4. PLANNING OBJECTIVES

4.01 Goals

Identification and consideration of the problems, needs, and opportunities of the study area in the context of Federal authorities, policies, and guidelines resulted in the establishment of the following goals:

a. Reduce the adverse economic and environmental effects of hurricanes and other storms at Topsail Beach.

b. Find problem solutions that are protective of the environment through avoidance or minimization of impacts to natural resources, including beach invertebrates, shorebirds, marine fish, marine mammals, and their habitats, throughout the economic life of any proposed Federal action.

c. Protect endangered and threatened species and their habitats within the project area.

4.02 Constraints

The planning process is subject to the limitations imposed by the following constraints:

a. Geographic limits of the study authority but including the affected area of the environment.

b. Applicable Federal and State laws.

c. Current limits of knowledge, information, and predictive ability.

5. PLAN FORMULATION AND EVALUATION OF ALTERNATIVES

Following identification of existing conditions, problems, needs, opportunities, planning goals and planning constraints, this section describes the plan formulation process. A number of alternatives are usually identified early in the planning process, and their number is reduced by screening, evaluation, and comparison in an iterative sequence in increasing levels of detail to lead to identification of the selected plan.

This General Reevaluation Report (GRR) follows a previous feasibility study for Topsail Beach completed in December 1990. That feasibility study described a National Economic Development (NED) and a locally preferred plan. The locally preferred plan was the recommended plan, which was a beachfill consisting of a 25-foot top width dune at elevation 13 feet NGVD, fronted by a 35-foot wide storm berm at elevation 9 feet NGVD and a 40-foot wide beach berm at elevation 7 feet NGVD. The southern end of the main beachfill was located at the north end of reach 2 of the present GRR. The total project length was 19,200 feet, including 10,250 feet of the main fill, 7,150 feet of the northern transition fill, and 1,800 feet of the southern transition fill. The difference between the NED plan and the recommended plan involved the southern termination of the project and resulting differences in renourishment interval. The NED plan terminated with a 1,010-foot long terminal groin and had a 4-year renourishment interval. The recommended plan terminated with the transition fill and had a 2-year renourishment interval.

Several conditions have changed in the years between completion of the 1990 feasibility study and the initiation of the GRR in February 2001. The value and numbers of structures have increased significantly. Repeated storms in the 1990's eroded much of the beach and destroyed several structures. New Topsail Inlet moved southward approximately 2,000 feet as shown in Figure 5.1. Therefore in this GRR, the plan formulation process has been reinitiated rather than merely updating the costs, benefits, and impacts of the originally formulated plans. The goals and constraints of the plans remain effectively the same.

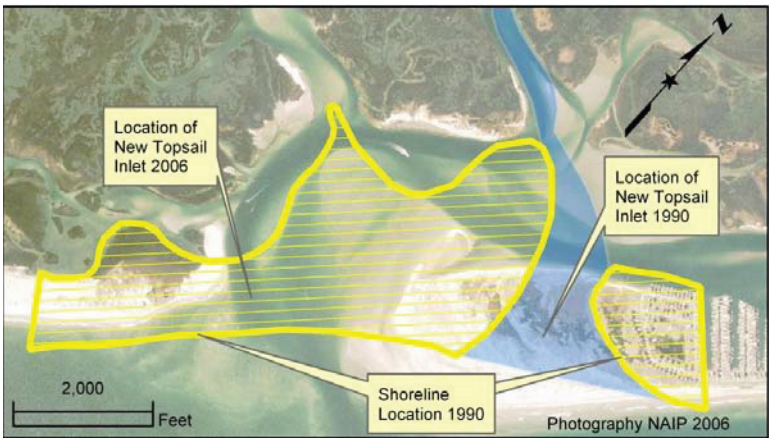

Figure 5.1 Changes in New Topsail Inlet

Plan formulation for this study consisted of the following: (1) establishment of criteria by which alternatives would be evaluated; (2) identification, analysis, and screening of measures; (3) identification of alternative plans; (4) screening of alternative plans; and (5) evaluation of alternative plans. The costs and benefits described in Section 5, Plan Formulation And Evaluation of Alternatives, and in Table 5.2 were developed during Fiscal Year 2005 and use October 2004 costs and prices and the Federal Water Resources FY 2005 interest rate of 5.375%. After comparative evaluations of the alternatives in Section 5 and identifications of the NED Plan and LPP in Section 6, detailed evaluations of the NED plan and the LPP are made in Section 7 at October 2008 costs and prices and the FY2009 interest rate of 4.625%.

5.01 Formulation and Evaluation Criteria

Alternative plans are evaluated through application of numerous, rigorous criteria. These include basic, general criteria as well as four categories of technical criteria, including (1) engineering, (2) economic, (3) environmental, and (4) institutional items. These are as follows:

General Criteria

- Plan must comply with applicable Federal laws and regulations;
- Plan must comply with applicable State and local laws and regulations, to the maximum extent practicable;
- Plan must comply with Corps of Engineers regulations.

Engineering Criteria

- Must represent sound, acceptable, and safe engineering solution;

Economic Criteria

- Plan must contribute benefits to National Economic Development;
- Tangible benefits of a plan must exceed economic costs;
- Each separable unit of improvement must provide benefits at least equal to costs;
- Recreation benefits may not be more than 50 percent of the total benefits required for economic justification;
- Plan implementation may not preclude development of more economical means of accomplishing the same purpose;

Environmental Criteria

- Plan will fully comply with all relevant environmental laws, regulations, policies, executive orders;
- Plan will represent an appropriate balance between economic benefits and environmental sustainability;
- Plan will be developed in a manner that is consistent with the Corps' Environmental Operating Principles (EOP);

- Adverse impacts to the environment will be avoided. In cases where adverse impacts cannot be avoided, mitigation shall be provided to minimize impacts to at least a level of insignificance.

Institutional Criteria

- Plan must satisfactorily address the identified needs and concerns of the public;
- Plan must be implementable with respect to financial and institutional capabilities;
- Plan must be implementable with regard to public support

5.02 Identification, Examination, and Screening of Measures

There are an extremely large variety of potential measures that might be considered in the formulation of plans. The measures generally are categorized as either structural or nonstructural. Structural measures are those that directly affect conditions that cause storm damage and erosion. The nonstructural measures are those taken to reduce damages without directly affecting those conditions. Finally there is the No-Action Plan where no nonstructural or structural measure is applied.

A wide variety of structural measures are possible. They are beachfills, breakwaters, seawalls, and groins. Beachfill measures consist of berms, dunes, and terminal sections. The beachfill measures are considered some of the most appropriate, since they mimic the natural environment and can be shaped to maximize net storm damage reduction benefits. Groins can be a terminal groin near an inlet, or can be installed as a repetitive groin field throughout the project length. A terminal groin at New Topsail Inlet was identified as a measure in the NED plan in the original report. This measure was retained for consideration. Groin fields can be used to prolong the life of a beach nourishment project. However, groin fields create the risk of potential adverse effects on adjacent shorelines due to trapping or shunting sand offshore. Groin fields have high initial costs, don't provide storm protection, have the potential to negatively impact turtles seeking beach nesting sites, and would require an extensive monitoring program with triggers that would initiate remediation. There are situations that warrant the acceptance of the risk that accompanies the use of a groin field. These situations include short beach fills, hot spots, areas adjacent to sediment sinks, and offset or convex shorelines. The study area does not include any of the situations which warrant the use of a groin field. Seawalls, bulkheads, and revetments are appropriate for reducing structural damage, however they would not meet the goal of preserving recreational and environmental value of the beach profile and were rejected as measures. Breakwaters can be used in erosional hotspots where it is difficult to maintain a beachfill, however, no such condition appropriate for breakwaters was found in the project area. Moreover, while offshore breakwaters may reduce erosion in their lee, these benefits may be offset by accelerated erosion of the downdrift shoreline due to interruption of the littoral drift. Vegetation and sand fencing help retain windblown sand, but do not provide adequate storm protection for moderate to severe storms.

Nonstructural measures considered are changes in regulations and physical modifications to reduce damages. Some regulatory measures are coastal building codes, building

construction setbacks, and floodplain regulations. Most regulatory measures are no longer considered for potential in the alternative plans because these measures have already been implemented, they do not affect older structures, and there are few remaining vacant lots, suitable for development, which would benefit. These measures are considered as part of the existing conditions. They have reduced damages from past events, and as older structures are replaced, will help to reduce future damages. Another category of nonstructural measures is reduction of the damage threat by removing beachfront structures from the threat. The three removal measures are retreat, relocation, and demolition. Retreat is moving an existing structure away from the shoreline a short distance within the same property parcel. Relocation is moving an existing structure away from the shoreline a longer distance to a vacant property. Acquisition of the property and demolition of the structure is a third measure where retreat or relocation is not feasible. These removal measures were retained for consideration in the nonstructural alternative. Additional non-structural measures considered for implementation include hurricane and storm education efforts, support for hurricane warning activities, updating of hurricane evacuation planning, building code upgrading, and long-term critical infrastructure and services upgrades.

The selected structural measures for detailed evaluation and consideration are beach fills and a terminal groin. The selected non-structural measures for detailed evaluation and consideration are retreat, relocation, and demolition. These measures can be applied independently and in combinations with each other to develop alternative plans.

5.03 Identification of Initial Alternative Plans

Beachfill plans were initially developed to extend the entire length of the town. The two basic types of beachfills are a berm only and a berm and dune together. For all plans the berm elevation is 7 feet-NGVD, the locally natural berm elevation for this coast. This is a reduction in berm elevation from the previously authorized plan's berm elevation of 7.6 feet-NGVD. The authorized plan's 9.6 feet-NGVD storm berm was eliminated because of concerns that the artificially high berm would result in persistent scarping along the beach face, which would reduce the project beach use for recreation and sea turtle nesting. The north end of the beachfill plans would be a tapered transition section. The two alternatives for the south end of the beachfill plans are a transition section and a terminal groin. The nonstructural plans consist of retreats, relocations, and demolitions applied to threatened structures on an individual case basis. Combinations of beachfill and nonstructural plans were also considered.

5.04 Screening of Alternative Plans

All but two of the initial alternative plans developed using the selected measures were considered to have sufficient potential for feasibility to be continued into economic evaluations of costs and benefits. One plan screened out was a combination beachfill and nonstructural plan. That combination plan would relocate any structures that were identified as being substantially closer to the beach than nearby structures and place the overall location of the beachfill more landward, reducing the beachfill volume. After a

close examination of the area no such structures were identified and the combination plan was dropped from further consideration. Another plan dropped during the screening process was the terminal groin and beachfill plan. This plan was dropped for two reasons. First, New Topsail Inlet has migrated southward far enough that a tapered beachfill transition could now be situated at the southern terminus of the project to reduce end losses, instead of a terminal groin. Second, the terminal groin had a higher initial cost, approximately $2,900,000, than the tapered beachfill transition initial cost, approximately $600,000, yet did not reduce renourishment costs nor provide any additional project benefits. Therefore, the terminal groin was dropped for both technical and economic feasibility reasons.

5.05 Evaluation of Alternative Plans

5.05.1 Beachfill Evaluations.

The remaining alternative plans would now be evaluated based on costs and benefits. Benefits of all the plans were evaluated using the GRANDUC program. The program estimates the present worth of average annual damages for the no-action plan, and the various alternative plans, including the nonstructural plan. GRANDUC estimates present worth costs for the alternative plans based on initial sand volumes and renourishment sand volumes needed to replenish sand lost due to long-term and storm erosion. GRANDUC applies unit costs for dredging these sand volumes and applies mobilization and demobilization costs for each job. Other costs included are engineering and design costs and contract supervision and administration. Other minor costs for tilling, vegetation, and walkover structures were omitted from the beachfill formulation process because the incremental differences between plans are negligible. These costs would later be included in the evaluation of the final plans.

A common assumption of all beachfill plans was regarding borrow material. While geotechnical, environmental and cultural resource surveys of the borrow sites were conducted, plans were being simultaneously evaluated. It was assumed that sufficient quantity of off-shore sand was available for the project within 5.5 miles and that a pipeline dredge would perform the initial construction with following renourishments performed by hopper dredges. Costs for all beachfill alternatives used the same mobilization costs and unit costs per cubic yard of dredging. A common loss factor between volume dredged and volume placed was used for all beachfill plans.

To evaluate alternative plan benefits, a comparison was made of without project damages with the with-project residual damages. This difference defines the damage reduction benefits. These benefits were determined for each reach and for each alternative. Recreation benefits were not included at this level of plan evaluation.

To assist in incremental analysis of the beachfill plans, costs and benefits of the beachfill plans were computed for each reach. The process of identifying potentially feasible reaches was called scoping. A mid-range dune and berm cross section was chosen as being representative for reach scoping. For this project, the cross section chosen had a

dune with a 25-foot top width at elevation 13 feet NGVD fronted by a 50-foot wide berm at elevation 7 feet NGVD.

The results of the scoping showed most reaches had relatively good net benefits, some had very high net benefits, and a few had negative net benefits. Reaches 1 and 2 do not have shorefront development and were dropped from additional study. Located together at the southern endpoint of the project, reach 3 had negative net benefits and was considered not to have further potential for feasibility. These were the only reaches excluded by the scoping analysis.

5.05.2 Nonstructural Evaluation.

Costs for moving structures are very specific and vary greatly depending on site conditions, travel route, and on structure size and construction. Several broad assumptions were necessary to make a manageable evaluation of this plan. Structures were categorized as one of three general relocation types, plus large commercial structures such as hotels. Because of the rapid rate of development in Topsail Beach, only one third of the existing vacant lots were assumed available for relocation. Costs for each relocation type of structure were estimated for each of the three measures – retreat, relocation, and demolition. The costs for each structure were subtotaled by project reach and for the entire project area. More detailed discussion of the nonstructural plan is contained in Appendix P, Nonstructural Alternatives

The GRANDUC program was also used to evaluate benefits of the nonstructural plan. The structure database was modified to delete all first row structures, whether actually planned for retreat or for removal. The without project condition damages were recomputed based on this revised database to estimate residual damages for the nonstructural plan. The difference in residual damages represented the present worth of average annual storm damage reduction benefits. Because the nonstructural plan does not prevent beach erosion, no recreation benefits were assigned. The nonstructural plan does not benefit highway NC50 where it is threatened by erosion at the north end of town.

The present value economics of the nonstructural plan are displayed in Table 5.1. The overall net benefits are less than zero with a benefit to cost ratio of 0.9, and is not economically feasible. Combination plans of nonstructural measures in some reaches with beachfill in other reaches were also considered, but no applicable reach was found in this project area. Because the nonstructural plan is not economically feasible, it was not further evaluated for technical feasibility or for acceptability.

Table 5.1. Nonstructural plan economics, present worth, October 2004 levels, 5.375% interest rate.

Benefits	Costs	Net Benefits
$108,000,000	$117,300,000	-$9,300,000

5.06 Optimization and Comparison of Alternative Plans

Evaluation of plans at this point has narrowed the alternatives to beachfills in reaches 4 through 26 with tapered transition sections at each end. The end of the south transition section is limited to the middle of reach 2 by an area identified by USFWS as foraging habitat for the piping plover, an endangered species. Cost estimates were now developed using the MCACES format based on construction quantities produced from the GRANDUC evaluations. Plans were designated in the format, Plan DDBB, where DD represents the dune elevation in feet NGVD datum, and BB represent the berm width from the seaward toe of dune to the top of the foreshore slope. For example, a plan with a 12 foot elevation dune and a 25 foot wide berm is named Plan 1225.

5.06.1 Cross sections.

Higher storm dunes and wider berms result in both higher benefits and higher costs. Initially, dune elevations of 11, 13, and 15 feet were evaluated for berm widths of 25, 50, and 75 feet, and the 50-foot wide berm was found to consistently yield the greatest net benefits. Next various dune elevations were evaluated with the preferred 50-foot berm width. Dune elevations between 11 and 17 feet were all found to be economically feasible. There was little difference in net benefits for dune elevations between 13 and 16 feet with Plan 1550 having the maximum net benefits.

5.06.2 Modifications.

Before identifying Plan 1550 as the NED plan a modification to the southern transition was considered. During the prior scoping analysis reach 3 did not appear to have sufficient expected annual damages to support a project. However, the distribution of damages within that reach is unbalanced. Of the $120,981 in Total Average Annual Damages for reach 3 shown in Table 3.2, $33,014 is in the southern 600 feet and $87,967 is in the northern 400 feet. A plan to extend the 1550 dune and berm to include the more developed shoreline in the northern 400 feet of reach 3 was developed and named 1550X. The south transition of Plan 1550X was shortened to 1,000 feet to end at the piping plover foraging habitat in reach 2, the same endpoint as with Plan 1550. This modification was also applied to the other plans to create Plans 1150X, 1250X, 1350X, 1450X, and 1650X.

5.06.3 Borrow Site Comparisons.

The preliminary identification of borrow areas for the project included New Topsail Inlet, the connecting channel between the AIWW and New Topsail Inlet, Banks Channel behind Topsail Island, and ocean waters off Topsail Beach in water depths greater than 30 feet below NGVD. The results of a geophysical investigation conducted by Ocean Surveys, Inc. (OSI) were used to define the boundaries of the offshore borrow areas.

As identified in Section 2 (b) of the Coastal Barrier Resources Act CBRA, Public Law 97-348 (96 Stat. 1653; 16 U.S.C. 3501 et seq.), the purpose of CBRA is to "minimize the loss of human life, wasteful expenditure of Federal revenues, and the damage to fish, wildlife, and other natural resources associated with the coastal barriers along the Atlantic and Gulf coasts by restricting future Federal expenditures and financial assistance which have the effect of encouraging development of coastal barriers, by establishing a Coastal Barrier Resources System, and by considering the means and measures by which the long-term conservation of these fish, wildlife, and other natural resources may be achieved." The CBRA designated various undeveloped coastal barrier islands, depicted by specific maps, for inclusion in the Coastal Barrier Resources System (CBRS). Areas so designated were made ineligible for direct or indirect Federal financial assistance that might support development, including flood insurance, except for emergency life-saving activities. These areas included in the System are to be reviewed by the Secretary of the Interior "at least once every five years in order to make minor and technical modifications to the boundaries of system units as are necessary solely to reflect changes that have occurred in the size or location of any system units as a result of natural forces." The last such boundary modification occurred in 1990, and at the time extended the northern boundary of the Lea Island CBRS (aka Lea Island CBRA Zone L07) to the middle of New Topsail Inlet. Subsequent realignment of that inlet through natural causes now places the entire inlet, and portions of the south end of Topsail Island and Banks channel, completely within the Lea Island CBRS (Appendix A, Figure A-1). New reviews of the CBRS boundaries are currently underway, but whether or how those boundaries may be adjusted was unknown during preparation of this report.

In general, no Federal funding may be used for physical or planning activities carried out within a CBRS area. However, exceptions for certain activities identified in Section 6 of the CBRA allow Federal expenditures or financial assistance within the CBRS. Specifically, "the maintenance of existing channel improvements and related structures, such as jetties, and including the disposal of dredge materials related to such improvements…scientific research, including but not limited to aeronautical, atmospheric, space, geologic, marine, fish and wildlife and other research, development, and applications…[and] nonstructural projects for shoreline stabilization that are designed to mimic, enhance, or restore natural stabilization systems" are exempt from CBRA restrictions. As such, Corps geological studies of the area are authorized, as is maintenance dredging of the existing navigational channel within New Topsail Inlet. The Department of the Interior, however, reads CBRA to prohibit the transfer of sand from within a CBRS to a location outside the CBRS. While Wilmington District does not necessarily agree with this interpretation, it does acknowledge that in combination with other environmental factors, which include the constituent elements of piping plover habitat and other estuarine resources, the CBRA issue makes it impractical to pursue borrow sites within CRBA zones as viable alternatives at this time.

A sediment compatibility analysis was performed for all potential borrow areas for this project. The analysis compared the grain size of the "native beach" or the "reference beach" with the material in the potential borrow area. The overfill ratio is the primary indicator of the compatibility of the borrow material to the beach material, with a value of 1.00 indicating that one cubic yard of borrow material is needed to match one cubic yard of beach material. The procedure for calculating the overfill ratio for borrow areas in relation to the reference beach was performed in accordance with the U.S. Army Corps of Engineers Coastal and Hydraulics Laboratory Automated Coastal Engineering System (ACES) software version 4.01. This procedure is discussed in section V-4-1.e.(2)i. of the U.S. Army Corps of Engineers Engineer Manual (EM) 1110-2-1100, part V, titled Coastal Engineering Manual. As stated in this manual, an overfill ratio of 1.00 to 1.05 is considered optimum for sediment compatibility. However, obtaining this level of compatibility is not always possible due to limitations in available borrow sites. A compatibility analysis was conducted for the New Topsail Inlet and the connecting channel between the AIWW and New Topsail Inlet. The analysis indicated New Topsail Inlet material was compatible with native material at Topsail Beach with an overfill ratio of 1.02. The overfill ratio for the connecting channel material was 4.55 indicating the material would not be compatible with native material due to presence of finer material in the channel which would produce losses at a high rate. Regardless, the New Topsail Inlet and the connecting channel between the AIWW and New Topsail Inlet were eliminated as borrow areas because they are currently located within the Lea Island complex (L07) of the CBRS, and contain constituent elements of piping plover habitat and other estuarine resources to the extent that other alternatives are environmentally preferable.

As discussed in section 1.01, a Federal shore protection project was authorized for Topsail Beach in 1992. The proposed borrow area for this 1992 project is shown in Appendix A, Figure A-6 and included a portion of Banks Channel. Banks Channel was also considered as a potential borrow area for this current Federal project. Banks

Channel is a Federal authorized connecting channel of 7 feet deep (+2 feet) and 80 feet wide extending from the CBRA zone at the New Topsail Inlet to the AIWW for an approximate length of 6.27 miles. The USACE, Wilmington District, collected 32 vibracore borings in Banks Channel from June to August 2003. A total of 82 samples were tested for grain size analysis and a compatibility analysis was conducted to compare the grain size of the native Topsail Beach to the material in Banks Channel. The analysis determined an overfill ratio of 1.08 which indicates the material in Banks Channel is compatible with the native material at Topsail Beach. Hydrographic surveys of Banks Channel were conducted by USACE, Wilmington District from July 2001 to February 2003. A conservative estimate of the volume of sediment available in the Federally authorized navigation boundaries of Banks Channel is approximately 94,000 cubic yards.

The use of Banks Channel to supplement a renourishment cycle would require the mobilization of a second dredge for a negligible amount of material. In addition, expansion of the borrow area in Banks Channel beyond the authorized navigation channel boundaries to the 1992 borrow area boundaries, would require extensive coordination with the environmental agencies. Also, this would potentially increase mitigation requirements, due to the fact that this area contains the constituent elements of piping plover habitat as well as other estuarine resources. Therefore, Banks Channel is eliminated as a borrow area for this project.

Six offshore borrow areas were identified for the further evaluation as potential borrow sources for Topsail Beach. These borrow areas are discussed in more detail in section 7.04.

5.06.4 Economic Comparisons.

Table 5.2 presents the economic comparisons of the plans as described in section 5.06. All values are shown as average annual equivalent value discounted at the FY2005 federal water resources interest rate of 5 3/8 % over a 50-year project life. The GRANDUC model estimates damages in three categories and selects the greatest of the three for both the with and without project conditions, preventing the double counting of benefits in the analysis. Regarding the increase in flood damages indicated in Table 5.2, as storm erosion and long-term land losses are reduced, flood damages begin to dominate. Also, structures that might have otherwise been taken out by storm and wave damage without a project are now subject to additional flood damages. Recreation benefits will be included as incidental benefits in the total benefit accounting, but they are not included in Table 5.2 in the formulation of the project with respect to size and scope.

Table 5.2 Economic Comparisons, Average Annual Values in Thousands. October 2004 levels. 5.375% interest rate.

Plan	Benefits						Costs	Net Benefits
	Storm Erosion	Flood	Wave	Land & Long Term Erosion	Reduced Emergency Costs	Total		
1150	$5,432	$(53)	$68	$850	$87	$6,383	$2,927	$3,456
1150X	$5,437	$(54)	$68	$850	$87	$6,387	$2,943	$3,444
1250	$5,633	$(55)	$69	$850	$87	$6,584	$3,013	$3,571
1250X	$5,638	$(55)	$69	$850	$87	$6,588	$3,027	$3,561
1350	$5,772	$(62)	$128	$850	$87	$6,775	$3,185	$3,590
1350X	$5,781	$(63)	$128	$850	$87	$6,783	$3,204	$3,579
1450	$5,984	$(69)	$150	$850	$87	$7,002	$3,321	$3,681
1450X	$5,995	$(70)	$150	$850	$87	$7,012	$3,337	$3,675
1550	$6,136	$(74)	$168	$850	$87	$7,168	$3,440	$3,728
1550X	$6,149	$(76)	$168	$850	$87	$7,179	$3,463	$3,716
1650	$6,250	$(75)	$189	$850	$87	$7,301	$3,574	$3,727
1650X	$6,263	$(77)	$189	$850	$87	$7,312	$3,596	$3,716
1750	$6,322	$(77)	$204	$849	$87	$7,385	$3,705	$3,680

5.06.5 Environmental Comparisons of Plans.

In addition to the economic comparison, the impacts of the major categories of plans on the resources described in Section 2.00, Affected Environment, are considered. Since all beachfill plans have the same length, borrow sources, and construction methods, the various beachfill plan cross sections have very minor differences in potential environmental effects. Table 5.3 presents the comparative impacts on these resources. The “No Action” alternative is defined as no action by the Federal government on this particular proposed shore protection project.

Table 5.3 Comparative Impacts of the Proposed Plan to the Nonstructural and No Action Alternative, Part 1 of 5.

Alternative→ Resource ↓	Beachfill Alternatives	Nonstructural Alternative	No Action
Socioeconomic Resources	1. Improved recreational quality on expanded beach 2. Greater protection of oceanfront land, roads/utilities, structures, and personal property 3. Economically Justified	1. More remote undisturbed beach 2. Eliminates need for future protection of structures, land loss continues 3. Displaces beachfront homeowners and businesses. Reduced tax base. Expected cost exceeds benefits.	1. Continued deterioration of the existing beach 2. Continued threat to oceanfront land, roads/utilities, structures, and personal property 3. NED benefits foregone
Recreational and Aesthetic Resources	1. Improved appearance of beach will enhance recreational experience. Wider berm would increase recreation area. 2. Temporary inconvenience to beach users during initial construction and future maintenance.	1. More natural appearance along the beach. Recreation capacity would decrease as the beach erodes. 2. Temporary inconvenience to beach users during demolition or removal of structures.	1. Continued deterioration of beach appearance and berm width 2. Status quo maintained

Table 5.3 (continued) Comparative Impacts of the Proposed Plan to the Nonstructural and No Action Alternative, Part 2 of 5.

Alternative→ Resource ↓	Beachfill Alternatives	Nonstructural Alternative	No Action
Marine Resources	1. Benthic organisms in borrow areas will be removed, but will be recolonized by opportunistic species 2. Temporary impacts on intertidal microfauna in the immediate vicinity of the beach nourishment 3. Reduces needs for bulldozing, beach scraping, and sand bags 4. Short term, recurring impacts to fishing areas 5. Temporary impacts to adult, larval, and juvenile fish due to turbidity and reduced benthic food in dredging and renourishment areas.	1. Status quo maintained 2. Status quo maintained 3. Eliminates needs for bulldozing, beach scraping, and sand bags. Eliminates re-occurring loss of invertebrates along beach. 4. Temporary inconvenience to beach fishermen during demolition or removal of structures. Status quo maintained in near shore waters. 5. Status quo maintained.	1. to 5. Status quo maintained
Natural Communities	1. The dune and berm would be re-established and the dune vegetated, resulting in an extended shoreline 2. Bottom substrate and bathymetry within 4,210 acres of nearshore ocean would be modified.	1. The beach would continue to erode, existing overwash areas would expand and new overwash areas would form. 2. Status quo maintained	1. The beach would continue to erode, existing overwash areas would expand and new overwash areas would form. 2. Status quo maintained

Table 5.3 (continued) Comparative Impacts of the Proposed Plan to the Nonstructural and No Action Alternative, Part 3 of 5.

Alternative→ Resource ↓	Beachfill Alternatives	Nonstructural Alternative	No Action
Threatened and Endangered Species	1. Placement of fill will increase nesting habitat for sea turtles. 2. Placement of fill may increase beach hardness and alter other physical characteristics of the beach that may affect the nesting environment of sea turtles. 3. May adversely affect loggerhead, green, and Kemp's Ridley sea turtle species through lethal entrainment within hopper dredge dragheads. 4. May affect piping plover foraging, sheltering, and roosting areas. 5. Placement of fill would increase seabeach amaranth habitat. 6. Minimal threat of collision with whales during dredging operations.	1. Conditions for loggerhead and green sea turtle nesting would be improved by reduced disturbance and artificial lighting 2. Status quo maintained 3. Status quo maintained 4. Conditions for piping plover may be improved by reduced disturbance and new overwash areas. 5. Conditions for seabeach amaranth may be improved by reduced disturbance 6. Status quo maintained	1. Continued erosion of the beach would result in losses of sea turtle nesting habitat and possible poor site selection by females. 2. Status quo maintained 3. Status quo maintained 4. Status quo maintained 5. Continued erosion of beaches would result in loss of seabeach amaranth habitat 6. Status quo maintained
Water Quality	1. Temporary elevated turbidities over existing conditions during initial construction and nourishment in nearshore areas and offshore borrow areas.	1. Status quo maintained	1. Status quo maintained

Table 5.3 (continued) Comparative Impacts of the Proposed Plan to the Nonstructural and No Action Alternative Part 4 of 5.

Alternative→ Resource ↓	Beachfill Alternatives	Nonstructural Alternative	No Action
Cultural Resources	1. No effects	1. Potential resource impacted by natural processes or storms. Relocation could affect any historic structures.	1. Potential resource impacted by natural processes or storms.
Contaminated Sediments	1. Remote possibility exists that OEW (anti-aircraft ammunition) could be present in the material to be dredged from offshore borrow areas and placed on the beach. The only ordnance that would be expected to be encountered would be spent shells from anti-aircraft target practice. In 1994, inspectors surveyed the beach area to the water's edge and did not find evidence of ordnance. Offshore areas were not surveyed. 2. Remote possibility that dredging in offshore borrow areas could encounter a missile (no OEW) and place it on beach. The missiles that were tested during Operation Bumblebee contained no OEW and were fired approximately 40 miles offshore, well beyond the project area, so the likelihood of encountering them in an offshore borrow area is remote.	1. Status quo maintained 2. Status quo maintained	1. Status quo maintained 2. Status quo maintained

Table 5.3 (continued) Comparative Impacts of the Proposed Plan to the Nonstructural and No Action Alternative, Part 5 of 5.

Alternative→ Resource ↓	Beachfill Alternatives	Nonstructural Alternative	No Action
Other significant resources	1. Temporary noise increases during construction and maintenance events 2. Minor, short-term increases in boat/floating plant traffic 3. Beneficial effects of the storm protection project on community cohesion, public facilities (including roads and utilities) and services.	1. Temporary noise increases during demolition or removal of structures 2. Status quo maintained 3. Initially detrimental to community cohesion, public facilities (near beach) and some services.	1. and 2. Status quo maintained 3. Continued erosion of beaches would be detrimental to community cohesion and public facilities.