3.0 PROJECT ALTERNATIVES

Project alternatives designed to respond to the erosion threat associated with the eastward migration of the Bogue Inlet ocean bar channel have been identified. The alternatives ranged from no action, abandon and/or relocate threatened homes, to relocation of the inlet ocean bar channel to a central position between Bogue Banks and Bear Island.

3.1 RATIONALE

The alternatives were developed and evaluated based on the assumption that the inlet shoreline would continue to erode over the next 10 years in response to the continued eastward migration of the inlet bar channel. This would position the inlet shoreline 600 to 900 feet east of its present location (see Appendix B – Engineering Report). This potential shoreline migration zone is well within the present Inlet Hazard Area as established by the North Carolina Division of Coastal Management. In this regard, the Inlet Hazard Area was established based on historic changes in the inlet position. For Bogue Inlet, the Inlet Hazard Area (see Figure No. 4 and 5) includes most of the western tip of Bogue Banks beginning at a point approximately 3,000 feet east of the existing inlet. Alternatives A through H, described in detail below, have been identified during the scoping process under the following considerations: environmental consequences, feasibility, logistics, cost, and applicable laws.

3.2 DESCRIPTION OF ALTERNATIVES

3.2.1 Alternative A – No Action Project Alternative

The No Action Alternative was evaluated to determine the impacts associated with continued channel migration to the east over a 10-year period. The current response to the erosion threat has included the construction of temporary sandbag revetments by individual property owners and the Town of Emerald Isle to provide interim protection to threatened homes and roads. The No Action Alternative assumes that no such measures would be implemented during the analysis period. Under this alternative, threatened homes and roads would simply be abandoned and demolished with all of the debris transported to existing sanitary landfills or the structures would be allowed to fail and fall into the inlet. Erosion rates of the Emerald Isle inlet shoreline have ranged from 60 to 90 feet per year since the mid-1980's; however, the No Action Alternative was evaluated using an erosion rate of 60 feet/year. The tax value of real property located within the area that would be impacted by continued inlet shoreline erosion

over the 10-year evaluation period totals almost $11.0 million. In addition to impacts to real property and the associated impact on the town and county

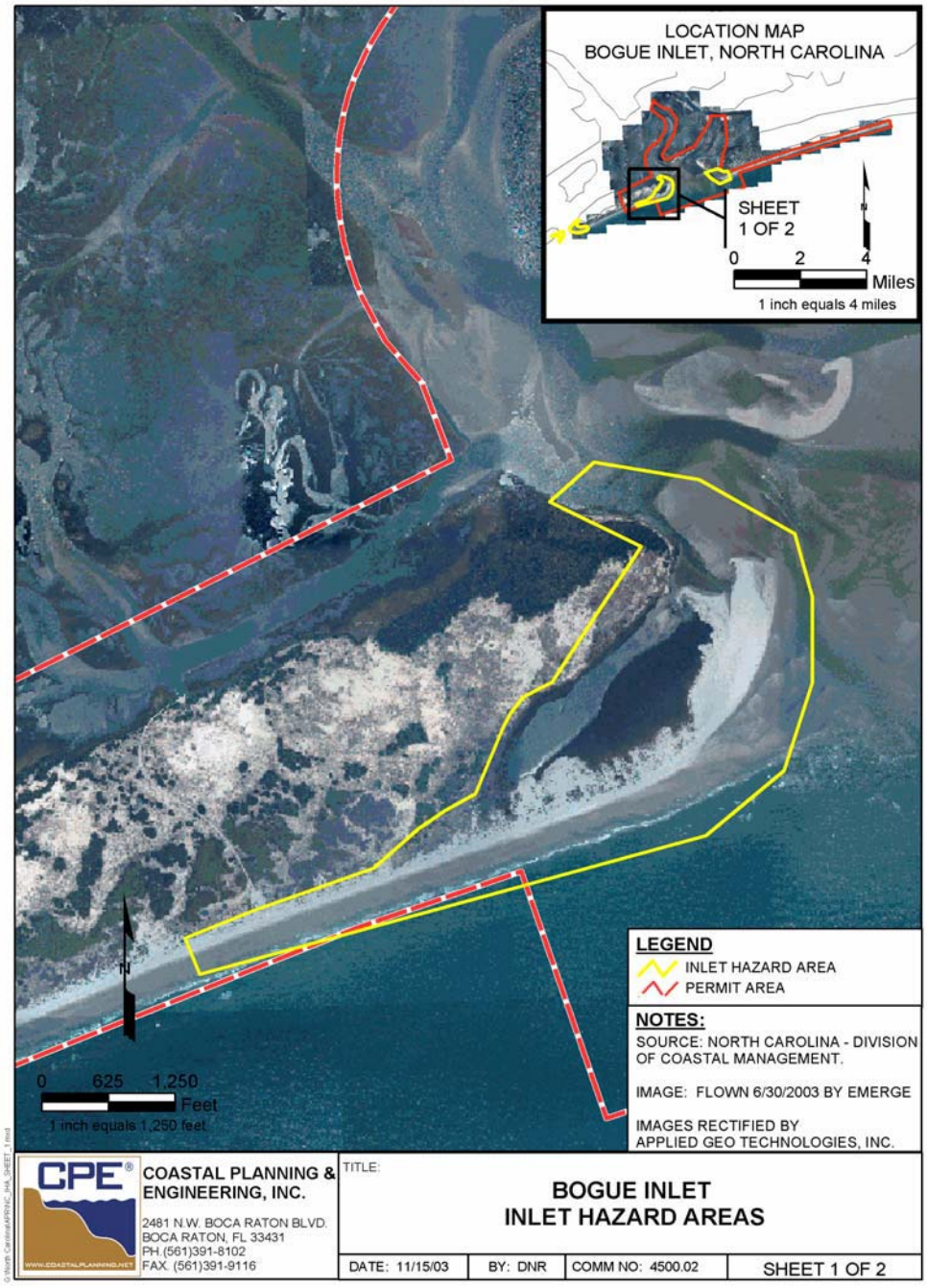


Figure No. 4 – Inlet Hazard Area on Bear Island

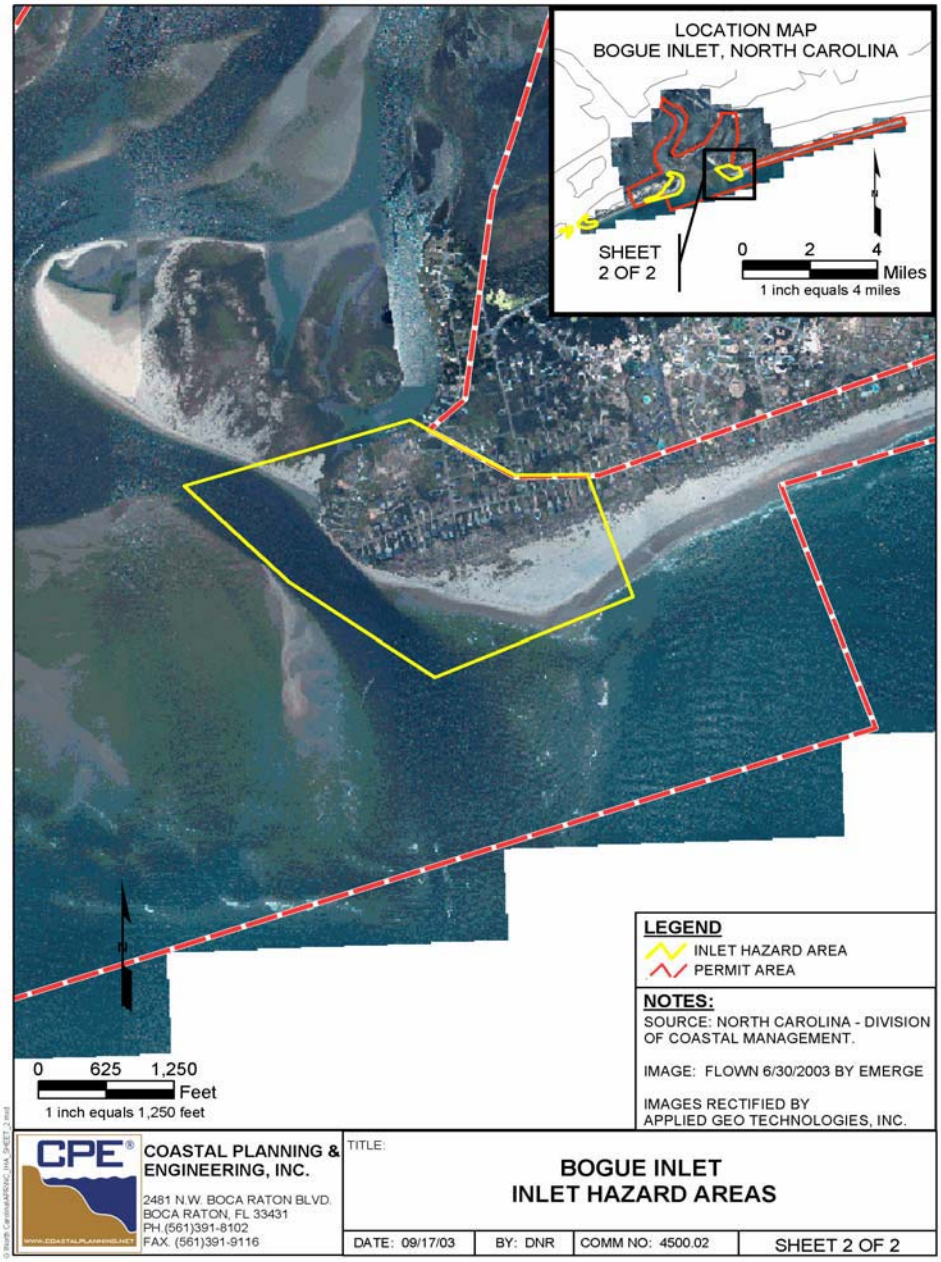


Figure No. 5 – Inlet Hazard Area on Emerald Isle

tax bases and local economy, continued inlet shoreline erosion would impact roads and utilities in the Pointe subdivision.

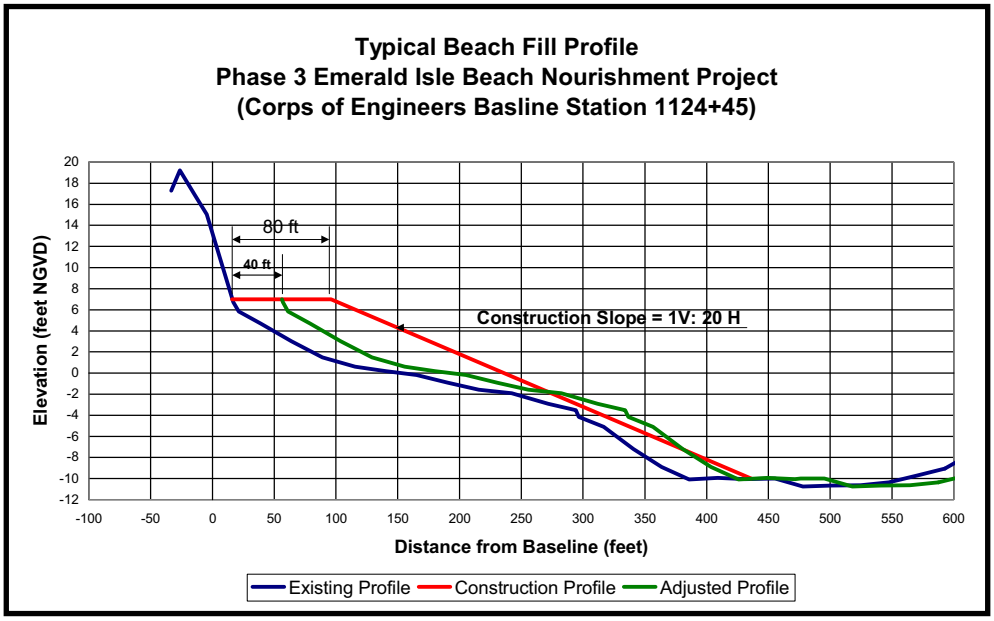
The No Action Alternative would result in the Town of Emerald Isle using offshore borrow areas to complete Phase 3 of its beach nourishment project. Phase 1 and Phase 2 of the Bogue Banks beach nourishment projects were constructed using the offshore borrow areas. Pre-construction sampling from the offshore borrow areas found mean grain sizes ranging from 0.28 mm to over 0.50 mm with mud and silt contents ranging from 3% to 4%. Once placed along the shoreline, the offshore borrow material proved to have a rather high shell content (ranging from 35% to 44%) but otherwise appeared to be compatible with the native beach material.

Phase 3 of the Emerald Isle beach nourishment project extends from Pinta Drive (Coastal Science and Engineering [CSE] Baseline Station 693+54 - west end of the Phase 2 beach fill) to the west boundary of the Lands End Subdivision (approximate CSE Baseline Station 906+54) for a length of 21,300 feet. The fill would include a 531-foot taper section on the east end to tie back into the terminus of the Phase 2 fill, which ended at CSE Baseline Station 688+23, and a 2,000-foot taper on the west end of the fill (west end of transition near intersection of Sea Breeze Road and Windjammer South) resulting in a total fill length of 23,831 feet.

The recommended design template for the Phase 3 fill involves the net placement of 35.2 cubic yards/lineal foot of beach. The placement rate within the taper sections would average 50% of this placement rate. The total net in-place volume needed to construct the recommended Phase 3 fill would be 794,300 cubic yards. Using 15% losses between the borrow area measure and in-place measure, the gross amount of material that would have to be removed from the offshore borrow area to construct the design template for Phase 3 including the two taper sections, would be 913,400 cubic yards. If the depth of excavation in the offshore borrow areas is restricted to 4 feet, which was the case for Phases 1 and 2, construction of Phase 3 would involve the disturbance of 141.5 acres of offshore bottom.

A typical profile of the beach fill template is shown below. The crest elevation of the berm would be at +7.0 feet National Geodetic Vertical Datum (NGVD), which is equal to natural berm elevation along Bogue Banks. During construction, the width of the berm would be approximately 80 feet. Over a period of approximately 3 to 6 months, the beach fill profile will adjust to slopes comparable to that of the native beach and the width of the berm will approach 40 feet. The slope adjustments will result in material moving to the seaward limit of the active profile. For the Bogue Banks area, the seaward limit of the active beach profile, i.e., the depth at which

engineeringly significant sediment transport occurs, appears to be around -20 feet NGVD.



Under Alternative A, the U.S. Army Corps of Engineers (USACE) would continue to use sidecast dredges to maintain the navigation channel through Bogue Inlet. Between 1984 and 1999, an average of 151,500 cubic yards/year was reportedly removed from the inlet bar channel. From 2000 to 2002, maintenance dredging increased considerably with the removal of an average of 514,200 cubic yards/year. Material removed from the channel is discharged off of the side of the dredge into open waters of Bogue Inlet. The USACE would also continue to maintain the channel connecting Bogue Inlet with the Atlantic Intracoastal Waterway (AIWW) with disposal of the maintenance material along 1,000 to 2,000 feet on west end of Emerald Isle beginning at a point 1,500 feet from the inlet shoulder. Between 1984 and 2002, the USACE deposited a total of 325,000 cubic yards in this area, or an average of 20,300 cubic yards/year. The disposal operations occur on a frequency varying from 1 to 3 years.

Once the existing sandbags are removed from The Pointe shoreline, five structures would immediately fall victim to the inlet shoreline erosion. At the end of the first two years of the analysis, a total of seven structures would be destroyed. If erosion continues at a rate of 60 feet/year over the 10-year analysis period, 36 structures could be lost along with all of Bogue Court, Inlet Court, and a considerable portion of Inlet Drive.

3.2.2 Alternative B – Without Project – Relocate Homes

The Structure Relocation Alternative was evaluated for the same erosion rate as the No Action Alternative (i.e., 60 feet/year), however, rather than abandon and demolish the homes, affected property owners were assumed to purchase new lots available within the town limits of Emerald Isle and move the threatened buildings to a new location. Under this alternative, the tax value of the buildings would be preserved but the abandoned lots would be removed from the town and county tax bases. Also, roads and utilities affected by the No Action Alternative would also be affected under the Structure Relocation Alternative. The major economic impact of this alternative would fall on the individual property owners for the cost of the new lot and expenses for moving the structure to a new location.

Under this alternative, construction of Phase 3 of the Emerald beach nourishment project would be accomplished using offshore borrow areas (see Alternative A for description of beach fill and characteristics of the offshore borrow material) and maintenance of the Bogue Inlet navigation channel and connecting channel by the USACE would continue as described under Alternative A.

3.2.3 Alternative C – Without Project – Sand Bag Revetments

Individual property owners and the Town of Emerald Isle would continue to respond to the erosion threat in much the same manner as has occurred in the past (i.e., they would elect to install temporary sandbag revetments to protect threatened homes and infrastructure). In this regard, the property owners and the town have installed a 700-foot long sandbag revetment to protect seven threatened homes and portions of Inlet Drive and Bogue Court. Adhering to the State rules that allow sandbags to be installed when a structure is considered to be threatened the interim sandbag alternative was based on property owners and the Town of Emerald Isle installing sandbags to protect threatened homes and roadways. State rules allow sandbag structures to remain in place for a period of two years if they are protecting individual homes and five years if they are protecting roads. At the end of these permit periods, State rules require the sandbag structures to be removed. Once removed, the threatened homes would be abandoned and demolished by the property owners. The analysis was carried out on a yearly basis over a period of 10 years using an inlet shoreline erosion rate of 60 feet/year. Removal of the sandbag revetment would expose the next row of homes to the erosion threat resulting in the construction of sandbag revetments to protect these newly threatened homes. When a section of a road is threatened, sandbags would be installed to protect that section of the road. The sandbags protecting the road would remain in place for a period of five years after which the sandbag structure would have to be removed

resulting in the loss of that section of the road and a new threat to other sections of the roads. The installation of the temporary sandbag revetments would effectively slow the rate of the inlet shoreline advance to the east thus reducing the number of homes and length of roads and utilities that would be lost.

Under this alternative, Phase 3 of the Emerald Isle beach nourishment project would be constructed using offshore borrow areas (see Alternative A for description of beach fill and characteristics of the offshore borrow material) and the USACE would continue to maintain the Bogue Inlet navigation channel and connecting channel as described under Alternative A.

3.2.4 Alternative D - Suspension Channel Maintenance

The U.S. Army Corps of Engineers Navigation Branch has been using shallow draft sidecast dredges to maintain the authorized 8-foot mlw by 150-foot wide channel for navigation purposes only since 1984. During each maintenance operation, the USACE's dredging activities is restricted to deepwater channel that exist at the time. As a result, the maintenance dredging does not maintain a fixed channel alignment and the channel has continually migrated to the east during the entire maintenance dredging period. Between 1984 and 1999, the USACE removed an average of 151,500 cubic yards/year from the Bogue Inlet bar channel with disposal of this material in the open waters of Bogue Inlet. Maintenance dredging has increased dramatically between 2000 and 2002 with an average of 514,200 cubic yards/year removed by the USACE sidecast dredges. The assumption associated with the suspension of USACE maintenance dredging is that the eastward migration of the channel would slow and a new channel would eventually breach through the ebb tide delta in a more central location. If the channel did assume a new central location at some time in the future, the USACE Navigation Section would presumably resume maintenance of the navigation channel.

Under Alternative D, Phase 3 of the Emerald Isle beach nourishment project would be constructed using offshore borrow areas (see Alternative A for description of beach fill and characteristics of the offshore borrow material).

3.2.5 Alternative E – Channel Relocation Without Beach Nourishment

The Bogue Inlet bar channel would be repositioned to a location centrally located between Bogue Banks and Bear Island and would be oriented along an alignment perpendicular to the adjacent islands. A portion of the material removed to construct the new channel would be used to construct a sand dike across the existing channel with the balance of the material stockpiled for eventual transfer to the existing channel once construction of the new channel is completed. A total of six channel alternatives were evaluated

with depths ranging from -13.5 feet NGVD to -17.5 feet NGVD. Maximum channel widths across the ebb tide delta ranged from 400 feet to 500 feet. The minimum channel needed to capture the majority of the tidal flow through Bogue Inlet would have a depth of -13.5 feet NGVD and a maximum width of 500 feet. Construction of the channel would require the removal of 1,009,500 cubic yards of material with 200,000 cubic yards needed to construct the sand dike. Closure of the existing channel cannot begin until the new channel is opened to its designed width, across the ebb tidal delta; therefore, some of the dredged material must be stockpiled. Construction of the channel would begin on the seaward side and proceed toward the sound with the first 809,500 cubic yards of material stockpiled on the Emerald Isle sand spit and the last 200,000 cubic yards pumped directly into the channel to construct the sand dike (see Appendix B). The available dry land area on the spit totals about 900,000 square feet (about 21 acres). Stockpiling 809,500 cubic yards in this area would result in a mound approximately 25 feet high. Once the new channel is completed, the stockpiled material would be mechanically transferred to the new channel using standard earth moving equipment.

The material that would be removed to construct the new channel has a mean diameter of 0.30 mm and contains 1.25% silt and minimal shell content.

With material from the inlet channel being used to close the existing channel, the Town of Emerald Isle would use offshore borrow areas to complete Phase 3 of the Bogue Banks beach nourishment project (see Alternative A for description of beach fill and characteristics of the offshore borrow material). Completion of Phase 3 of the beach nourishment project would probably be delayed until 2007-2008 while the Town of Emerald Isle develops the financial capability to accomplish the work. In this regard, the cost of Alternative E would deplete the funds the town presently has available to address the inlet shoreline erosion problem and accomplish the Phase 3 nourishment.

Maintenance of the Bogue Inlet navigation channel would not be required for one and possibly two years following the relocation of the channel (see Appendix B). Following this respite period, maintenance dredging would resume. Once maintenance dredging of the navigation channel resumes, the amount of material removed should initially be relatively low compared to historic dredging efforts but will likely increase over time as the channel assumes natural characteristics. Maintenance of the connecting channel will continue with the maintenance material deposited on the west end of Emerald Isle as described under Alternative A.

3.2.6 Preferred Alternative F - Channel Relocation With Beach Nourishment

The Bogue Inlet bar channel would be repositioned to a location centrally located between Bogue Banks and Bear Island and would be oriented along an alignment perpendicular to the adjacent islands. A portion of the material removed to construct the new channel would be used to construct a sand dike across the existing channel with the balance of the material used to construct Phase 3 of the Emerald Isle beach nourishment project. Like Alternative E, evaluation of this alternative included an analysis of the size of the channel required to capture the tidal prism of Bogue Inlet and divert flow away from The Pointe shoreline and the need to construct the sand dike across the existing channel. A total of six channel alternatives were evaluated with depths ranging from -13.5 feet NGVD to -17.5 feet NGVD. Maximum channel widths across the ebb tide delta ranged from 400 feet to 500 feet. The optimum channel would have a depth of -13.5 feet NGVD and a maximum width of 500 feet. Construction of the new channel would require the removal of 1,009,500 cubic yards of material with 200,000 cubic yards used to construct the sand dike across the existing and the balance of 809,500 cubic yards used to nourish the shoreline included in Phase 3 of the Emerald Isle beach nourishment project. Like Alternative E, construction of the new channel would begin on the seaward side and proceed toward the sound with the first 809,500 cubic yards used to nourish the Phase 3 shoreline and the last 200,000 cubic yards pumped directly into the existing channel to form the sand dike (see Appendix B).

The material that would be removed to construct the new channel has a mean diameter of 0.30 mm and contains 1.25% silt and minimal shell content. Comparison of the inlet material with the native beach sands on the west end of Emerald Isle indicated that the inlet material is slightly coarser but otherwise completely compatible with the native beach sands. The 809,500 cubic yards of channel material would be distributed along the 21,300 feet of beach comprising Phase 3 of the Emerald Isle beach nourishment project and construct the east and west taper sections as described under Alternative A. The rate of placement, based on the total volume of material that would be removed from the inlet, would be 35.9 cubic yards/lineal foot of beach. The net in-place placement rate, using 15% losses between the borrow area and the beach, would be 31.2 cubic yards/lineal foot. This net placement rate is approximately 88.6% of the recommended net placement rate of 35.2 cubic yards/lineal foot. Since the rate of placement for the inlet material would be slightly less than the recommended placement rate, the beach fill template will be slightly smaller than that described under Alternative A. In this regard, the construction berm width would be about 70 feet with the berm width adjusting to approximately 35 feet within 3 to 6 months. Post-construction adjustments

of the fill would be essentially the same as that described under Alternative A.
Numerical model studies of the inlet combined with the geomorphic history of the inlet concluded that the sand dike across the existing channel would be needed to assure the new channel would capture the majority of the flow through Bogue Inlet and eliminate residual flows adjacent to the Pointe shoreline. However, there is still a chance that the residual flows could continue to cause some erosion problems along the Pointe shoreline. Therefore, the existing sandbag revetment protecting 700 feet of inlet shoreline would remain in place for a maximum of 2 years or until such time that the encroaching sand spit off the west end of Emerald Isle fills the existing channel.

The sand dike would have a maximum elevation of +4.5 feet NGVD and a top width of 50 feet and a maximum bottom width of approximately 700 feet and would extend approximately 1,700 feet across the channel from the existing middle ground shoals west of the existing channel to the Bogue Banks sand spit. Preferred Alternative F would consist of the following:

- Channel depth = -13.5 feet NGVD; maximum channel width =500 feet. Construction volume =1,009,500 cubic yards.

- Sand dike across the existing channel – required construction volume of 200,000 cubic yards.

- Disposal of 809,500 cubic yards of inlet material along 23,831 feet of ocean shoreline on the west end of Emerald Isle to complete Phase 3 of the Emerald Isle beach nourishment project.

Maintenance dredging in the relocated channel should not be required for one to two years after construction. Eventually, the new channel will assume natural characteristics and will again require annual maintenance dredging. As with Alternative E, maintenance dredging would initially be relatively low but will increase over time to dredge quantities comparable to past efforts. Maintenance of the connecting channel will continue with the maintenance material deposited on the west end of Emerald Isle as described under Alternative A. See Appendix C for Applicant's Preferred Alternative Map.

3.2.7 Alternative G - Hard Structure

Erosion of the Pointe shoreline could be protected against further erosion by constructing a combination sloping rubble revetment and terminal groin that would extend around the west end of the Emerald Isle Inlet shoreline and project into the ocean. The revetment segment would begin at a point near the north end of Bogue Court and extend to just seaward of the west end of

Inlet Drive. From that point, the structure would be a rubble mound (i.e., gravity structure) that would extend approximately 1,000 feet beyond the existing shoreline. The total length of the structure would be approximately 2,400 feet with equal segments of revetment and groin.

3.2.8 Alternative H - Inlet Sand Management

Reasonable control of the location and orientation of the Bogue Inlet bar channel could be accomplished through a dedicated program of channel maintenance in which the material removed from the channel would be deposited on both Bogue Banks and Bear Island to maintain the sediment balance on both islands. The existing 8-foot mlw authorized depth for the inlet channel is too shallow to allow ocean certified pipeline dredges (the type of plant necessary to accomplish the work) to routinely maintain the channel given the minimum digging depths of these type dredges is 12 feet. Accordingly, the dimensions of the bar channel would be increased to accommodate this type of dredge plant. The minimum dimensions of the channel would be comparable to the dimensions of the channel described under the Channel Relocation Alternative.