North Carolina Outer Continental Shelf Sand Resource Investigation

Final ASAP Technical Report

BOEM Cooperative Agreement No. M14AC00009

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Introduction

North Carolina's coastal communities rely heavily on indigenous natural resources as a foundation upon which to build and expand their largely tourism-based economies, and no more important among these resources are the area's beaches which sit at the core of this economic engine. Increased storm frequency and intensity, along with rising sea levels threaten the state's beaches which are, in the large majority eroding, leaving communities vulnerable to partial or total ruin with each passing season. Damages from recent storms (Hurricanes Isabel in 2003, Irene in 2011, and Sandy in 2012 are three salient examples) bear this out. Shoreline hardening is no longer permitted in North Carolina. The only viable response to these threats and the ever-shrinking beaches is restoration. Areas from which to mine suitable sands in sufficient quantities in State waters to effect such restoration (nourishment) efforts are, however, limited. This is especially true for the waters south of Cape Lookout. The only recourse for these and other coastal communities is to reveal and explore sources farther offshore in federal waters (beyond 3 nautical miles) of the continental shelf.

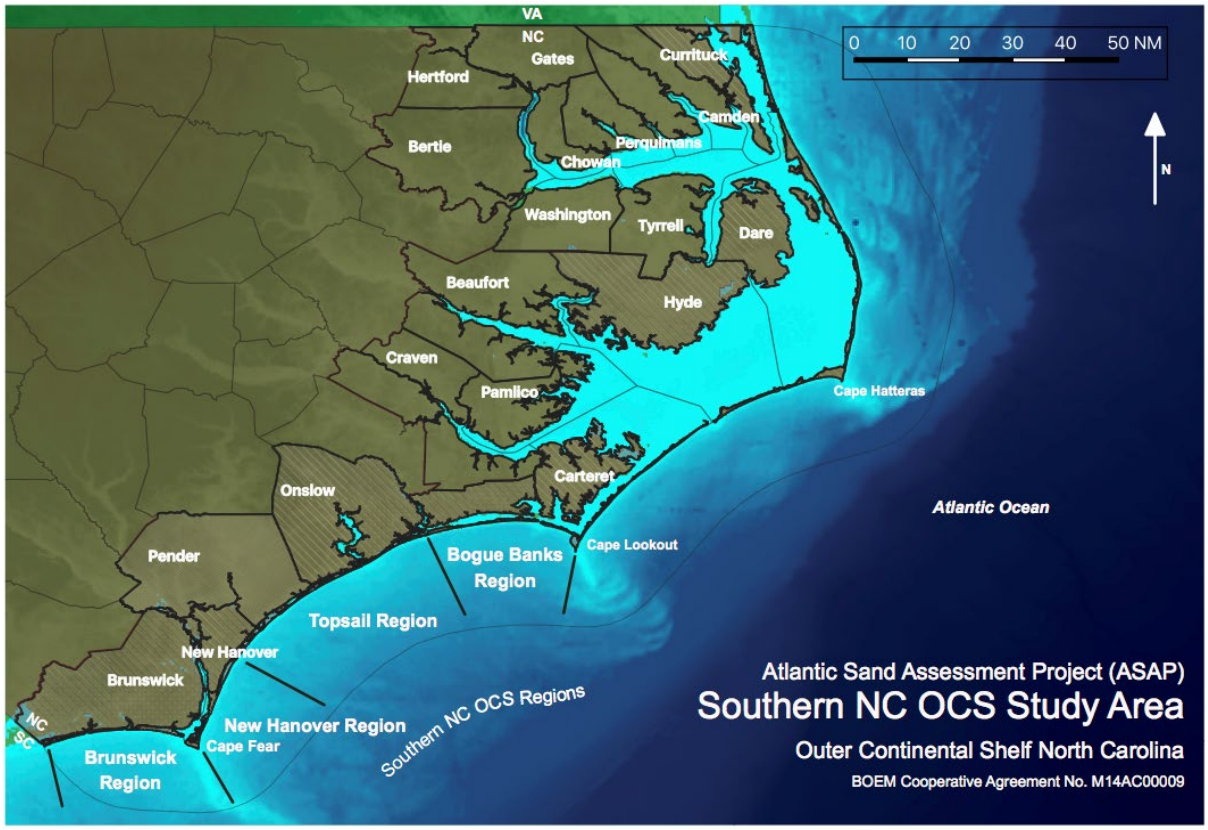

Figure 1: The North Carolina Coast and Continental Margin. The outer continental shelf study area is shown, partitioned into the four study regions from northeast to southwest: Bogue Banks, Topsail, New Hanover, and Brunswick.

The overarching objective of the NC-BOEM Cooperative Project was to begin exploring outer continental shelf waters (3-12 nautical miles offshore) off of North Carolina for viable sand resources that could be mined in the short and/or long-term, to meet the needs of current and future beach reconstruction. A prior companion study, representing Phase 1 of this cooperative research, focused on need and sand availability north of Cape Lookout. This report continues that work but focuses efforts on the areas south of the Cape (Figure 1), a region where much less research has been conducted and so less is known of the surface and subsurface geology and geography of the outer continental shelf. The region under consideration is large, covering several hundred square miles of ocean bottom. Thus, no single study can begin to offer a comprehensive picture of these areas and a concomitant assessment of the sand resources available. Nevertheless, by focusing on areas along the outer shelf where exploration and recovery are both technically and economically feasible in the present day, some insight can be gained. Further, results here will inform any future investigations that might either revisit these same areas but, in more detail, or extend exploration to other adjacent areas on the outer shelf, and perhaps beyond. Tangible deliverables from the investigations include spatial data products that locate and describe potential sand bodies, specifically identifying areas where subsurface material depths likely meet or exceed specified quantity thresholds (i.e., > 5 ft and > 10 ft body thicknesses). This report provides a brief description of these data, along with representative maps which depict the location and approximate estimated sand material qualities.

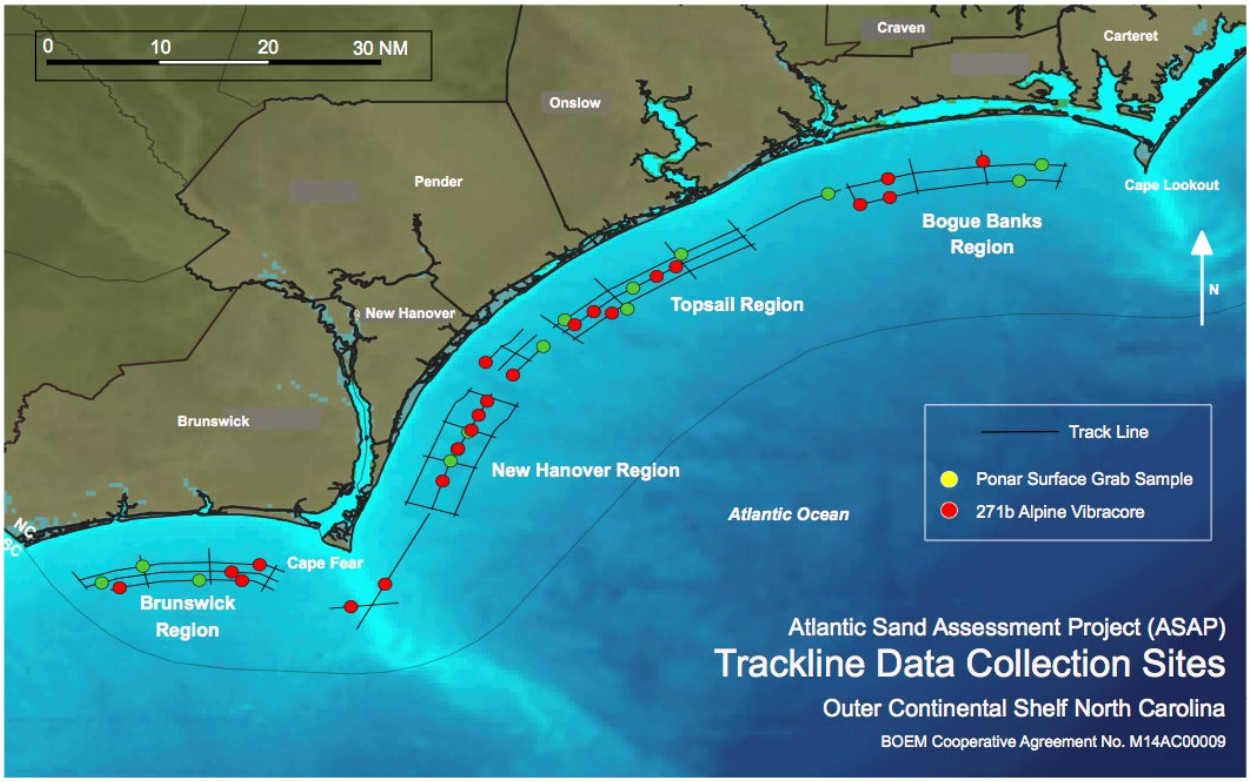

Figure 2: The track line surveys conducted in each of the four shelf regions. Shown on the map are the positions where the 24 vibracores and ponar surface sediment samples were collected along with the track line paths.

A central component of this research was the Atlantic Sand Assessment Project (ASAP). Field data collection associated with the ASAP included a series of shallow, sub bottom seismic (chirp) surveys, bathymetry, side-scan sonar, and 24 shallow (approximately 20 ft.) cores (Figure 2). The seismic, bathymetric, and side-scan sonar data was manually interpreted to generate sediment thickness estimates along the survey lines using the commercial software application SonarWiz. The cores were sampled and analyzed using standard grain size analytical techniques (Folk, 1980). Fractions included bulk sand, silt, and clay components. When warranted, the sand component was further evaluated using mechanical sieves. This report focuses on and describes the sediment thickness assessments.

The seismic interpretations attempted to locate shelf surface and subsurface sediments of relative recent (geologic) age that offered potential suitable sand resources for beach restoration projects in the state. Seismic reflectors were identified in software using Chesapeake Technology, Inc.'s geophysical survey and analysis toolset SonarWiz^{TM} to locate the horizontal and vertical extents of unconsolidated Quaternary (QT and QC) and later Holocene (H) sedimentary units. The Quaternary designations QC and QT units distinguish channel-fill and non-channel sediments, respectively. Data that are included here provide the location of and volumetric extents for each of these units. In addition, in accordance with the requirements specified in Agreement M14AC00009, a composite thickness estimate that includes sediments from the H, QT, and QC unit layers is included, with depths defined in continuous units of meters and U.S. feet, along with depths grouped (binned) into 0 to 5 foot, 5 to 10 foot, and greater-than 10 foot thick divisions. These data are presented as a series of map graphics in the Regions section of this report (see below). The raw data used to produce the maps are found GIS-ready in the accompanying [open-source format] geopackage available for download.

The Regions

The area along the North Carolina Outer Continental Shelf (OCS) south of Cape Lookout (refer to Figure 1) is partitioned into four discrete, non-overlapping assessment regions. From north to south these include: Bogue Banks, Topsail, New Hanover, and Brunswick. The included maps show the seismic survey lines and sampling locations, along with the potential sand resource estimates. The mapped data is further partitioned into groups where sediment thickness is not associated with paleo channel fill sediments, and a second group that represent channel-fill sources. The estimates are depicted as per contract delivery instructions such that surveyed sediment bed thicknesses in the range of 5 to 10 feet and those beds greater than 10 feet are shown. Sediment thickness interpretations from the seismic observations are presented on the regional map graphics (Figures 3 - 10) using two cartographic visualization strategies. The first uses simple vector point features to mark the locations where seismic observations and interpretations were made during the study. Here, atop the regularly-spaced track line sample positions are symbolized to reflect interpreted sediment depths both in the range between 5 and 10 feet, and those greater than 10 feet thickness. Color differences are used to differentiate these two classes: yellow (255:255:0) for depths from 5 to 10 feet, and red (255:0:0) for those that exceed 10 feet. Interpreted thicknesses less than 5 feet are not overtly identified on the maps. The second strategy used to illustrate sediment bed thickness on these maps

applies a kernel density function to the observed seismic data to estimate thickness at locations within a limited distance from the survey track lines. These density function "halos" surround positions along the track lines where thickness is estimated to be 5 feet or more. The reader is cautioned that these density estimates are probability based extrapolations and that their reliability diminishes with increasing distance away from the track line. The variability in this estimator further explains the "haloing" seen on the maps in places along the track lines where direct interpretation interprets sediment body depths less than 5 feet. Bed characteristics are known with certainty only along the track lines where seismic data was actually collected and assessed. Regional descriptions follow:

The Bogue Banks Region

The Bogue Banks region spans the section of North Carolina's coast from Cape Lookout southwest to New River Inlet. Estimated sand resources from all non-channel sources surveyed are depicted in Figure 3. Figure 4 displays the survey-estimated potential sand resources sourced from relic bottom and sub bottom paleo-channel features.

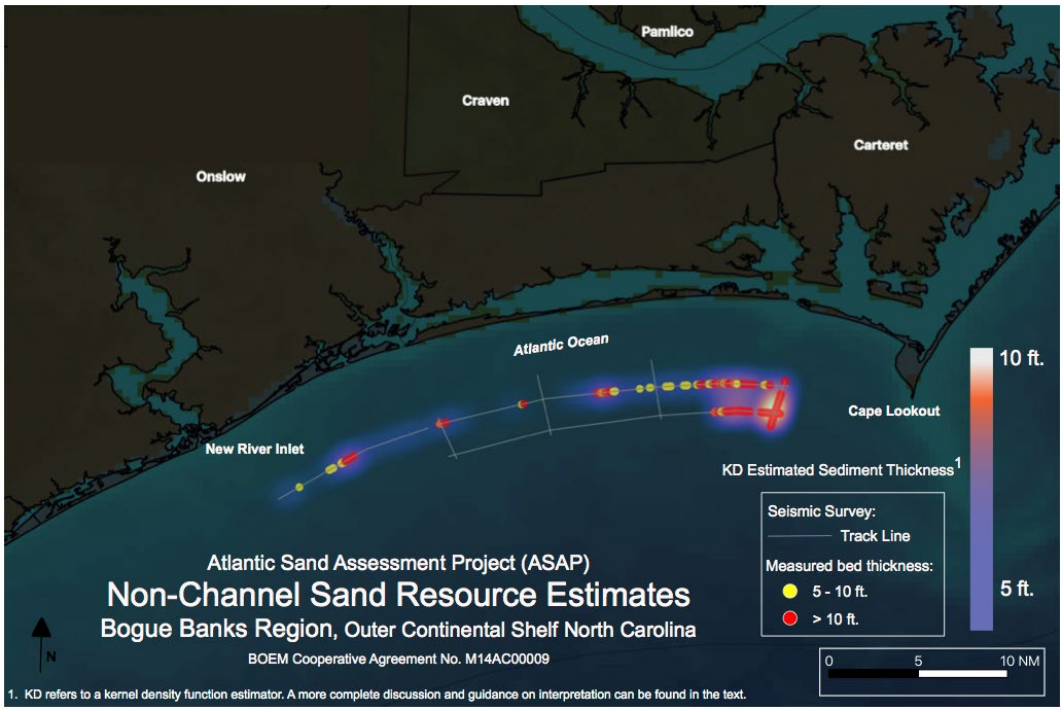

Figure 3: Non-channel sediment resource estimates for the Bogue Banks OCS Region.

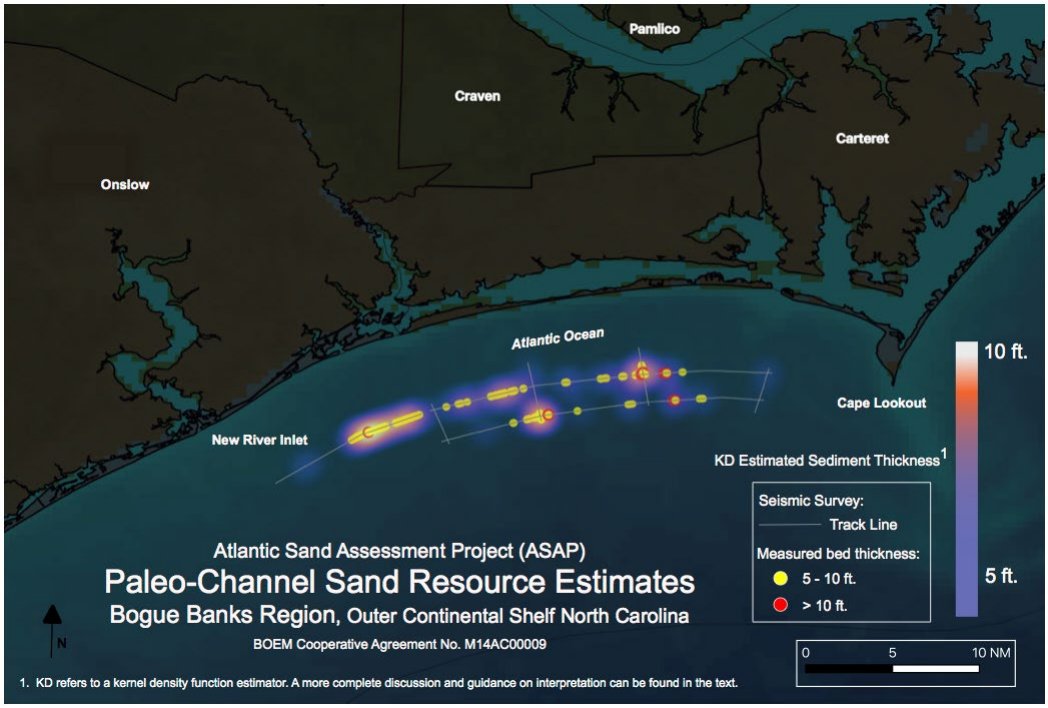

Figure 4: Quaternary channel sediment resource estimates for the Bogue Banks OCS Region.

The Topsail Region

The Topsail survey region runs from New River Inlet southwestward past Wrightsville Beach to Masonboro Inlet. Potential non-channel-sourced sand resource estimates for this region are shown in Figure 5. Estimates for potential sand resources from relic paleo-channel fills are shown in Figure 6.

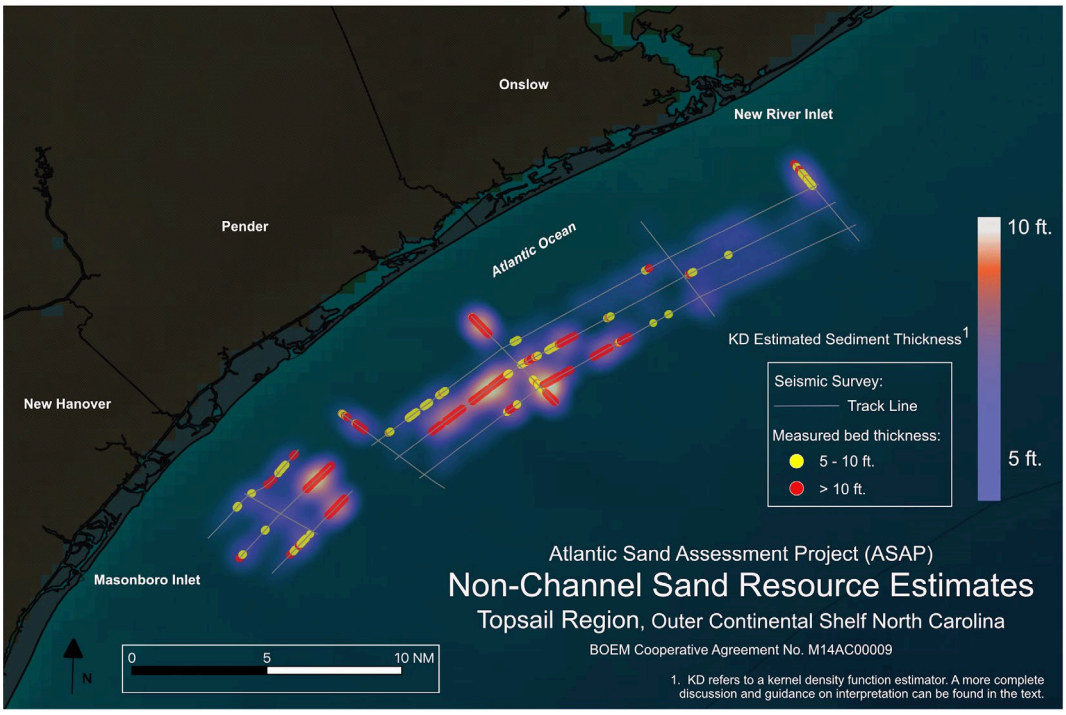

Figure 5:Non-channel sediment resource estimates for the Topsail OCS Region.

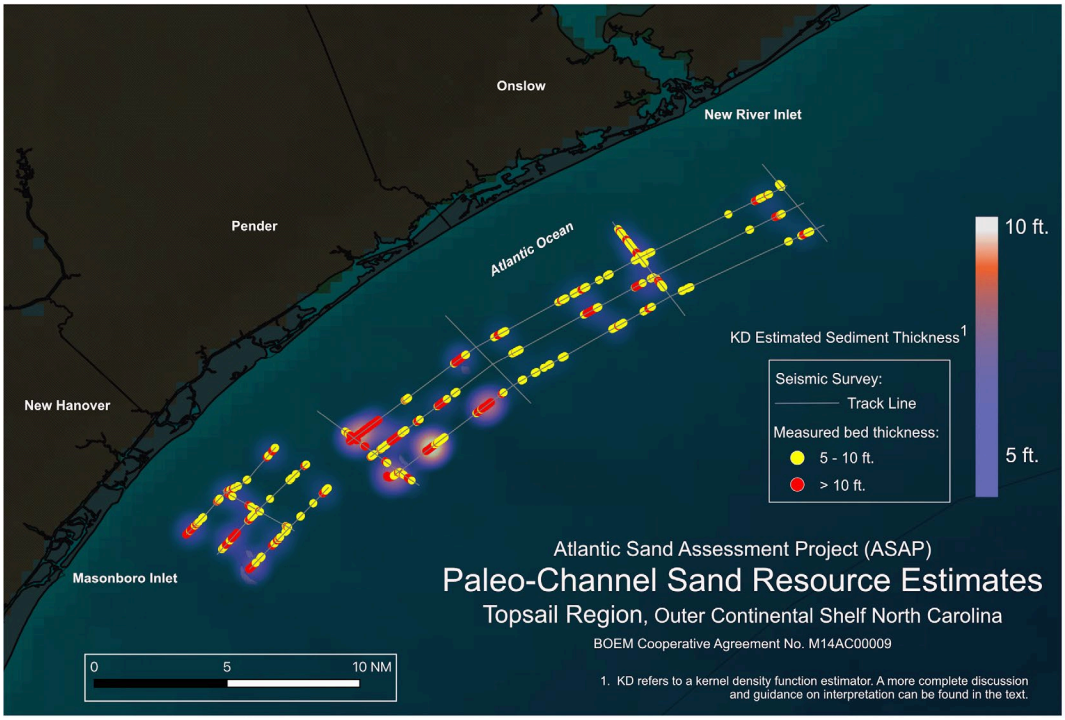

Figure 6: Quaternary sediment resource estimates for the Topsail OCS Region.

The New Hanover Region

The New Hanover survey region consists of the portion of the North Carolina coastline from Masonboro Inlet southwest to Cape Fear and the Cape's adjoining Frying Pan Shoals. Non-channel sand resources are shown in Figure 7. New Hanover sand resources from channel fill material is displayed on the map in Figure 8.

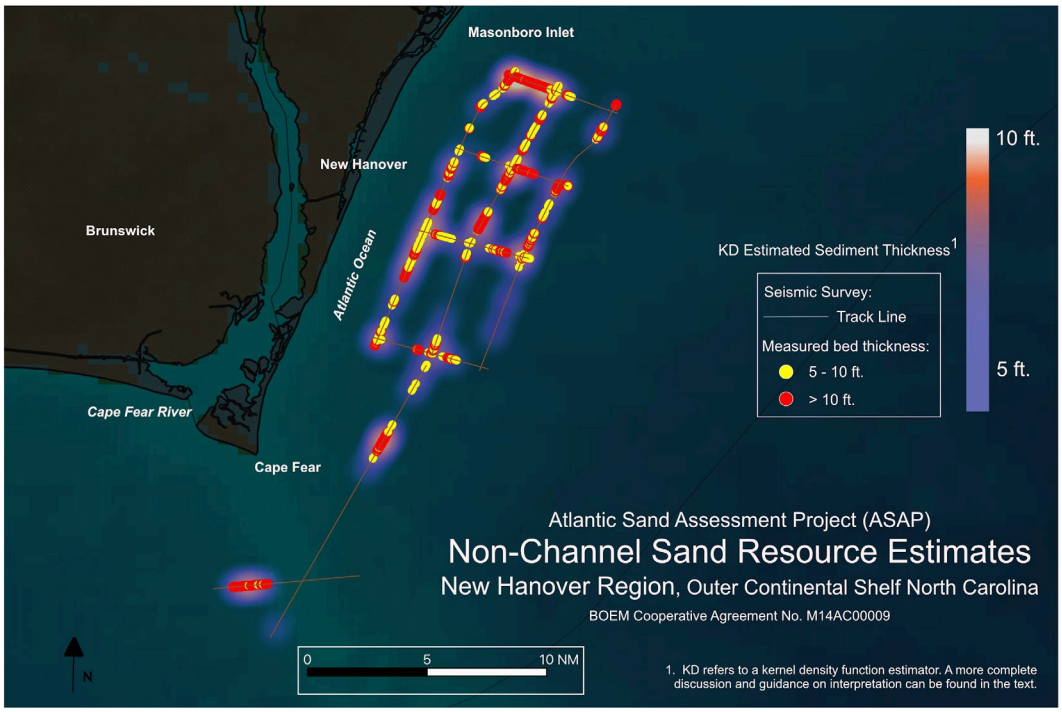

Figure 7: Non-channel sediment resource estimates for the New Hanover OCS Region.

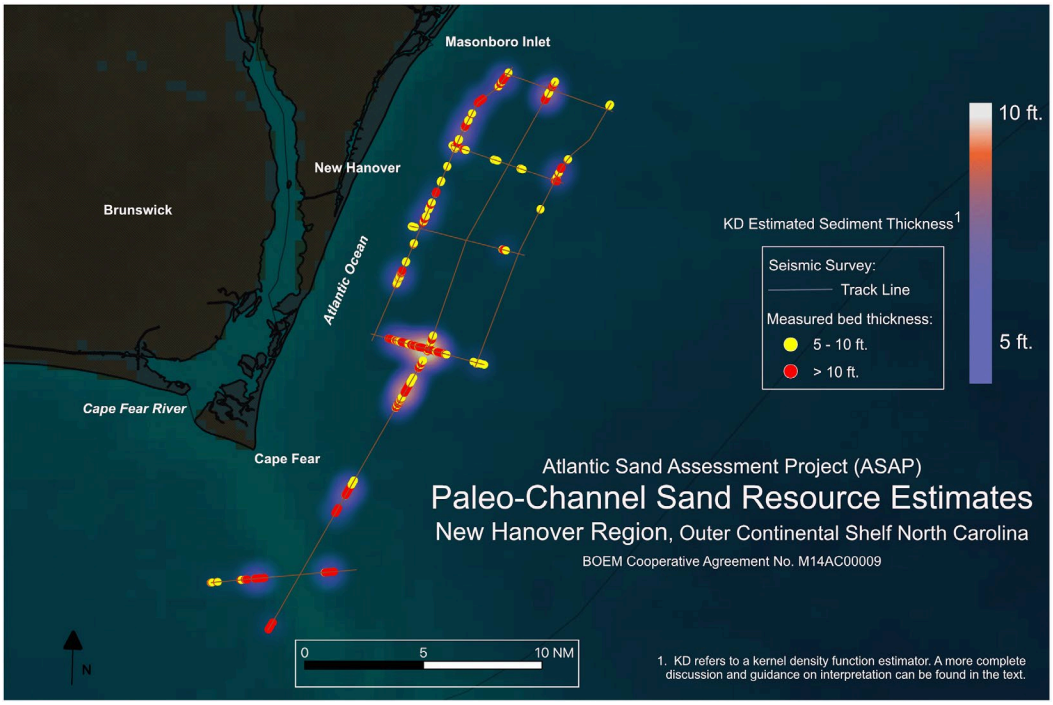

Figure 8: Quaternary sediment resource estimates for the New Hanover OCS Region.

The Brunswick Region

The southernmost survey region Brunswick extends further westward from Frying Pan Shoals and Cape Fear to the North Carolina-South Carolina state line at Little River Inlet. Non-channel potential sand resources identified in this study for Brunswick are shown on the Figure 9. Potential beach restoration quality sands from channel fill materials for the Brunswick Region are detailed in Figure 10.

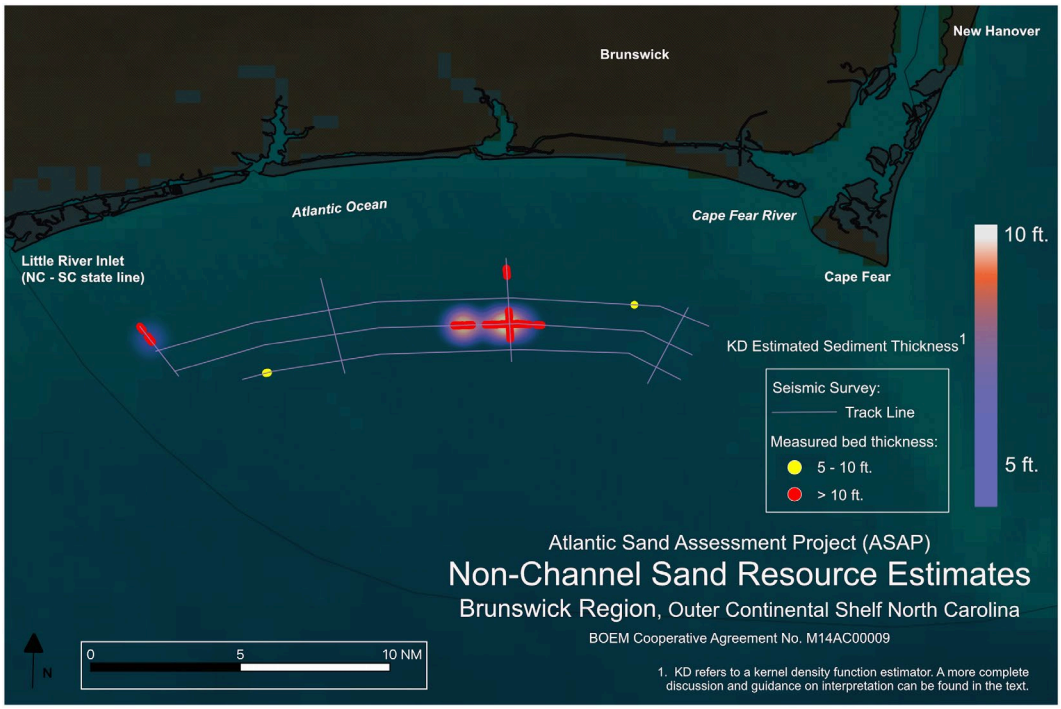

Figure 9: Non-channel sediment resource estimates for the Brunswick OCS Region.

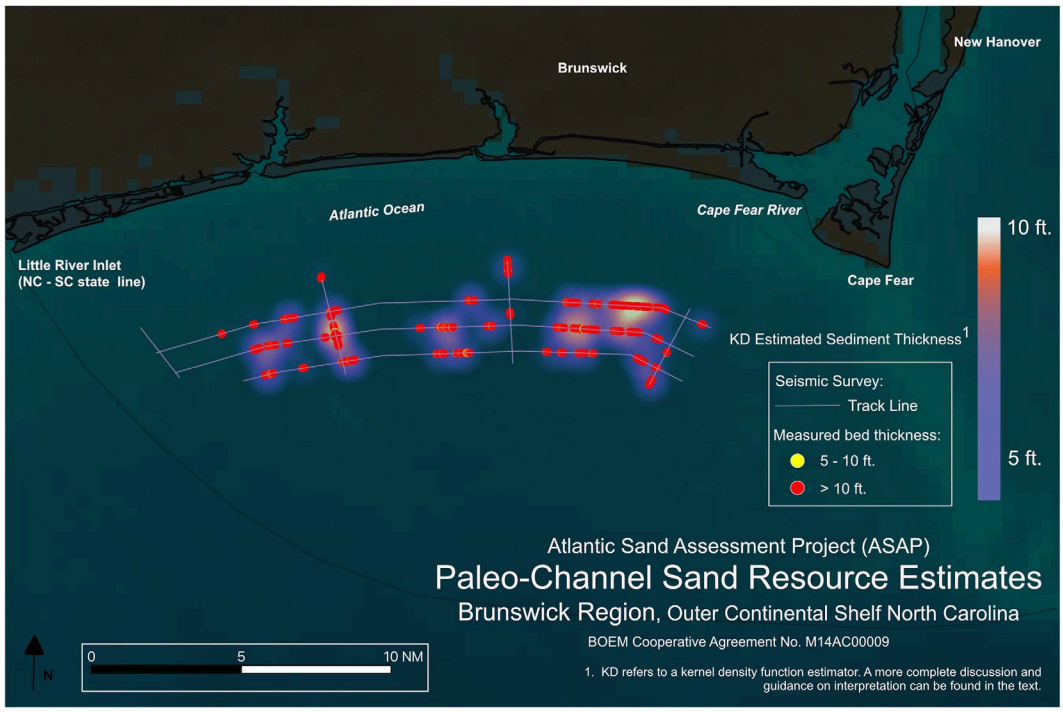

Figure 10: Quaternary sediment resource estimates for the Brunswick OCS Region.