The eastward migration of the ebb channel and the attendant morphologic changes in the inlet system has not only controlled the shoreline change patterns along Bogue Banks, but concurrently they have played a significant role in the Bear Island oceanfront erosion.

4.5 Inlet Interior Island Shoreline Changes. The marsh and sandy shoreline segments that comprise the seaward portion of Dudley Island have also been significantly impacted by configuration changes in the channel/shoal system of Bogue Inlet. Segments of Dudley Island have experienced significant and rapid erosion primarily due to the eastward migration of the ebb channel; the attendant spit growth along the Bogue Banks shoulder, and the migration of the Eastern Channel toward Dudley Island. Elongation of the Bogue Banks spit and the extension of its subaqueous platform had caused the thalweg of Eastern Channel to shift toward Dudley Island, resulting in erosion and overtopping of the landward bank.

The encroachment of the Eastern Channel on the eastern portion of the marsh complex in response to the continued growth of the Bogue Banks sand spit has generally resulted in recession of the marsh shoreline located immediately to the northwest of the Bogue Banks spit. The majority of the marsh and sandy shoreline along the western portion of Dudley Island has also receded due to encroachment of various feeder channel segments. Generally, the least amount of erosion and the greatest buildup occurred north of Island 2.

Islands 1 and 2 represent small sand accumulations located within the mid inlet shoal complex. These islands are ephemeral in nature and of low relief (elevations generally less than 2 feet NGVD). Island 1 began to develop in 1995/96 along the western margin of the ebb channel. The feature increased in size and extent until 2001 but appears to have recently diminished in size as evidenced by a September 2002 aerial photograph of the inlet shown in Figure 4.6. The extremely shallow depths across the landward portion of the mid inlet shoal favored the development of Island 2 through a combination of processes associated with breaking waves and the associated swash that partially or completely overtops the low relief island. Extreme wave action during elevated water levels will likely erode a portion or the entire feature. Although no measurements were made, the eastern margin of Island 2 appears to be eroding in response to the westward movement of Eastern Channel that is occurring as a result of the growth of the Bogue Banks spit. Comparison of the September 2001 aerial photograph with that of September 2002 showed that Island 2 has migrated approximately 1,000 feet to the west.

4.6. Proposed Channel Location. The primary goal of the geomorphic analysis was to develop an understanding of the relationship between the inlet's temporal and spatial morphologic changes and the changes that occurred along the adjacent oceanfront segments since 1973. A secondary goal was to utilize this understanding to select an optimum channel location and to evaluate the impacts of the relocated channel on the various components of the system. Detailed analysis of the historic changes that have taken place since 1973 clearly show that the movement of the ebb channel and the attendant ebb-tidal delta symmetry changes are the forcing variables that dictate the erosion and accretion trends along the inlet and oceanfront shorelines of both Bogue Banks and Bear Island. The erosion of the eastern inlet shoreline in the vicinity of The

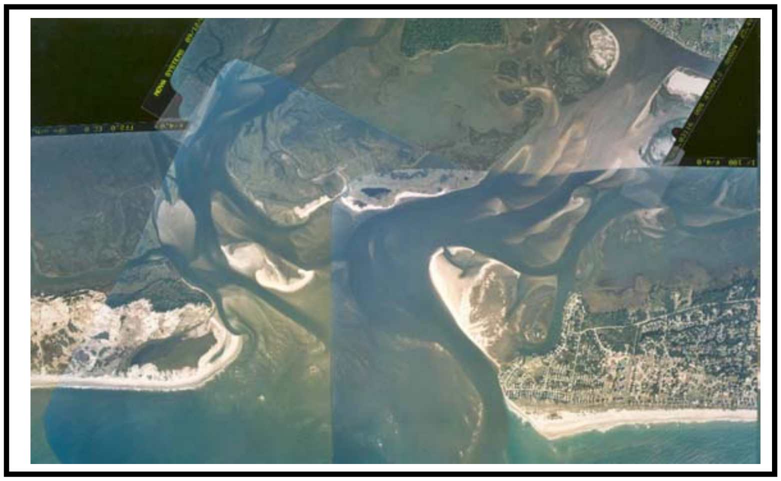

Figure 4.6 September 2002 Aerial Photograph of Bogue Inlet

Pointe and the concurrent accretion of the adjacent oceanfront shoreline on the west end of Bogue Banks are directly related to the eastward migration of the ebb channel. The data also indicates that the inlet and oceanfront erosion along adjacent Bear Island stem directly from the complex morphologic changes related to the eastward migration of the ebb channel and the associated shoal shape changes. Based on the results of this analysis, the optimal channel location is one situated within a corridor midway between the two islands with the channel oriented essentially perpendicular to the general alignment of the two islands. This optimum channel corridor corresponds to an area bounded by the 1976 and 1978 ebb channels. The proposed channel location shown on Figure 2.1 falls within this optimal channel corridor.

5. **GRAIN SIZE CHARACTERISTICS:** The size characteristics of the material to be removed from the inlet were compared to the size characteristics of the native beach material in order to determine the suitability and compatibility of the inlet material for use as beach nourishment. Table 5.1 provides a summary of the grain size analyses (both sieve and visual) for the samples collected from the jet probes located on or near the centerline of the proposed channel.

5.1 Jet Probes and Vibracores. Overall, the jet probes, performed in July 2002, consisted of fine to medium sand with minor amounts of shell (5 percent or less). The average mean grain size for all of the jet probe samples subjected to a sieve analysis was 0.27 mm (Table 5.1). The silt content of the jet probe samples analyzed by standard sieves was generally below 2 percent, however, since most of the fine grained material is washed out of the sediment during the jet probe process, the silt content indicated by the jet probe samples may not necessarily be indicative of the *in situ* silt content.

The results of the vibracore investigations, conducted in July 2002, indicate fairly uniform sand deposits throughout the proposed channel corridor with minor layers of shell fragments and shell hash and minimal amounts of silt. No layers of clay were observed in any of the vibracores. Silt content, as documented in both the jet probe samples and the vibracore samples had generally less than 2 percent silt (i.e., grain sizes less than 0.0625 mm).

For the Bogue Inlet/Bogue Banks area, grain sizes equal to or greater than 1 mm are generally composed of shells (King, 2002). The average amount of vibracore material with grain sizes equal to or greater than 2 mm was approximately 6% and material equal to or larger than 1 mm averaged nearly 11% for the vibracore samples. The higher concentration of coarse grain material in the vibracore samples was mostly found at depths greater than –17.5 feet NGVD. If only the samples obtained from depths equal to or less than –17.5 feet NGVD are used to determine the percent of coarse-grained material in the vibracore samples, the amount of material equal to or greater than 2 mm is about 4.5% while the percent greater than 1 mm is about 8%.

Vibracore samples were used exclusively to compute weighted composite grain size distributions for 3 channel depths; namely, -13.5 feet NGVD, -15.5 feet NGVD, and -17.5 feet NGVD. These three channel depths cover the range of optional depths that could be recommended for the relocated channel. The results of the composite distributions for the three channel depths are summarized in Table 5.2.