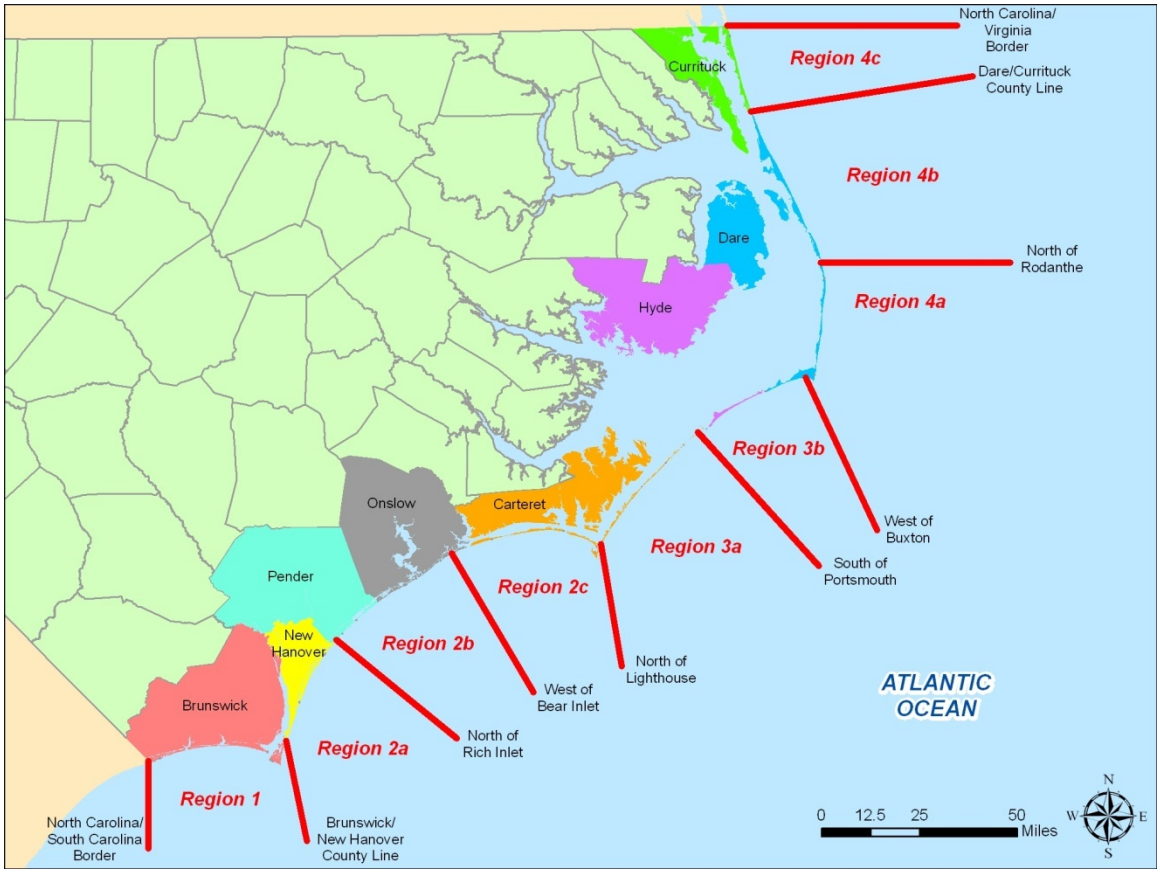


Figure V-9. Delineation of BIMP Sub-regions

It should be noted that while sociopolitical factors were considered, the physical features and processes were the primary drivers in determining the regions. It is convenient that the boundaries also closely match existing county boundaries.