impacts within the project area, but shellfish resources are not expected to be adversely influenced by project construction since the closest shell fish area is located in the western end of Bogue Sound approximately 700 feet from the landward end of the proposed channel.

Cumulative Effects. No cumulative impacts to shellfish should occur from the channel relocation with beach nourishment alternative.

Compatibility with Project Objectives. This alternative fully supports the project objectives as established by the Town of Emerald Isle.

Finfish

An Essential Fish Habitat (EFH) assessment has been prepared for the Bogue Inlet Channel Erosion Response Project. A copy of the draft EFH is included in the DEIS.

Alternatives A, B, and C would have the same impacts on finfish as described below.

Direct and Indirect Impacts. No direct or indirect impacts to finfish species are anticipated to result from Alternatives A, B, and C.

Cumulative Effects. No cumulative effects are expected to result from the Alternatives A, B, and C.

Compatibility with Project Objectives. Alternatives A, B, and C do not support the project objectives.

Alternative E – Channel Relocation without Beach Nourishment

Direct and Indirect Impacts. Loss of infaunal prey for finfish may result from the stockpiling of sand from the inlet onto land areas and the transfer of the stockpiled material to fill the seaward portion of the existing channel. However, impacts are expected to be temporary and minimal during project construction with infaunal community loss restricted to the immediate channel area and dike construction area. Turbidity impacts are predicted to be minimal because of the low silt/clay percentage and low suspension time of the sediment.

Cumulative Effects. No cumulative effects to finfish species are expected to occur as a result of this alternative.

Compatibility with Project Objectives. This alternative is compatible with most of the project objectives.

Alternative F – Channel Relocation with Beach Nourishment

Direct and Indirect Impacts. Direct and indirect impacts from Alternative F within the inlet system should be similar to those impacts to finfish from the channel relocation without beach nourishment.

Cumulative Effects. Cumulative impacts to finfish are not likely to occur from the channel relocation with beach nourishment alternative.

Compatibility with Project Objectives. This alternative fully supports the project objectives as established by the Town of Emerald Isle.

Marine Mammals - Dolphins

Alternatives A, B, and C would have the same impact on dolphins as described below.

Direct and Indirect Impacts. Dolphins could be distracted by the noise associated with the routine maintenance dredging of the Bogue Inlet channel, however, dolphins are expected to continue to access the resources of Bogue Inlet.

Cumulative Effects. No cumulative effects to marine mammals are expected to result from Alternatives A, B, and C.

Compatibility with Project Objectives. Marine mammals are not directly associated with the stated project needs or objectives.

Alternative E – Channel Relocation without Beach Nourishment

Direct and Indirect Impacts. Noise from construction activities associated with the dredging of the new channel, construction of the sand dike, stockpiling of material, mechanical transfer of the stockpiled material to the existing channel, and eventual resumption of the routine channel maintenance by the USACE may temporarily affect dolphins that may be present around Bogue Inlet. This impact is expected to be minimal and temporary as dolphins can easily move to other quieter areas outside of the influences from project construction noise.

Cumulative Effects. No cumulative impacts to dolphins are expected to occur from Alternative E.

Compatibility with Project Objectives. Dolphins are not directly associated with the stated project needs or objectives.

Alternative F – Channel Relocation with Beach Nourishment

Direct and Indirect Impacts. Noise from construction activities associated with the dredging of the new channel and construction of the sand dike, and the eventual resumption of routine channel maintenance by the USACE may temporarily affect dolphins that may be present around Bogue Inlet. This impact is expected to be minimal and temporary as dolphins can easily move to other quieter areas outside of the influences from project construction noise.

Cumulative Effects. No cumulative impacts to dolphins are expected to occur from Alternative F.

Compatibility with Project Objectives. Dolphins are not directly associated with the stated project needs or objectives.

Intertidal Flats and Shoals

Alternatives A, B, and C would have the same impacts on intertidal flats and shoals as described below.

Direct and Indirect Impacts. The continued erosion of the Pointe area of Emerald Isle will convert upland areas to intertidal shoals and sand flats with the material eroded from the upland area being redistributed to the sound shoals and sand flats as well as to the outer portions of the Bogue Inlet ebb tide delta. Maintenance dredging of the inlet bar channel will continue to deposit material to the side of the channel while maintenance of the channel connecting Bogue Inlet with the AIWW will remove material from the inlet complex and deposit it on the extreme west end of Emerald Isle. The dredging activities may have some impact on the formation of new intertidal shoals and sand flats, particularly along the areas adjacent to the connecting channel.

Cumulative Effects. The shoal system of Bogue Inlet is a very dynamic system with areas being submerged one time during the year and well above mean high water at other times. Therefore, the continued erosion of western Emerald Isle and the maintenance dredging of the channel are not expected to create any cumulative impacts to the intertidal flats.

Compatibility with Project Objectives. Conservation of intertidal flats and shoals will be accomplished under the no action alternative.

Alternative E – Channel Relocation without Beach Nourishment

Direct and Indirect Impacts. Construction of the new channel will result in the direct loss of 47.6 acres of subtidal shoals while stockpiling of the dredged material for eventual transfer to the existing channel would involve 22.8 acres of storage

area on the Emerald Isle sand spit. Construction of the sand dike across the existing channel followed by the disposal of the stockpiled dredged material in the existing channel will partially restore approximately 154 acres of subtidal and intertidal habitat (22.2 acres due to the construction of the sand dike, and 131.8 acres of littoral material in the seaward portion of the existing channel). This initial restoration of loss subtidal and intertidal habitat will be further enhanced by the rapid development of the sand spit off the west end of Emerald Isle. The size of the new sand spit could eventually reach 127.5 acres. Over time, the subtidal and intertidal features will assume characteristics of the natural system.

Cumulative Effects. Cumulative effects to intertidal flats and shoals from the realignment of the inlet channel without beach nourishment are expected to be offsetting with the losses associated with the new channel partially replaced by the sand dike and eventually offset by the development of the sand spit off the west end of Emerald Isle.

Compatibility with Project Objectives. Intertidal flats and shoal resources will be restored through the construction of the sand dike and filling of the existing channel. This alternative would satisfy the project objective to restore the 700 feet of inlet shoreline presently protected by sandbags.

Alternative F – Channel Relocation with Beach Nourishment

Direct and Indirect Impacts. The construction of the new channel would remove 47.6 acres of subtidal shoals while the construction of the sand dike would partially restore 22.8 acres. The seaward portion of the existing channel will eventually fill with the influx of littoral sediment off the west end of Emerald Isle and the onshore movement of the abandoned ebb tide delta material, however, the time required for the existing channel to fill could range from 4 to 6 years. The gradual filling of the existing channel will convert approximately 127.5 areas of deepwater habitat to shallow water and intertidal habitat.

Cumulative Effects. Because the intertidal sand flat system is projected to reach equilibrium rapidly, cumulative effects should be minimal from the channel relocation with beach nourishment alternative.

Compatibility with Project Objectives. This alternative fully supports the project objectives as established by the Town of Emerald Isle.

5.5.2 **Beach Resources**

Supratidal Beach and Dune Communities

Alternatives A and B are expected to have the same impacts on supratidal beach

and dune communities as described below.

Direct and Indirect Impacts. Impacts to the supratidal beach and dune communities associated with the continuation of the eastern migration of the channel. The extensive damage may include the loss of beach and dune habitat along western Emerald Isle. Ocean shoreline erosion and the associated loss of supratidal beach and dune communities are also likely to continue on the eastern 7,500 feet of Bear Island.

Cumulative Effects. Dunes are important to the North Carolina coast by providing protection from large storm surges and hurricanes, in addition to providing habitat for flora and fauna. In some places along western Emerald Isle, dune ridges reach elevations of 4 to 5 m (13 to 16.4 ft) above NGVD. With the continuation of the eastern migration of the inlet channel over the next 10 years, beach and dune communities located 600 feet east of Bogue Inlet may be lost, resulting in less protection from hurricanes and less habitat for floral and faunal species. The potential for the reformation of beach and dune habitat along western Emerald Isle could not occur, as the area would be lost due to erosion and overwash. Losses would also continue on Bear Island as the east end of the island would become more exposed to wave attack with the eastward movement of the channel and ebb tide delta. Therefore, negative cumulative impacts to beach and dune communities on Bogue Banks and Bear Island could result from Alternatives A and B due to the extensive loss of a section of the essential dune ridge and the loss of the potential for formation of beach and dune communities in the area.

Compatibility with Project Objectives. The continuing loss of supratidal beach and dune communities associated with the eastward migration of the inlet shoreline would not preserve the tax base of the town and county as the loss of these communities would include the loss of homes, roads and associated infrastructure in the Pointe subdivision. The inlet habitat would continue to deteriorate and access to the inlet shoreline could not be restored to past conditions. Material to nourish Phase 3 of the permitted Emerald Isle beach nourishment project would be obtained from an offshore borrow area which is known to contain high concentrations of shell and shell hash. As a result, the ocean front supratidal beach and dune communities would differ in character from the native setting.

Alternative C – Without Project - Sand Bag Revetments

Direct and Indirect Impacts. The construction of sand bag revetments to protect threatened homes and roads over the course of 10 years would only tend to slow the advance of the inlet shoreline to the east. Once the existing 700-foot long revetment protecting seven homes is removed, the shoreline will quickly erode resulting in the loss of those seven homes and threatening others located immediately to the east. A new line of sand bags would be constructed to protect

the newly threatened homes, but again, this new line of sand bags can only remain in place for 2 years after which they must be removed. This scenario would continue resulting in the loss of dune and supratidal habitat over the 10-year impact period. The use of interim sand bags to protect threatened structures should limit the shoreline migration to 360 feet compared to 600 feet for Alternatives A and B. The impacts on the supratidal beach and dune communities on Bear Island would be similar to Alternatives A and B as the eastward migration of the inlet channel and ebb tide delta would expose the east end of the island to direct wave attack.

Cumulative Effects. Supratidal and dune habitat would be lost during the 10 year impact period; however, the magnitude of the loss would be somewhat less than Alternatives A and B. With the installation of the sand bag revetments, the eastward migration of the shoreline should be limited to around 360 feet compared to 600 feet projected for the no action alternative.

Compatibility with Project Objectives. The continuing loss of supratidal beach and dune communities associated with the eastward migration of the inlet shoreline would not preserve the tax base of the town and county as the loss of these communities would include the loss of homes, roads and associated infrastructure in the Pointe subdivision. The inlet habitat would continue to deteriorate and would be constantly disturbed by the construction and removal of the temporary sand bag revetments. The sand bag revetments would present hard barriers that would prevent successful nesting of sea turtles. Access to the inlet shoreline could not be restored to the extent desired by the Town as the shoreline would continue to migrate to the east albeit at a slower rate. Material to nourish Phase 3 of the permitted Emerald Isle beach nourishment project would be obtained from an offshore borrow area which is known to contain high concentrations of shell and shell hash. As a result, the ocean front supratidal beach and dune communities would differ if character from the native setting.

Alternative E – Channel Relocation without Beach Nourishment

Direct and Indirect Impacts. The relocation of the inlet channel to a more central position between Bogue Banks and Bear Island combined with the construction of the sand dike and infilling of the existing channel with stockpiled dredged material would significantly reduce the erosion of the inlet shoreline and initiate a fairly rapid recovery of the inlet supratidal beach and dune communities along the 700 feet of inlet shoreline presently protected by sandbags. The nearly complete filling of the existing channel would hasten the development of the sand spit off the west end of Emerald Isle which would contribute to the restoration of the inlet habitat. In this regard, the sand spit is expected to merge with the sand dike in about 2 years (see Appendix B). Material to nourish Phase 3 of the permitted Emerald Isle beach nourishment project would be obtained from an offshore borrow area which is

known to contain high concentrations of shell and shell hash. As a result, the ocean front supratidal beach and dune communities would differ if character from the native setting. Due to the financial constraints on the Town of Emerald Isle, construction of Phase 3 could be delayed for several years resulting in the continued loss of ocean front supratidal beach and dune communities during this interim period.

The shoreline erosion on the western 7,500 feet of Emerald Isle expected to accompany the relocation of the channel would result in the loss of existing supratidal beach and dune communities within this zone. Inclusion of 3,000 feet of the affected shoreline on the west end of Emerald Isle in the Phase 3 beach nourishment project and the continued disposal of connecting channel maintenance material on the extreme west end of Emerald Isle should partially offset these erosive impacts. Shoreline adjustments on Bear Island associated with the new channel location should result in the creation of additional supratidal beach and dune communities along the eastern 7,500 feet of that island.

Cumulative Effects. The inlet shoreline would gradually take on natural characteristics as the sand spit builds into the inlet and merges with the sand dike. The wide dry sand beach that would be created west of the existing inlet shoreline, which is expected to eventually reach approximately 100 acres, would provide ample quantities of wind blown sand to support the development of a dune system on the extreme western end of Emerald Isle. The gains in supratidal beach and dune communities would be partially offset by the loss of similar communities along the western 7,500 feet of Emerald Isle as the shoreline adjust to the new channel location. The adjustments on the west end of Emerald Isle could take 10 years. Inclusion of 3,000 feet of the affected shoreline on the west end of Emerald Isle in the Phase 3 beach nourishment project and the continued disposal of connecting channel maintenance material on the extreme west end of Emerald Isle should partially offset these erosive impacts. New supratidal beach and dune communities would also be created on the eastern 7,500 feet of Bear Island as that shoreline would build seaward in response to the new channel location.

Compatibility with Project Objectives. Alternative E would significantly reduce erosion of the inlet shoreline for at least 15 years and possibly 35 years depending on migratory behavior of the new channel. As a result, Alternative E would provide protection to the seven homes presently threatened by the inlet shoreline erosion and would prevent the additional loss of homes and infrastructure thus preserving the tax base of the town and county for the foreseeable future. The inlet shoreline habitat would eventually be restored to conditions existing in the mid 1970 to early 1980's which would allow the restoration of public access to the inlet shoreline to past conditions. Since the material removed to construct the new channel would be used to fill the existing channel, Alternative E would not provide high quality beach nourishment material for Phase 3 of the permitted Emerald Isle beach

nourishment project. Nourishment of Phase 3, which would be delayed for several years due to financial constraints on the Town of Emerald Isle, would be accomplished using offshore borrow areas. Material from the offshore borrow areas is known to contain high concentrations of shell and shell hash. As a result, the ocean front supratidal beach and dune communities within Phase 3 of the permitted Emerald Isle beach nourishment project would differ in character from the native setting.

Alternative F – Channel Relocation with Beach Nourishment

Direct and Indirect Impacts. The relocation of the inlet channel to a more central position between Bogue Banks and Bear Island combined with the construction of the sand dike would significantly reduce the erosion of the inlet shoreline and initiate a fairly rapid recovery of the inlet supratidal beach and dune communities. The recovery of the inlet shoreline will not be as rapid as under Alternative E since most of the material removed to construct the new channel would be used to nourish Phase 3 of the permitted Emerald Isle beach nourishment project. Therefore, filling of the existing channel would rely on the migration of the abandoned ebb tide delta and material eroded off the west end of Emerald Isle. The development of the sand spit off the west end of Emerald Isle should be rather substantial after four years and essentially complete after six years as the spit merges with the sand dike across the existing channel (see Appendix B). During this interim 4 to 6 year period, residual currents along the inlet shoreline could pose some erosion potential; therefore, the existing sand bag revetment should be allowed to remain for at least 2 years following the channel relocation. If the inlet shoreline recovers more rapidly, the sand bag revetment would be removed earlier.

The supratidal beach and dune communities located within Phase 3 of the permitted Emerald Isle beach nourishment project would be restored using the highly compatible inlet material (see Appendix B) which should lead to the rapid recovery of the biological communities that are located within the supratidal beach and dune systems.

The shoreline adjustments on the western 7,500 feet of Emerald Isle expected to accompany the relocation of the channel would result in the loss of existing supratidal beach and dune communities within this zone. Inclusion of 3,000 feet of the affected shoreline on the west end of Emerald Isle in the Phase 3 beach nourishment project and the continued disposal of connecting channel maintenance material on the extreme west end of Emerald Isle should partially offset these erosive impacts. Shoreline adjustments on Bear Island associated with the new channel location should result in the creation of additional supratidal beach and dune communities along the eastern 7,500 feet of that island.

Cumulative Effects. The inlet shoreline would gradually take on natural

characteristics as the sand spit builds into the inlet and merges with the sand dike. The wide dry sand beach that would be created west of the existing inlet shoreline would provide ample quantities of wind blown sand to support the development of a dune system on the extreme western end of Emerald Isle. The gains in supratidal beach and dune communities would be partially offset by the loss of similar communities along the western 7,500 feet of Emerald Isle as the shoreline adjust to the new channel location. The adjustments on the west end of Emerald Isle could take 10 years. Inclusion of 3,000 feet of the affected shoreline on the west end of Emerald Isle in the Phase 3 beach nourishment project and the continued disposal of connecting channel maintenance material on the extreme west end of Emerald Isle should partially offset these erosive impacts. New supratidal beach and dune communities would also be created on the eastern 7,500 feet of Bear Island as that shoreline would build seaward in response to the new channel location. The use of the inlet material to construct the beach fill along the 23,831 feet of beach included in Phase 3 of the permitted Emerald Isle beach nourishment project would result in the rapid recovery of the biological communities within the supratidal beach and dune system. As a result, full recovery of the biological communities should occur long before the initiation of the Federal storm damage reduction project.

Compatibility with Project Objectives. Alternative F would substantially reduce erosion of the inlet shoreline for at least 15 years and possibly 35 years depending on migratory behavior of the new channel. As a result, Alternative F would provide protection to the seven homes presently threatened by the inlet shoreline erosion and would prevent the additional loss of homes and infrastructure thus preserving the tax base of the town and county for the foreseeable future. The 700 feet of inlet shoreline presently protected by sandbags would eventually be restored to conditions existing in the mid 1970 to early 1980's which would allow the restoration of public access to the inlet shoreline to past conditions. Alternative F would also satisfy the objective of obtaining highly compatible material for nourishing Phase 3 of the permitted Emerald Isle beach nourishment project which should enhance the recreational opportunities along the ocean shoreline. This alternative fully supports the project objectives as established by the Town of Emerald Isle.

Intertidal Beach

Alternatives A and B would have the same impact on the intertidal beach as described below.

Direct and Indirect Impacts. Phase 3 of the permitted Emerald Isle beach nourishment project would be accomplished using material from offshore borrow areas. Nourishment of the beach will result in the burial of all intertidal infauna. The abundance and diversity of infauna will be low for a period of 3 to 12 months

which could negatively impact various shorebirds and waterbirds that feed on the infauna. Most of the material in the offshore borrow areas has a relatively high shell content and it is unlikely that selective dredging of the borrow areas could substantially reduce the shell content along the nourished beach. Once in place, the shell material tends to accumulated in the swash zone, i.e., the zone between mean low water and the crest of the beach berm. If concentrations are too high, beach use could be impacted due to the discomfort swimmers and other beach users encounter when walking across the shell deposits.

The intertidal beach along the inlet shoreline and at least 600 feet of ocean shoreline on the west end of Emerald Isle is predicted to be impacted by the eastward migration of the inlet channel and shoreline over the next 10 years.

Cumulative Effects. Phase 3 of the permitted Emerald Isle beach nourishment project would be accomplished using offshore borrow areas. The offshore sand sources have been found to contain higher concentrations of shell and shell hash compared to the native beach materials. The higher shell content may or may not impact the recovery rate of the infauna that populate the intertidal beach, however, the concentration of shell near the waterline could negatively impact beach use. The Phase 3 shoreline may eventually be included in a federal long-term storm damage reduction project which could be implemented sometime after 2008.

Compatibility with Project Objectives. Alternatives A and B would not provide highly compatible material for nourishing Phase 3 of the permitted Emerald Isle beach nourishment project. The habitat along the inlet shoreline would be continually disturbed as the channel migrates to the east.

Alternative C – Without Project - Sand Bag Revetments

Direct and Indirect Impacts. Phase 3 of the permitted Emerald Isle beach nourishment project would be accomplished using material from offshore borrow areas. Nourishment of the beach will result in the burial of all intertidal infauna. The abundance and diversity of infauna will be low for a period of 3 to 12 months which could negatively impact various shorebirds and waterbirds that feed on the infauna. Most of the material in the offshore borrow areas has a relatively high shell content and it is unlikely that selective dredging of the borrow areas could substantially reduce the shell content along the nourished beach. Once in place, the shell material tends to accumulated in the swash zone, i.e., the zone between mean low water and the crest of the beach berm. If concentrations are too high, beach use could be impacted due to the discomfort swimmers and other beach users encounter when walking across the shell deposits.

The intertidal beach along the inlet shoreline and at least 360 feet of ocean shoreline on the west end of Emerald Isle is predicted to be impacted by the

eastward migration of the inlet channel and shoreline over the next 10 years. Also, the installation of future sandbag revetments below the mean high water line will negatively impact the intertidal beach along the inlet shoreline.

Cumulative Effects. The cumulative impacts for Alternative C would be the similar to Alternatives A and B.

Compatibility with Project Objectives. Alternative C would not provide highly compatible material for nourishing Phase 3 of the permitted Emerald Isle beach nourishment project. The habitat along the inlet shoreline would be continually disturbed by the construction of sandbag revetments as the channel migrates to the east. The eastward migration of the inlet channel could also impact 360 feet of ocean shoreline over a 10-year period.

Alternative E – Channel Relocation without Beach Nourishment

Direct and Indirect Impacts. Phase 3 of the permitted Emerald Isle beach nourishment project would be accomplished using material from offshore borrow areas. Most of the material in the offshore borrow areas has a relatively high shell content and it is unlikely that selective dredging of the borrow areas could substantially reduce the shell content along the nourished beach. Once in place, the shell material tends to accumulated in the swash zone, i.e., the zone between mean low water and the crest of the beach berm. If concentrations are too high, beach use could be impacted due to the discomfort swimmers and other beach users encounter when walking across the shell deposits.

Cumulative Effects. Alternative E would have similar cumulative impacts on the intertidal beach along the ocean shoreline as Alternatives A, B, and C.

Compatibility with Project Objectives. Alternative E would not provide highly compatible material for nourishing Phase 3 of the permitted Emerald Isle beach nourishment project. The habitat along the inlet shoreline is predicted to be restored as a result of the direct filling of the existing channel and development of the sand spit off the west end of Emerald Isle

Alternative F – Channel Relocation with Beach Nourishment

Direct and Indirect Impacts. Material derived from the relocation of the inlet channel is highly compatible with the native beach sands found along the 23,831 feet of beach included in Phase 3 of the permitted Emerald Isle beach nourishment project. Even though the material is completely compatible, nourishment of the beach will result in the burial of all intertidal infauna. The abundance and diversity of infauna will be low for a period of 3 to 12 months which could negatively impact various shorebirds and waterbirds that feed on the infauna. Given the compatibility

of the inlet material with the native sands, substantial recovery of the infauna is expected within 6 months and complete recovery within 12 months. The intertidal beach communities along the 700 feet of inlet shoreline presently protected by the sandbag revetment should also be positively impacted with the elimination of the inlet shoreline erosion and the relatively rapid development of the sand spit off the west end of Emerald Isle.

Cumulative Effects. The intertidal zone is widely used by birds and finfish as foraging grounds. The use of the highly compatible inlet material to construct the Phase 3 beach fill should result in additional intertidal beach habitat and prey resources for foraging birds and finfish within 12 months following the completion of the beach nourishment. Since future beach nourishment in this area under a Federal storm damage reduction project would not occur for at least four and possibly 6 years, there should be no lingering effects of the Phase 3 nourishment project on the intertidal beach communities.

Compatibility with Project Objectives. The inlet channel material, having been derived from the adjacent beaches, in completely compatible with the native beach material found along the 23,831 feet of beach located within Phase 3 of the Emerald Isle each nourishment project (see Appendix B). Accordingly, Alternative E satisfies the project objective of obtaining compatible material for beach nourishment. This alternative fully supports the project objectives as established by the Town of Emerald Isle.

Nearshore Soft Bottom (Unconsolidated Sediment) Communities

Alternatives A, B, C, and E would have the same impacts on nearshore soft bottoms as described below.

Direct and Indirect Impacts. The unvegetated, oceanic nearshore soft bottom (unconsolidated sediment) communities located directly offshore of Emerald Isle may be directly and indirectly affected by the placement of fill material from offshore borrow sites along the 23,831 feet of ocean shoreline of Emerald Isle. Construction of the beach fill will result in the direct deposition of material from the toe of the dune seaward to approximately the 10-foot NGVD depth contour. Over time, the slope of the fill will adjust with material being transported seaward to approximately the 20-foot NGVD depth contour. Therefore, softbottom habitats located landward of the 20-foot NGVD depth contour will be directly or indirectly impacted by the construction of the beach fill. Offshore sediments may be higher in carbonate material (shells), which may inhibit the burrowing ability of soft bottom beach infauna. However, monitoring of Phase 1 of the Bogue Banks beach nourishment project, which was completed in 2001 with material from the offshore borrow areas and covered the shoreline from Pine Knoll Shores to Indian Beach, has shown almost complete recovery of the beach benthic communities.

Cumulative Effects. As a nourished beach area erodes over time, the fill material moves into adjacent aquatic habitats both near and offshore. Changes in the content of the sandy soft bottom habitat can affect the composition of the micro and macrofauna living within or on the sandy substrate. Changes to the benthic community in the soft bottom areas can have cumulative effects on the other organisms such as birds and fish that feed upon them. Therefore, changes in the nearshore soft bottom communities may have cumulative effects on the food chain.

Compatibility with Project Objectives. Alternatives A, B, C, and E would nourish the Phase 3 shoreline with material from an offshore borrow area which has proved to contain higher than natural concentrations of shell and shell hash. Therefore, these alternatives do not completely satisfy the objective of nourishing Phase 3 with highly compatible material.

Alternative F – Channel Relocation with Beach Nourishment

Direct and Indirect Impacts. Channel relocation with beach nourishment involves the use of fill material dredged from the new inlet to construct a sand dike across the existing channel and to nourish 23,831 feet of the Emerald Isle ocean shoreline. Construction of the beach fill will involve the direct disposal of material from the toe of the dune seaward to approximately the 10-foot NGVD depth contour. Over time, the slope of the fill will adjust with material being transported seaward to approximately the 20-foot NGVD depth contour. Therefore, softbottom habitats located landward of the 20-foot NGVD depth contour will be directly or indirectly impacted by the construction of the beach fill.

Cumulative Effects. Comparison of the fill material and the native beach on Emerald Isle indicate that the fill material is slightly coarser but otherwise compatible with the natural beach (see Appendix B). A study by Van Dolah et al. (1994) found that the use of fill sediments that closely matched the native sediments showed an ecological recovery of infaunal species within 8 months. Thus, the use of inlet sediment, which closely approximates the composition of the natural sediment on Emerald Isle, should prevent any negative cumulative impacts to the nearshore soft bottom communities due to differences in sediment composition. Construction of the new channel will alter the sediment transport patterns, and thus, may affect the areas of erosion and accretion. The eventual accretion along Bear Island is expected which would lead to a loss of existing nearshore soft bottom habitat, however, due to the relatively slow rate of accretion, new softbottom habitats should evolve as the shoreline builds seaward. The western 7,500 feet of Emerald Isle is expected to erode in response to the new channel location, however, this should not negatively impact the nearshore softbottom communities.

Compatibility with Project Objectives. The channel relocation with beach nourishment alternative is compatible with the project objectives.

Offshore Soft Bottom (Unconsolidated Sediment) Communities

Alternatives A, B, C, and E would have the same impacts on offshore soft bottom communities as described below.

Direct and Indirect Impacts. The placement of the beach fill along the 23,831 feet of shoreline included in Phase 3 of the permitted Emerald Isle beach nourishment project will probably only directly or indirectly impact softbottom resources located landward of the 20-foot NGVD depth contour. However, some of the material could eventually move farther seaward, particularly during severe storm events. The use of offshore borrow areas would directly impact softbottom communities within the borrow sites. In this regard, permits for the use of the offshore borrow areas limit the depth of the dredge cut to 4 feet. In order to obtain the 913,400 cubic yards needed to construct Phase 3, approximately 141.5 acres of ocean bottom lying off the west end of Emerald Isle would be directly disturbed by the dredging activity. Increased turbidity and sedimentation due to dredging may also indirectly affect other soft bottom communities in areas located near the borrow sites by burying organisms or affecting their ability to filter feed.

Cumulative Effects. A study conducted in 2001 by Rakocinski noted that the offshore soft bottom community, in Perdido Key, Florida, is less resilient to dredge and fill projects than those near shore. A decrease in density and species richness was noted during the study. Thus, it is possible that similar conclusions may result with the offshore dredging. In addition, changes to the soft bottom community may be realized by vertebrate consumers higher in the food chain.

Compatibility with Project Objectives. The material obtained from the offshore borrow areas may contain higher concentrations of shell and shell hash than the native beach material. The shell material would accumulate along the intertidal zone of the beach which could impact beach use. Therefore, Alternatives A, B, C, and E would not satisfy the project objectives to obtain high quality beach nourishment material for Phase 3.

Alternative F – Channel Relocation with Beach Nourishment

Direct and Indirect Impacts. Channel relocation with beach nourishment involves the use of dredged material from Bogue Inlet as beach fill which would avoid the direct disturbance of approximately 141.5 acres of offshore softbottom communities. The impacts associated with the direct placement and eventual offshore transport of material from the beach fill area would be similar to the other

alternatives.

Cumulative Effects. No cumulative effects to offshore soft bottom resources are expected to result from the implementation of the channel relocation with beach nourishment alternative.

Compatibility with Project Objectives. The channel relocation with beach nourishment alternative is compatible with the project objectives.

Benthic Infaunal Community

Alternatives A, B, C, and E would have similar impacts on the ocean beach benthic infaunal community as described below.

Direct and Indirect Impacts. Phase 3 of the permitted Emerald Isle beach nourishment project would be accomplished using material from offshore borrow areas. Most of the material in the offshore borrow areas has a relatively high shell content and it is unlikely that selective dredging of the borrow areas could substantially reduce the shell content along the nourished beach. Disposal of the material along the beach would directly cover the area from the toe of the exiting dune seaward to a depth of approximately 10 feet below NGVD. The thickness of the fill would range from a maximum of about 6 feet near the existing 0-foot NGVD contour and decrease to 0 at the -10-foot NGVD contour. Following the initial placement, the fill material will gradually adjust with some of the material migrating to approximately the 20-foot NGVD depth contour on the active beach profile. The initial disposal would have a direct negative impact on benthic communities located in the nearshore placement area; however, monitoring of Phase 1 of the Bogue Banks beach nourishment project, which was completed in 2001 with material from the offshore borrow areas and covered the shoreline from Pine Knoll Shores to Indian Beach, has shown almost complete recovery of the beach benthic communities. The offshore migration of the fill material following the initial placement should be slow enough to allow the benthic communities to adapt to the new material.

Cumulative Effects. The offshore migration of the beach fill material should occur within the first 6 months following placement resulting in no long-lasting impacts on the benthic communities. The benthic communities impacted by the Phase 3 fill should be fully recovered by the time the Federal storm damage reduction project is initiated except in the case of Alternative E which could involve the construction of Phase 3 in 2007-2008. Physical disturbances, such as, fishing with bottom-dwelling gear, deposition of organics onto the community (Thompson et al., 1999), changes in dissolved oxygen content, high water temperatures, decrease in food supply, and stagnant water conditions can alter benthic communities. Alternatives A, B, C, and E are not expected to alter any of the conditions affecting the beach

resource benthic community and thus, no cumulative impacts are anticipated.

Compatibility with Project Objectives. The material from the offshore borrow areas, which is known to contain higher concentrations of shell and shell hash compared to that of the native beach material, does not completely satisfy the objective to provide high quality beach nourishment material.

Alternative F – Channel Relocation with Beach Nourishment

Direct and Indirect Impacts. Both direct and indirect impacts to the beach benthic infaunal resources are expected from beach nourishment activities. The project will result in mortality of individuals located in the beach nourishment area. While the inlet material is highly compatible with the native beach material found along the 23,831 feet of shoreline included in Phase 3 of the permitted Emerald Isle beach nourishment project, the direct impacts on the benthic communities would be the same as Alternatives A, B, C, and E. Since the inlet material is essentially of the same quality as the native beach, the recovery time for the benthic communities could be slightly less than that associated with the offshore borrow material.

Cumulative Effects. The offshore migration of the beach fill material should occur within the first 6 months following placement resulting in no long-lasting impacts on the benthic communities. The benthic communities impacted by the Phase 3 fill should be fully recovered by the time the Federal storm damage reduction project is initiated.

Compatibility with Project Objectives. The use of the inlet material to construct Phase 3 would satisfy the project objective of using compatible beach material to nourish the 23,831 feet of shoreline. This alternative fully supports the project objectives as established by the Town of Emerald Isle.

Finfish (Beach Resources)

Alternatives A, B, and C would have the same impacts on ocean finfish as described below.

Direct and Indirect Impacts. The nourishment of Phase 3 of the permitted Emerald Isle beach nourishment project using the offshore borrow areas would result in temporary periods of increased turbidity in the immediate disposal area. Typically, the high turbidity diminishes within one to two tidal cycles once the dredge pipe moves to another disposal location. The increased turbidity in the immediate disposal zone could impact the ability of finfish to see prey. Also, the suspended sediment could be drawn into the fish gills causing some damage. More than likely, finfish will migrate out of the high turbidity zone so no significant impacts are expected.

Cumulative Effects. No cumulative impacts to finfish from Alternatives A, B, and C are anticipated.

Compatibility with Project Objectives. Alternatives A, B, and C do not satisfy the objective of acquiring high quality material for beach nourishment.

Alternative E – Channel Relocation without Beach Nourishment

Direct and Indirect Impacts. Construction activities should be contained centrally in the Inlet, and thus, finfish residing in areas close to shore just seaward of the inlet are expected to only be minimally impacted by the channel relocation, sand dike construction, and filling of the existing channel with stockpiled material. The turbidity and suspended sediment plume generated from the project is predicted to be contained between the confluence of the inlet bar channel and Eastern Channel and the seaward edged of the existing inlet bar channel (see Appendix B) and should not impact finfish in the nearshore intertidal areas near the inlet due to the low turbidity levels and low concentrations of suspended sediment.

Nourishment of Phase 3 of the permitted Emerald Isle beach nourishment project using offshore borrow material would have the same impacts as described for Alternatives A, B, and C.

Cumulative Effects. No cumulative impacts to finfish should result from Alternative E.

Compatibility with Project Objectives. The channel relocation without beach nourishment alternative does not satisfy the objective of acquiring high quality material for beach nourishment.

Alternative F – Channel Relocation with Beach Nourishment

Direct and Indirect Impacts. Construction activities should be contained centrally in the Inlet, and thus, finfish residing in areas close to shore just seaward of the inlet are expected to only be minimally impacted by the channel relocation and sand dike construction. The turbidity and suspended sediment plume generated from the project is predicted to be contained between the confluence of the inlet bar channel and Eastern Channel and the seaward edged of the existing inlet bar channel (see Appendix B) and should not impact finfish in the nearshore intertidal areas near the inlet due to the low turbidity levels and low concentrations of suspended sediment.

In the beach nourishment area turbidity levels should be low due to the low silt content of the inlet material. However, some increase in turbidity in the immediate disposal area is to be expected.

Cumulative Effects. Cumulative impacts to finfish from this alternative should not occur.

Compatibility with Project Objectives. The inlet material is highly compatible with the native beach sand located within Phase 3 of the permitted Emerald Isle beach nourishment project. This alternative fully supports the project objectives as established by the Town of Emerald Isle.

5.6 TURTLE RESOURCES

5.6.1 Diamondback Terrapin

Alternatives A, B, C, E, and F would have the same impacts on diamondback terrapin as described below.

Direct and Indirect Impacts. The Carolina diamondback terrapin (*Malaclemys terrapin centrata*) is commonly found within the inshore waters of North Carolina. During the winter months, Carolina diamondback terrapins hibernate in the muddy burrows along the embankments of tidal creeks. They remain buried until mid to late February when they emerge to mate (K. Hart, pers. comm.). Twenty-five to thirty-five diamondback terrapins have been documented in the project area during an unknown period of time (K. Hart, pers. Comm.). Therefore it is possible that direct and indirect impacts to diamondback terrapins could occur since the diamondback terrapins may be found in the inlet water column during starting in mid February which coincides with the time of project activities.

Cumulative Effects. No cumulative effects to terrapins should result from Alternatives A, B, C, E, and F.

Compatibility with Project Objectives. Diamondback terrapins have been documented in the project area in the past and thus may be present during the time of project activities or regular maintenance dredging. Monitoring of terrapin activity in the area during project dredging should prevent contact with any turtles found within close proximity to the dredge. Due to the possible contact with turtles in the project area alternatives A, B, C, E, and F are not completely consistent with the project objectives.

5.6.2 Sea Turtle Nesting Habitat

Alternatives A, B, and C would have the same impact on sea turtle nesting habitat along the ocean beach as described below.

Direct and Indirect Impacts. Erosion of the ocean beach on the west end of

Emerald Isle due to the eastward migration of the inlet channel is likely to continue resulting in the erosion of 600 feet of ocean shoreline in the case of Alternatives A and B and 360 feet of ocean shoreline for Alternative C. The loss of these relatively small areas as potential sea turtle nesting habitat would not have any significant impact on the sustainability of the species.

Nourishment of Phase 3 of the permitted Emerald Isle beach nourishment project would be accomplished using offshore borrow areas. Beach nourishment operations for Bogue Banks completed in 2001 and 2002 included the use of hopper dredges which resulted in the taking of several turtles even though the operations were carried out during times when turtles are not normally present. The risk of additional turtle takes would continue if hopper dredges are used in the offshore borrow areas.

The construction of a beach fill with material that has characteristics different from that of the native material can result in differences in compaction, water content, gas diffusion, and thermal properties which can negatively impact the embryonic development of hatchling sea turtles. While the material obtained from the offshore borrow areas contained higher concentrations of shell than the native beach, studies of the impact of the material on turtle nesting have not been completed, therefore, no definitive conclusion can be made regarding the effects of the material on turtles reproductive success.

A major concern with any beach nourishment project is the potential for scarp formation. In general, scarps form when the compaction of the fill material exceeds that of the native material or the elevation of the artificial berm is higher than that of the natural beach. With regard to the potential for scarp formation, the design template for Phase 3 includes a maximum berm elevation of 7.0 feet above NGVD which is the same as the natural beach along Bogue Banks. Monitoring of the physical performance of the previous fills along Bogue Banks, which also had a maximum berm elevation of 7.0 feet NGVD, has not detected a high propensity for scarp development. The same type of behavior would be expected for the Phase 3 fill.

The construction of the Phase 3 fill with offshore borrow material would provide a relative wide beach that would be suitable for turtle nesting. However, the condition of the beach within the Phase 3 nourishment area is not so degraded as to prevent turtle nesting; therefore, the additional beach width should only have a minimal impact on turtle nesting along Bogue Banks.

Cumulative Impacts. If the inlet channel continues to migrate to the east over the next 10 years, 600 feet of ocean shoreline would be lost to erosion under Alternatives A and B and approximately 360 feet under Alternative C. The loss of these relatively small areas is not expected to have a significant impact of the

sustainability of the species. Erosion is also expected to continue on the eastern 7,500 feet of Bear Island. If this erosion results in the formation of erosion scarps, turtle nesting could be negatively impacted in this localized area.

The offshore borrow material contains high concentrations of shell and shell hash, however, 22 turtle nests have been document on Emerald Isle during the 2003 nesting season with many of the nests located in the recently nourished section of Emerald Isle. Shell material may negatively impact beach use, however, studies of the impact of the material on turtle nesting have not been completed, therefore, no definitive conclusion can be made regarding the effects of the material on turtles.

Compatibility with Project Objectives. The offshore borrow material used for Phase 1 and 2 of the Bogue Banks beach nourishment project, which would also be used to construct Phase 3 under Alternatives A, B, and C, contained high concentrations of shell and shell hash that tends to accumulate on the foreshore of the beach between mean low water and mean high water. While the shell material may negatively impact beach use, studies of the impact of the material on turtle nesting have not been completed, therefore, no definitive conclusion can be made regarding the effects of the material on turtles.

Direct and Indirect Impacts. Alternative E is predicted to cause erosion along the western 7,500 feet of Emerald Isle and accretion along the eastern 7,500 feet of Bear Island. If the predicted erosion along the west end of Emerald Isle is accompanied by vertical erosion scarps, turtle nesting in this localized area could be impacted. However, given the low density of turtle nest along Bogue Banks, the erosion of this localized area is not expected to significantly impact turtle nesting success. The predicted accretion on Bear Island could have a positive impact on turtle nesting by eliminating vertical erosion scarps along the eastern 7,500 feet of this island.

Direct and indirect impacts of Alterative E, which would also involve the use of offshore borrow areas to construct the Phase 3 beach fill, would be the same as that described for Alternatives A, B, and C.

Cumulative Impacts. The cumulative impacts of Alternative E on sea turtle nesting habitat would be similar to Alternatives A, B, and C.

Compatibility with Project Objectives. The offshore borrow material used for Phase 1 and 2 of the Bogue Banks beach nourishment project, which would also be used to construct Phase 3, contained high concentrations of shell and shell hash that tends to accumulate on the foreshore of the beach between mean low water and mean high water. While the shell material may negatively impact beach use, studies of the impact of the material on turtle nesting have not been completed; therefore, no definitive conclusion can be made regarding the effects of the

material on turtles.

Alternative F – Channel Relocation with Beach Nourishment

Direct and Indirect Impacts. The material dredged from Bogue Inlet and deposited directly along the Phase 3 shoreline is slightly coarser but otherwise compatible with the native beach material. The inlet material has a low shell content (less than 5%) and a low silt content (1.25%). Following a period of adjustment that could last 6 months, the beach within Phase 3 should be indistinguishable from the native beach. Therefore, turtles should use this beach in much the same manner as they use other areas along Bogue Banks. The use of a cutter-suction pipeline dredge to construct the new channel combined with the winter to early spring construction period should greatly reduce the possibility of turtle takes.

Cumulative Impacts. The construction of the Phase 3 fill with the inlet channel material would provide a relative wide beach that would be suitable for turtle nesting. However, the condition of the beach within the Phase 3 nourishment area is not so degraded as to prevent turtle nesting; therefore, the additional beach width should only have a minimal impact on turtle nesting along Bogue Banks. Erosion of the western 7,500 feet of Emerald Isle could negatively impact sea turtle nesting, particularly if the erosion is accompanied by vertical scarps; however, this should be offset by the accretion of the eastern 7,500 feet of ocean shoreline on Bear Island. The erosive impacts on the west end of Emerald Isle associated with the channel relocation would be partially offset by the inclusion of the eastern 3,000 feet of the beach impact area in the Phase 3 beach nourishment project and the continued disposal of navigation maintenance material on the extreme west end of Emerald Isle.

Compatibility with Project Objectives. The inlet channel material that would be used to construct the Phase 3 fill would be compatible with the native material and should provide suitable nesting habitat for turtles.

5.6.3 **Offshore Sea Turtle Habitat**

Alternatives A, B, C, and E would have the same impact on offshore sea turtle habitat as described below.

Direct and Indirect Impacts. The use of offshore borrow areas would disturb approximately 141.5 acres of ocean bottom. While construction would occur during the winter and early spring, past operations during these same times have resulted in turtle takes which delayed the dredging operation or resulted in its cessation. The use of the offshore borrow areas to construct the Phase 3 would experience the same risks.