5.30.2 **Bird Management Plan.** The Town of Emerald Isle will be responsible for the implementation of a Bird Management Plan. Any new land that could potentially be created either directly or indirectly as a result of the project would be (a) deeded to the Town of Emerald Isle or (b) included in conservation easements. In this regard, the Town of Emerald Isle may pursue ownership of any new land that forms west of the existing property lines on the west end of Emerald Isle. The Town of Emerald Isle may also pursue adopting an ordinance specifically prohibiting any new development within the area deeded to the town or included in the conservation easements. The Town may pursue other ordinances that would include, but not be limited to, restrictions prohibiting or limiting vehicular access to portions of the inlet shoreline, limiting pedestrian access within important foraging and/or nesting habitat, and prohibiting unleashed dogs in the inlet area. Important foraging and/or nesting habitat to which the ordinances would apply would be designated by the North Carolina Wildlife Resources Commission and would be posted and otherwise delineated by ropes and/or flagging. An information kiosk could be erected at the end of Inlet Drive to explain why access is being restricted and could include an explanation of the critical habitat needs of piping plovers and other bird species.

5.30.3 **Fishery Resource Monitoring/Mitigation Plan**. The submerged aquatic vegetation (SAV) and shellfish beds located within the Permit Area will be surveyed during the summer months following one full year of project operation. Based on the present project schedule, project construction will be completed by the end of February 2005. Therefore, the post-project monitoring would be scheduled for June, July, or August 2006. The survey will include digital aerial photographs and ground truth surveys within the Permit Area and digital aerial photographs of the Project Impact Area. Known shellfish beds and SAV beds located outside the Permit Area but proximate to the Permit Area will also be monitored with ground truth surveys to assess the accuracy of the pre-project predictions. The post-project monitoring results will be compared to pre-project conditions to assess any changes in SAV or shellfish habitat.

Negative changes in SAV or shellfish abundance will be assessed as to their significance with appropriate mitigation measures implemented should the impacts be determined to be significant.

5.30.4 **Shoreline Changes**. The relocation of the main ebb channel through Bogue Inlet to a more central position between Bear Island (Hammocks Beach State Park) and Emerald Isle (west end of Bogue Banks) has been predicted to cause significant changes in the position of the shoreline on both islands. The predicted changes in the shorelines for these two islands were based on a detailed geomorphic analysis of the inlet and adjacent shorelines over the period from 1973 to 2001. The predicted changes are essentially reversals in the shoreline behavior associated with the eastward migration of the main ebb channel from its central

location in the mid 1970's to its present location juxtaposed to the west end of Emerald Isle (the Pointe shoreline). In the case of Bear Island, the eastern 7,500 feet of the island is predicted to accrete over 450 feet along sections located immediately west of the inlet to around 130 feet at a point 7,500 feet west of the inlet. On Emerald Isle, the extreme west end of the town's shoreline could erode as much as 400 feet in response to the channel relocation while the shoreline 7,500 feet from the inlet is expected to erode approximately 10 feet.

Even though the geomorphic analysis and prediction of future shoreline adjustments were based on sound scientific principles, data, and procedures, predictions involving future changes in ocean shorelines are subject to considerable uncertainty. For example, the primary assumption associated with the future shoreline prediction is that the relocated channel will remain centrally located and oriented perpendicular to the adjacent shorelines for some period of time. Eventually, the relocated channel is expected to migrate toward Bogue Banks; however, based on historic channel behavior, the movement of the channel back to its present position could take a minimum of 15 years and a maximum of approximately 35 years. If the relocated channel does not behave in this manner, the prediction of future shoreline changes could be compromised. For example, if the channel moves to the west, this could result in greater amounts of erosion along the Emerald Isle shoreline while the Bear Island shoreline should be positively impacted, i.e., experience even greater amounts of accretion. Should the channel rapidly return to its present position, the Bear Island shoreline would not recover as predicted while predicted erosion along Emerald Isle would be more moderate.

Uncertainties associated with the impacts of the channel relocation project and uncontrolled movement of the channel following its relocation on the adjacent shorelines are addressed below. The uncertainties will be addressed by establishing erosion thresholds based on past shoreline changes. In the event these erosion thresholds are exceeded, the Town of Emerald Isle would be required to mitigate for the damages.

Shoreline changes on the west end of Emerald Isle and the east end of Bear Island were measured from aerial photographs taken between December 1973 and September 2001 with the results of that analysis presented in Appendix B. Changes in the shorelines were determined for transects spaced at 500-foot intervals along each island as shown on Figure 9. Since some of these transects are presently located within Bogue Inlet, this analysis will focus on transects 1 to 12 on Emerald Isle and transects 25 to 36 on Bear Island which cover 5,500 feet of shoreline on each island.

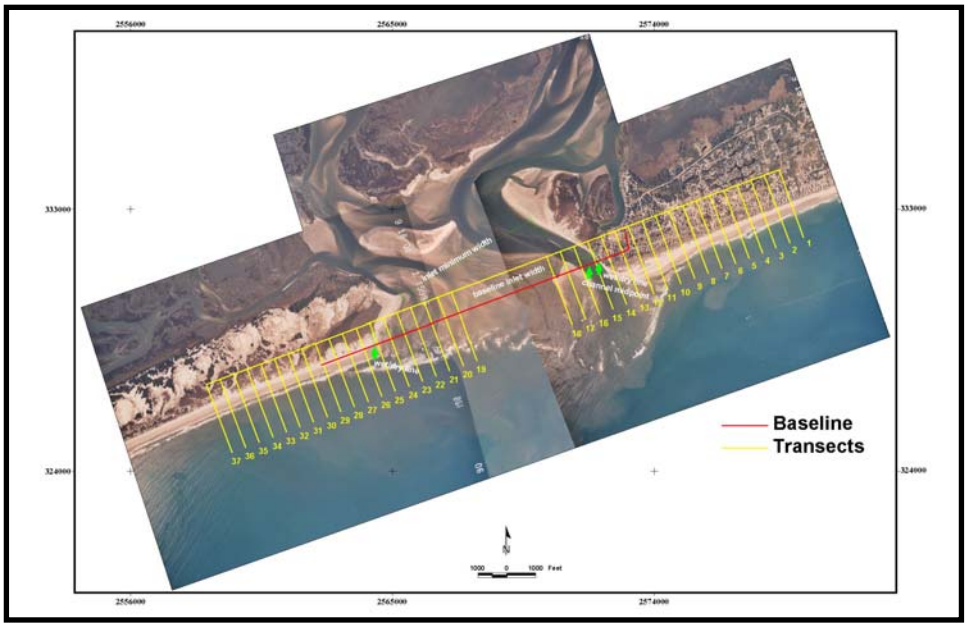

Figure 9 Transects used for Shoreline Changes

The shoreline changes determined in the geomorphic analysis between December 1973 and September 2001 were combined with shoreline change information available from the State of North Carolina COAST database to extend the historic shoreline change analysis to April 1938 for Bear Island and March 1943 for Emerald Isle. Cumulative shoreline changes on Emerald Isle for the period March 1943 to September 2001 for the 12 transects, in groups of 3 transects, are shown on Figures 10 to 13 while cumulative shoreline changes on Bear Island between April 1938 and September 2001 are given on Figures 14 to 17. Also shown these figures are the average cumulative shoreline changes for the three transects plotted on each figure.

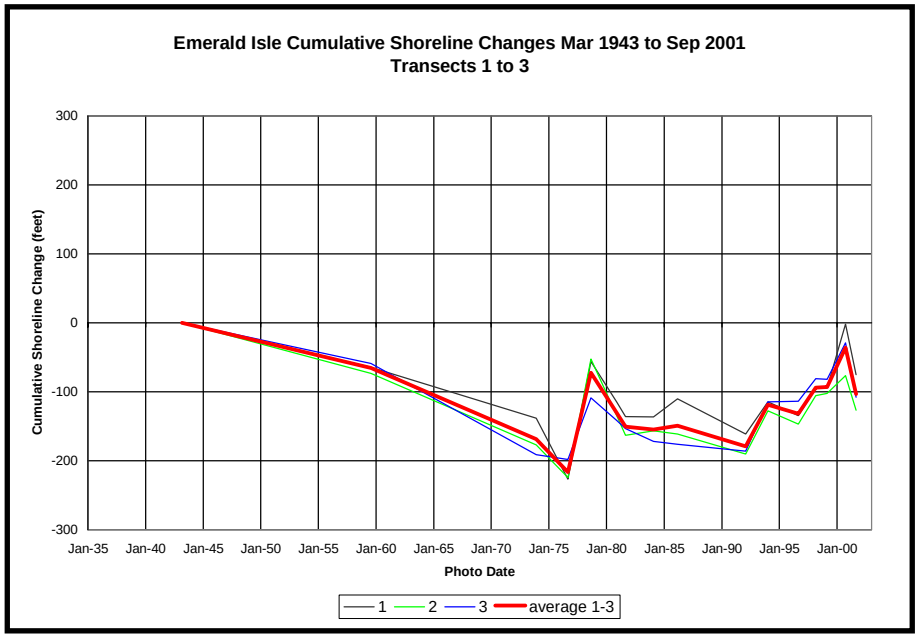

Figure 10– Cumulative Shoreline Changes on Emerald Isle – Transects 1 to 3

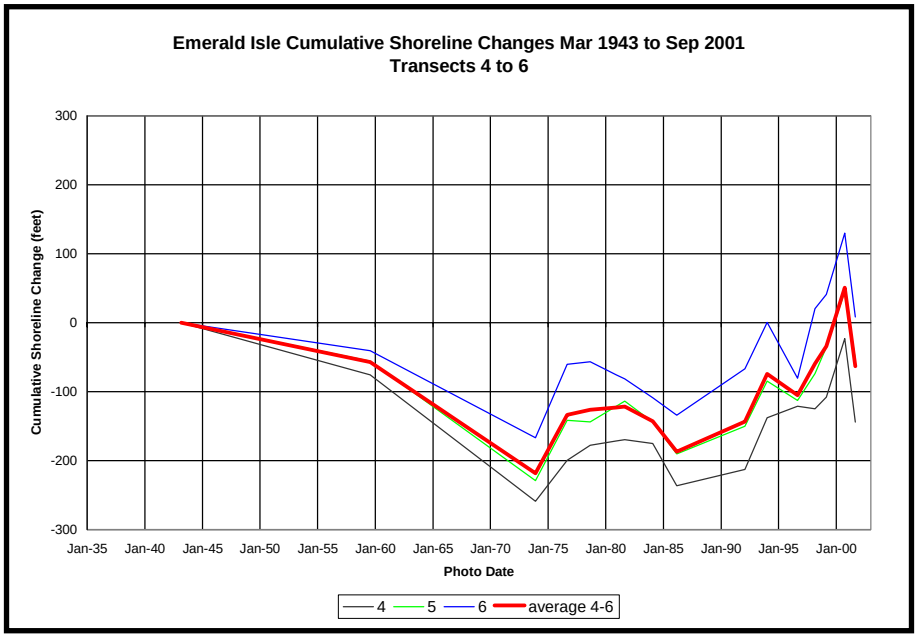

Figure 11 – Cumulative Shoreline Changes on Emerald Isle – Transects 4 to 6

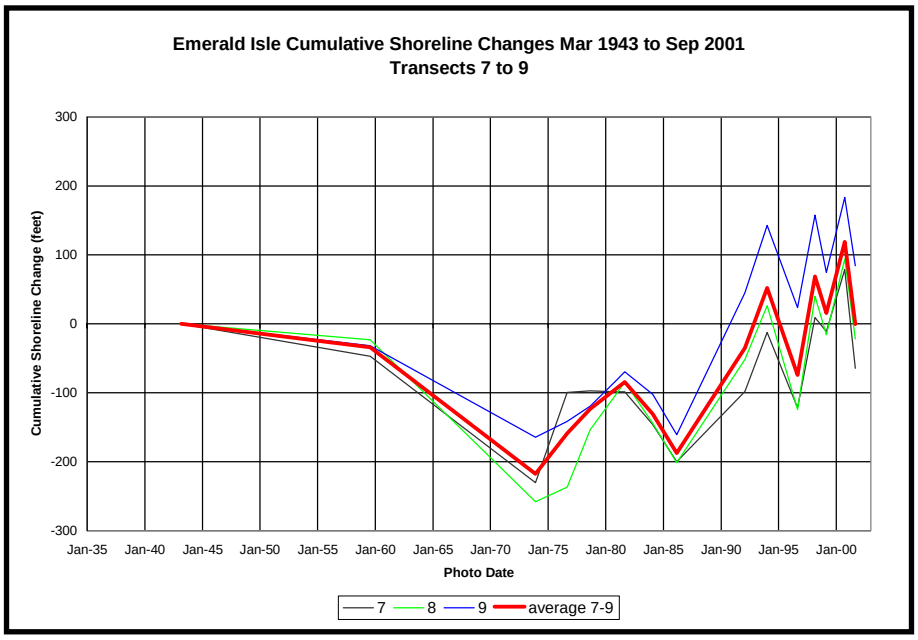

Figure 12 – Cumulative Shoreline Changes on Emerald Isle – Transects 7 to 9

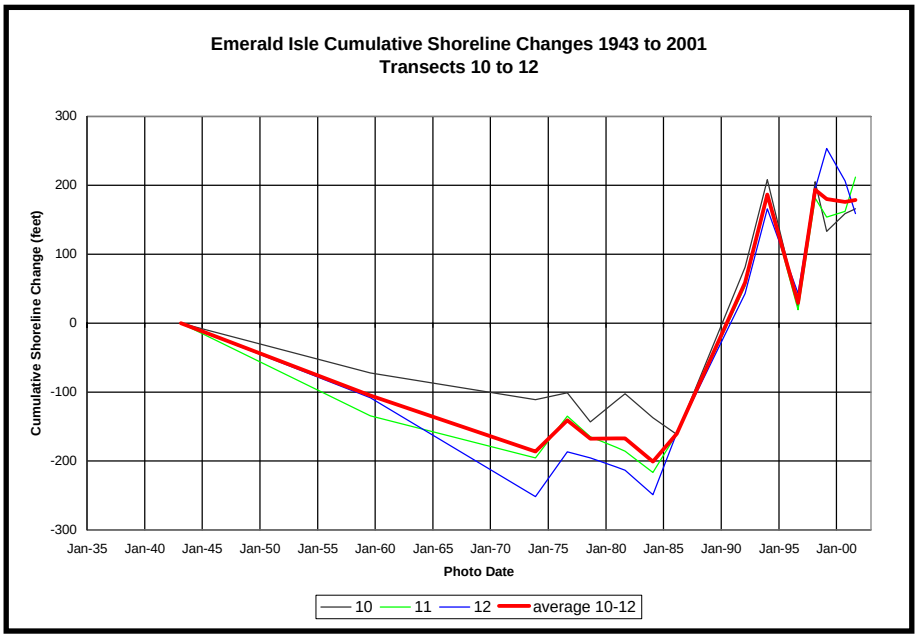

Figure 13 – Cumulative Shoreline Changes on Emerald Isle – Transects 10 to 12

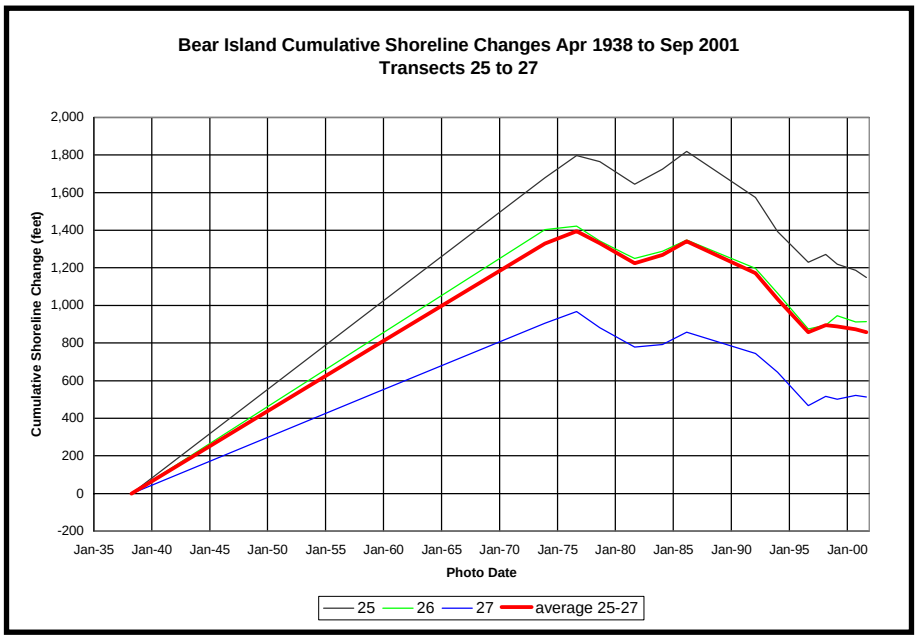

Figure 14 – Cumulative Shoreline Changes on Bear Island – Transects 25 to 27

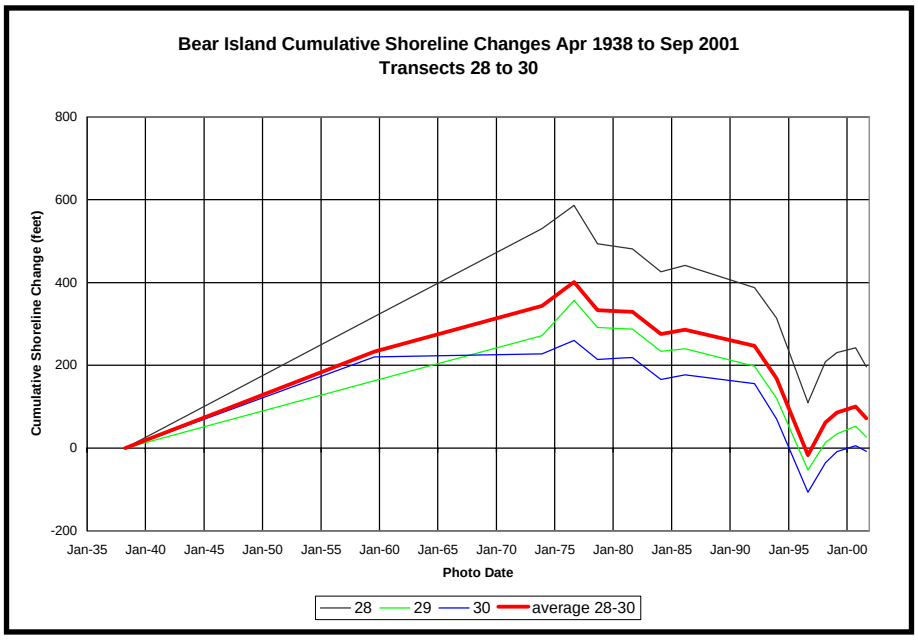

Figure 15 – Cumulative Shoreline Changes on Bear Island – Transects 28 to 30

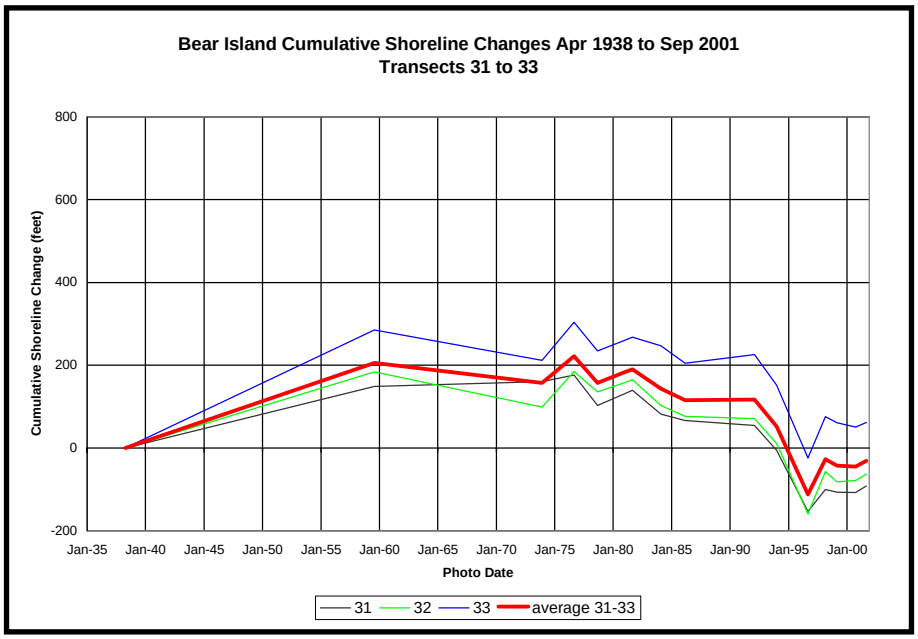

Figure 16 – Cumulative Shoreline Changes on Bear Island – Transects 31 to 33

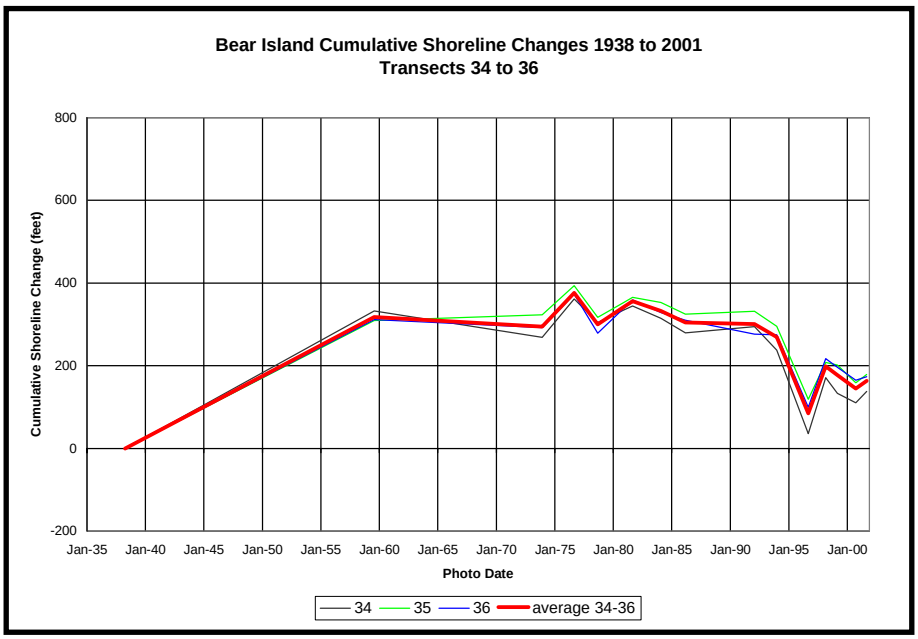

Figure 17 – Cumulative Shoreline Changes on Bear Island – Transects 34 to 36

The cumulative shoreline changes for Emerald Isle, given on Figures 10 to 13, show general high rates of erosion for all transects from March 1943 to around September 1976. This period of general erosion was followed by a short period of moderate erosion to relative stability between September 1976 and March 1986

(shoreline change rates varied from +1.4 ft/yr to –5.4 ft/yr). From March 1986 to September 2001, all transects accreted with the amount of accretion decreasing with increased distance from Bogue Inlet. With the exception of the September 1976 to March 1986 period, the behavior of the shoreline on Bear Island has been a mirror image of the shoreline changes on Emerald Isle with general accretion between April 1938 to September 1976 and erosion from March 1986 to September 2001. For the latter period, the highest rates of erosion occurred near Bogue Inlet with the rate of erosion decreasing with increased distance from Bogue Inlet. While Emerald Isle experienced both accretion and moderate erosion between September 1976 and March 1986, transects 25 to 33 on Bear Island eroded at rates ranging from –7.0 to –11.7 ft/yr. The average rates of change in the shoreline position for the various time periods discussed above and for the period from September 1976 to September 2001 are summarized in Table 21. The shoreline change rates were determined from linear regression trends through the average shoreline positions for each of the 3-transect groups over the various time periods.

Table 19
Average Shoreline Change Rates for Various Time Periods
(Rates are the average for 3 adjacent transects)

Emerald Isle	**Mar 43 to Sep 76**	**Sep 76 to Mar 86**	**Mar 86 to Sep 01**	**Sep 76 to Sep 01**
Transect Group	Rate ft/yr	Rate ft/yr	Rate ft/yr	Rate ft/yr
1 to 3	-6.2	+1.4	+6.1	3.0
4 to 6	-5.4	-5.4	+11.7	5.1
7 to 9	-6.1	-2.7	+13.9	9.1
10 to 12	-4.9	-3.0	+20.2	17.9
Bear Island	**Apr 38 to Sep 76**	**Sep 76 to Mar 86**	**Mar 86 to Sep 01**	**Sep 76 to Sep 01**
Transect Group	Rate ft/yr	Rate ft/yr	Rate ft/yr	Rate ft/yr
25 to 27	+36.7	-7.0	-33.2	-21.2
28 to 30	+10.0	-11.7	-15.7	-12.8
31 to 33	+4.9	-9.0	-12.7	-10.5
34 to 36	+8.8	-4.1	-11.8	-8.2

Historic shoreline positions on the west end of Emerald Isle for the period March 1943 to September 2001 are shown in Appendix C. The predicted shoreline following the relocation of the channel is represented by the September 1978 shoreline; however, as shown, historic shorelines on Emerald Isle have been located farther inland than the September 1978 shoreline. The maximum and minimum shoreline positions measured at each transect on the west end of Emerald Isle

during the 1943 to 2001 period have also been plotted (Appendix C). Also shown is the September 1978 shoreline, the shoreline position expected to following the relocation of the Bogue Inlet bar channel. Should the shoreline erode to or past the September 1978 shoreline or otherwise create a serious threat to upland development, the Town of Emerald Isle should consider nourishing the affected beach.

Bear Island has experienced a considerable amount of erosion since 1976 with the rate of erosion increasing between 1986 and 2001. The historic shoreline positions on the east end of Bear Island for the 1938 to 2001 period are shown in Appendix C. The maximum and minimum shoreline positions along with the predicted September 1978 shoreline (Appendix C). While the predicted response of Bear Island to the relocation of the Bogue Inlet channel is accretion, should the island actually experience an increase in the rate of erosion over the historic rate, the Town of Emerald Isle would be responsible for mitigating this erosion. In order to account for the most recent change in the erosion rate on Bear Island, the average erosion rate for each of the 3-transect groups for the period 1976 to 2001 was used as the base erosion rate with the upper limit of acceptable erosion for each of the 3-transect groups determined from the variability of shoreline changes that occurred between 1986 and 2001. For the 1986 to 2001 shoreline change rate, the upper 95% confidence limit was determined based on the standard deviation of the shoreline change rates within each of the 3-transect groups. The base shoreline erosion rates for the 1976 to 2001 time period were increased by one-half of the 95% confidence limit to determine the erosion threshold rate for each of the 3-transect groups. This procedure is summarized in Table 22.

Table 20
Erosion Threshold Shoreline Change Rates for Bear Island

Transect Group	Base SL Change Rate 1976 to 2001 (ft/yr)	Average SL Change Rate 1986 to 2001 (ft/yr)	95% Confidence Limit for 1986 to 2001 Rate (ft/yr)	Erosion Threshold = (1976 to 2001 rate) + (- one-half of the 95% confidence limit for 1986 to 2001)
25 to 27	-22.0	-33.2	11.0	-27.5
28 to 30	-13.8	-15.7	2.6	-15.0
31 to 33	-11.4	-12.7	0.8	-11.8
34 to 36	-9.0	-11.8	1.6	-9.8

By using the 1976 to 2001 rates as the base rate and adjusting the base rate by the variability in the shoreline change rates between 1986 and 2001, the erosion threshold shoreline change rates fall between the long-term 1976 to 2001 rates and the short term 1986 to 2001 rates. The rate of shoreline change on Bear Island will be determined from a combination of aerial photographic comparisons and conventional beach profile survey techniques with both aerial photographs and conventional surveys being made twice a year. In order to take into account possible short term fluctuations in the shoreline due to storms, the erosion threshold rates would have to be exceeded in two adjacent 3-transect groups for a period of one year. This one-year confirmation period is based on the amount of time shorelines normally take to recover from the impacts of severe coastal storms. Note that this time period would be extended if the area is impacted by a sequence of two or more significant storms within the confirmation period. For example, assume that transect groups 31 to 33 and 34 to 36 have erosion rates greater than the threshold amounts during the first year following channel relocation. If the erosion rates still exceed the threshold rates at the end of the second year following channel relocation, mitigation could be required. If however a storm occurs 6 months after the threshold violation and the storm causes significant shoreline recession not only on Bear Island but other nearby areas, the confirmation period would be extended 12 months from the date of that storm. Monitoring of the shoreline changes on Bear Island would continue for a period of 5 years following the channel relocation project.

The method of mitigating the erosion on Bear Island would be determined based on consultation with the NC Division of Parks and Recreation.