EDISTO BEACH
COASTAL STORM DAMAGE REDUCTION
GENERAL INVESTIGATION STUDY

APPENDIX B
ECONOMICS

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1. INTRODUCTION

FEDERAL INTEREST

Congress has authorized Federal participation in coastal storm damage reduction (CSDR) projects to prevent or reduce damages caused by wind and tidal generated waves and currents along the Nation's ocean coasts and Great Lake Shores.

STUDY AREA

The Town of Edisto Beach and Edisto Beach State Park are part of Edisto Island located in South Carolina. They are bounded by the South Edisto River and St. Helena Sound to the southwest and the Atlantic Ocean to the southeast. The Town of Edisto Beach occupies the central and southern portions of the island and is generally separated from Edisto Beach State Park by State Highway 174, which provides the only access to the island. Its beachfront extends approximately 4.5 miles between Highway 174 and the South Edisto River/St. Helena Sound. The town has been developed as a permanent and seasonal residential area with limited commercial development. Edisto Beach State Park occupies approximately 1,255 acres of the island and is structured around a dense live oak and maritime forest. It offers ocean and marsh side camping sites, as well as cabins, picnic areas, and nature and hiking trails. Its beachfront extends approximately 1.5 miles between Jeremy Inlet and Highway 174.

ASSUMPTIONS & CONSTRAINTS

The economic analysis is based on the following assumptions and constraints.

Assumptions:

- Structure values are based on depreciated replacement costs.
- Land use zoning and construction codes will not change during the period of analysis.
- Damaged or destroyed properties will be repaired to pre-storm conditions.
- Lost land will be valued at near shore prices.
- Empirical storm frequencies are based on historical records for the study area and are assumed to be predictive of the probability of future events.
- Existing state and county owned public park limits would remain the same in the future.

Constraints:

- For a project to be economically justified, the benefit to cost ratio needs to be greater than 1 to 1.
- The analysis recognizes the Threatened and Endangered Species Act and the Coastal Barrier Resources Act.
- Adequate Parking and Access

2. SOCIO-ECONOMIC OVERVIEW

DEMOGRAPHICS:

Edisto Island is a barrier island located at the mouth of the Edisto River in Colleton and Charleston Counties, South Carolina. It is approximately 45 miles southwest of Charleston, South Carolina and approximately 20 miles east-northeast of Beaufort, South Carolina. The incorporated Town of Edisto Beach is located on the island, as is Edisto Beach State Park and incorporates 2.3 square miles. Tourism is the largest industry on Edisto Island. Figure 1 is a map of South Carolina showing Colleton County in the southeastern region of the state which is where Edisto Beach can be found. This area of Colleton County is bordered by Beaufort County and Charleston County.

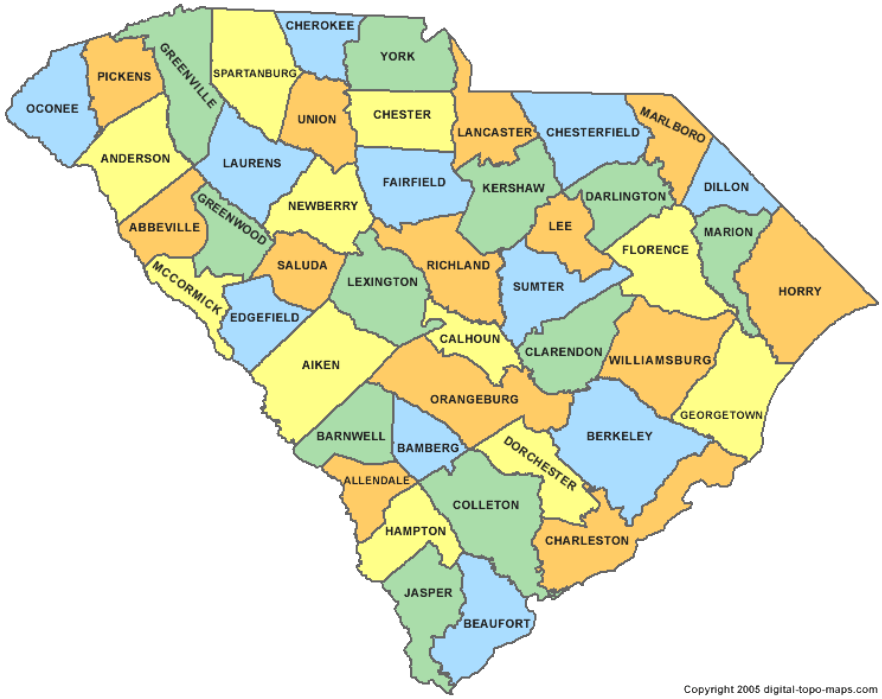


Figure 1
South Carolina Counties

POPULATION: As of the 2010 census data, there were 414 people in the Town of Edisto Beach which is a decrease of 35.4% since the 2000 census of 641 people. There were 2,181 housing units, with 10.6% being occupied and 89.4% being vacant housing units mainly for rent or seasonal use. There were 232 households out of which 3.4% had children under the age of 18 living with them, 62.9% were married couples living together, 1.7% had a female householder with no husband present, and 35.3% were non-families. The average household size was 1.78, and the average family size was 2.13. The population was spread out with approximately 4% under the age of 19, 1% from 19 to 24, 9% from 25 to 44, 41% from 45 to 64, and 45% who were 65 years of age or older. The median age was 64.6 years.

According to the Town of Edisto Beach representative, the 2010 population count of 414 has been challenged because the Town of Edisto Beach did not have a mail out census, just a door to door count during a season when many people are out of town. According to the sponsor, the voter registration is 704 people, a 10 percent increase from the 2000 census.

Table 1 shows the population characteristics for Colleton County and the surrounding southern counties. As a seasonal resort community, population in the Town of Edisto Beach fluctuates significantly during the year.

Table 1: Population Characteristics

	Population			Percent Change		
	1990	2000	2010	1990-2000	2000-2010	1990-2010
South Carolina	3,486,703	4,012,012	4,625,364	33%	15.3%	90%
Colleton County	34,377	38,264	38,892	46%	1.6%	171%
Charleston County	295,039	309,969	350,209	31%	13%	62%
Beaufort County	86,425	120,937	162,233	30%	34.1%	159%
Town of Edisto Beach	340	641	414	89%	-35%	22%

http://quickfacts.census.gov

EMPLOYMENT AND INCOME: In 2010, Edisto Beach had 261 people in the labor force. The occupations in Edisto Beach are as follows: management, business, science and arts (154 people), service occupation (22 people), sales and office (38 people), natural resources, construction and maintenance (12 people), and production, transportation and material moving (20 people). The unemployment rate was 5.7 percent.

In 2010, the per capita income was $51,628. The median income for a household in the town was $64,125, and the median income for a family was $96,250. About 2.9% of families were below the poverty line. Table 2 display the per capita income for Colleton County and the surrounding southern counties and Edisto Beach.

Table 2: Per Capita Income

Counties	Per Capita Income			Percent Change	Percent Change	Percent Persons
	1989	2000	2010	1989-00	2000-2010	Below Poverty Level - 2010
South Carolina	$11,897	$18,795	$23,443	58.0%	24.7%	16.4%
Colleton County	$9,193	$14,831	$17,842	61.3%	20.3%	21.3
Charleston County	$13,068	$21,393	$29,401	63.7%	37.4%	16.5%
Beaufort County	$15,213	$ 25,377	$ 32,731	66.8%	29.0%	10.5%
Edisto Beach	NA	$ 39,400	$51,628	NA	31.0%	2.9%

EDUCATION: According to the 2010 census, the education attainment in Edisto Beach for high school graduates is 20.8 percent. The population that attained an associate's degree is 6.5

percent, and the population percentage that received a bachelor's degree is 35.7, and 19 percent of the population has a graduate or professional degree.

HOUSEHOLDS: A household includes the related family members and all the unrelated people who share the housing unit. A person living alone in a housing unit, or a group of unrelated people sharing a housing unit such as partners or roomers, is also counted as a household. There were a total of 232 households in Edisto Beach in 2010, with an average household size of 1.78 people. Table 3 shows the number of households and the median household income for Colleton and surrounding counties.

Table 3: Select Household Characteristics

Counties	Households			Median Household Income
	1990	2000	2010	2010
South Carolina	1,258,044	1,533,854	2,137,683	$43,939
Colleton County	12,040	14,470	19,901	$33,263
Charleston County	107,069	123,326	137,844	$48,433
Beaufort County	30,712	45,532	93,023	$ 55,286
Edisto Beach	Not Available	329	232	$64,125

TRANSPORTATION & UTILITIES: The Town of Edisto is accessible from Edisto Island and the mainland via SC 174. The William McKinley Jr. Bridge connects Edisto Island to the mainland. Major local roads on the island include Palmetto Boulevard (SC 174), Lybrand Street, Jungle Road, Dock Site Road and Myrtle Street.

There is one company that supplies water to the Town of Edisto Beach from a well source. There is also one sewer plant for the Town of Edisto Beach.

According to the Town of Edisto Beach Local Comprehensive Beach Management Plan, the Town of Edisto is designated by the State Hurricane Plan as a Category 1 evacuation area. The evacuation route for residents and tourists from Edisto Beach is along SC 174 to US 17 South to SC 64 to Walterboro.

3. STUDY METHODOLOGY

EVALUATION FRAMEWORK

Coastal storm damage reduction projects are formulated to provide hurricane and storm damage reduction, with incidental recreation benefits. USACE participation in coastal storm damage reduction projects must produce economic justification from storm damage reduction benefits or

a combination of storm damage reduction benefits and recreation benefits not to exceed 50 percent of the total benefits required for justification.

The specific methodologies that will be used for the study are based on the general principles and guidelines (P&G) documented in Engineering Regulation 1105-2-100, 22 April 2000, Planning-Planning Guidance Notebook, Section I – Hurricane and Storm Damage Reduction, and Appendix D – Economic and Social Considerations.

INCORPORATING RISK AND UNCERTAINTY

The P&G recommends a life-cycle approach and risk and uncertainty analysis. The benefits and costs of storm damage reduction measures are highly uncertain. Predicted costs and benefits are dependent upon a variety of engineering and economic assumptions and models. Future damages are dependent on the sequence of storms, their characteristics, property inventory, erosion, wind and wave effects and a multitude of other factors.

In order to provide analytical support for projects involving storm damage reduction, a unified risk-based engineering-economic model called Beach-*fx* is being applied to the Edisto Beach, SC coastal storm damage reduction project for estimation of expected annual benefits. Beach-*fx* incorporates triangular distributions in capturing uncertainty in value of structures and contents, first floor elevations and number of times a structure is rebuilt.

BEACH-FX HURRICANE AND STORM DAMAGE SIMULATION MODEL

The Beach-*fx* model is a USACE Certified engineering-economic event based, Monte Carlo simulation model that relates beach profile change to storms, coastal processes and nourishment programs. Beach-*fx* represents an improvement on previous models in this arena by being strongly based on representation of the coastal and engineering processes, incorporating the impact of multiple storms and incorporating uncertainty in damage functions, physical characteristics of structures and economic valuations. Expected structural damages generated through the simulations are expressed as losses due to flooding, erosion and waves. Beach-*fx* is run for multiple project life-cycles and provides statistics on probable benefits and costs of the evaluated hurricane and storm damage reduction design alternatives, which is used to determine the economic justification of the project.

Beach-*fx* simulates beach response over time as storms, natural recovery, and management methods alter the beach profile. Events of interest (storms, beach nourishment) take place at calculated times. As each event takes place, the model simulates the physical and economic responses associated with that event. A set of simplified beach profiles, as defined by key data points, are tracked by the simulation model as the beach profile evolves over time.

As each storm is processed, the shoreline response is determined, and a post-storm beach configuration is calculated, as well as profiles of maximum water level, wave height, and erosion during the storm. This information is used to determine economic damages, based on empirical curves (damage functions) relating the percentage loss of value of structure and contents to "damage-driving parameters" calculated from the aforementioned profiles and characteristics of the structure.

4. EXISTING CONDITION

The 2003 South Carolina Annual State of Beaches Report by South Carolina Department of Health and Environmental Control Ocean & Coastal Resource Management (SCDHEC- OCRM) categorizes Edisto Beach as "very vulnerable to beach erosion", with areas that "are among the most critical in the state."

In 1948, construction of timber groins began along Edisto's beachfront. Throughout the years, the groin field has been eroded and modified. In 1995, the town of Edisto maintained and repaired the existing groins and widened the beach for recreational use and increased the buffer zone between existing structures and the ocean. After project completion, monitoring was conducted from 1995-2001 and concluded that the project was successful. The groin field along Edisto Beach had reduced the long-term erosion rate to a fraction of the pre-groin rate in the area encompassed by most of the groin field. However, groin maintenance is an ongoing issue. Sand fencing is also used as a precaution; however erosion continues to be an ongoing problem with sand fencing as well.

LAND USE AND FUTURE DEVELOPMENT

Land use on Edisto Beach is primarily residential in the form of single and multiple family dwelling units. The west end of the island has been developed as a planned gated community. The Edisto Beach State Park occupies approximately one third of Edisto Beach at the northern end and offers numerous scheduled activities and educational opportunities. Edisto Beach has relatively few commercial units, and commercial development is limited. Approximately 34 acres, 2 percent, of the 1,531 acres on the beach is zoned for commercial use, excluding resort amenities within the gated section of Wyndham Resort. There are 4.67 miles of walking/biking trails that provide recreational activities to the public throughout the town.

Development is ongoing and continuous at Edisto Beach and likely to continue into the immediate and near future until the remaining limited beach front, except for the State Park, is developed. There are public structures on Edisto Island such as the Town Hall and other parks that have facilities. However, the public structures are not in the Edisto Beach Study Area.

STRUCTURE INVENTORY

The structure inventory is a collection of information for the structures that may be potentially impacted by flooding, waves and/or erosion. The existing condition structure inventory is the basis for estimating the expected annual damages to the study area. Beach front development is predominantly single family dwellings. A complete structure inventory was completed in 2010 of existing structures that may benefit from a storm damage reduction project. The depreciated replacement cost for the structure values were used to estimate damages. The purpose was to gather data required for Beach-*fx* inputs and to obtain a database that would facilitate the gathering of critical metrics that locate the structure spatially in relation to the shoreline as well as its elevation. Beach-*fx* considers the inventory of structures (damage elements) as items that are containerized in 'lots'. Lots form boundaries that contain damage elements. An aggregation of lots that are for the most part contiguous composes a reach. All reaches taken in aggregate compose the study area. The Beach-*fx* model currently has 23 reaches, largely based on the

morphologically driven development of the representative profiles of Edisto Beach. Four planning reaches were identified to aggregate the Beach-*fx* reaches; Inlet Reach (Beach-fx reaches I1-I4), Atlantic Reach South (Beach-*fx* Reaches P1, P2, E1-E6), Atlantic Reach North (Beach-*fx* reaches E7-E15) and the State Park Reach.

Photos of structures along with pertinent information of construction and foundation type, number of floors, and accompanying detached structures that may benefit from a project were also collected. A summary of inventory is shown in Table 4. The 'SFR1' represents a single family residence, 'Walk' represents walkovers, 'Commercial' represents commercial structures and 'MFR' represent multi-family structures. The 'Road' damage element is Palmetto Boulevard. It has been divided based on reaches and modeled as a linear damage element. The 'Utility' damage element refers to the underground water pipes that run along the side of the road that have potential to be damaged. There are twice as many utilities as roads because the utilities run along both sides of the road.

Table 4: Structure Inventory Count by Beach-*fx* Reach

Reach	Beach-*fx* Reach	SFR1	Walk	Road & Utilities	Commercial	MFR
1	I1	68	33			16
2	I2	43	16			
3	I3	13	2			
4	I4	20	4			
5	P1	12	2			
6	P2	21	1			
7	E1	13				
8	E2	24	2			
9	E3	35	6			
10	E4	38	4			
11	E5	25	10			
12	E6	21	2			
13	E7	10				
14	E8	28	1	2		
15	E9	13		1		
16	E10	22		2		
17	E11	14		1		
18	E12	14		1		
19	E13	14		1		
20	E14	35	1	2	8	
21	E15	13		2	7	
22	S1					
23	S2	112	1	9	15	

Reach	Beach-*fx* Reach	SFR1	Walk	Road & Utilities	Commercial	MFR
	Total	**608**	**85**	**21**	**30**	**16**
	Grand Total	**760**				

VALUE OF COASTAL INVENTORY

Structure Value

The value of structures in the study area required for economic analysis to determine NED benefits should be expressed in terms of depreciated replacement costs. Staff from the Army Corps of Engineers Savannah District prepared the Edisto Beach Structure Inventory Analysis that determined the depreciated replacement cost for the structures using the Cost Approach. Tax Assessor's records were examined and analyzed on the current inventory to determine depreciated replacement cost using variables of interest relating to assessed value, date of construction, type of construction, number of floors, square footage, recent sales and selling prices, along with other information. Appendix C – Edisto Beach Structure Inventory Analysis gives further detail of the Cost Approach used to determine depreciated replacement cost. Walkovers were valued at an average of $100 per linear feet for the wood boardwalks also according to staff from the Army Corps of Engineers Savannah District.

Content Value

Content value was taken at 50% of the structure value. A web search of trade associations of homeowner casualty underwriters revealed that insurers generally use a content to structure ratio between 50 and 75 percent of replacement cost. For this analysis, the more conservative number of 50% was used. Table 5 presents the structure and content value of damageable property value based on depreciated replacement cost.

In conducting a sensitivity analysis for the content value, 40% and 60% were used to determine the range of content damages. The values are $50,403,000 and $75,604,000 respectively for all reaches.

Table 5: Edisto Beach Structure and Content Value by Reach

Reach	Beach-*fx* Reach	Structure	Content
1	I1	$ 30,533,000	$ 15,133,000
2	I2	$ 10,142,000	$ 4,988,000
3	I3	$ 2,597,000	$ 1,287,000
4	I4	$ 4,897,000	$ 2,421,000
5	P1	$ 3,188,000	$ 1,585,000
6	P2	$ 5,962,000	$ 2,976,000
7	E1	$ 3,134,000	$ 1,567,000
8	E2	$ 5,321,000	$ 2,653,000

Reach	Beach-*fx* Reach	Structure	Content
9	E3	$ 8,529,000	$ 4,241,000
10	E4	$ 5,272,000	$ 2,615,000
11	E5	$ 6,174,000	$ 3,060,000
12	E6	$ 4,590,000	$ 2,290,000
13	E7	$ 2,537,000	$ 1,268,000
14	E8	$ 6,456,000	$ 3,214,000
15	E9	$ 2,817,000	$ 1,402,000
16	E10	$ 3,359,000	$ 1,666,000
17	E11	$ 2,370,000	$ 1,179,000
18	E12	$ 2,443,000	$ 1,215,000
19	E13	$ 2,603,000	$ 1,295,000
20	E14	$ 9,393,000	$ 4,644,000
21	E15	$ 3,690,000	$ 1,832,000
22	S1	$ -	$ -
23	S2	$ -	$ -
	Total	$126,007,000	$62,531,000
	Grand Total	$188,537,900	

5. ECONOMIC BENEFIT EVALUATION

The alternatives analysis for identifying the NED plan used the FY12 discount rate of 4 percent. After identifying the NED plan, it was then calculated at the FY14 discount rate of 3.5 percent.

STORM DAMAGE REDUCTION

Beach-*fx* calculates the storm damage reduction from inundation, storm-induced erosion, long-term erosion and wave attack on a damage element-by-damage element basis for each storm event for the study period.

Damage Element

Damages are estimated based on the concept of a "damage element". A damage element represents any structure that can incur an economic loss such as structures, walkways, pools, etc. In Beach-*fx*'s system hierarchy reaches contain lots, and lots contain damage elements. For each storm, damages are estimated by examining the reach, lots, and damage elements within the lots. Thus, the basic unit on which damages are calculated at present is the damage element. Damage elements have attributes relating to type, geographic location, and value. Each damage element has information relating to structure and content value (treated as a three-parameter distribution for purposes of incorporating uncertainty). For location information, a structure's center point is referenced, as well as its width and length. A single value of ground elevation is specified, which

also includes a three-parameter distribution for describing the first floor elevation and uncertainty.

Damage Functions

The damage functions used in Beach-*fx* were those developed for the Institute for Water Resources (IWR) – Coastal Storm Damage Relationships Based on Expert Opinion Elicitation. However, the expert opinion elicitation did not capture all damage element types and the additional curves were based on best professional judgment by the Project Delivery Team. Damage curves not captured by the expert elicitation are presented in Attachment 1.

Damage functions for each damage type (erosion, inundation, and wave) are currently associated with damage element type (single family residential, multi-family residential, walkway, etc.) foundation type (shallow piles, deep piles, slab, etc.) construction type (wood frame concrete, masonry, etc.) and armor type (No armor, sheet pile, etc.) are used to select the appropriate damage function.

Damages are calculated at the damage element level, following each storm. For each damage type, a damage driving parameter is calculated for each damage element, and used as a lookup into stored damage functions.

LOST LAND REDUCTION

The land lost reduction benefit was determined for eroding reaches by calculating the amount of land that would be lost during the study period times the value of near shore upland.

LOSS OF LAND BENEFIT

With a project in place, land that would be lost in the without project future condition would be preserved by a project. The design template that represents the project that always provides full benefits to protected properties would be in place for the period of analysis preserved through the process of periodic renourishment. This benefit is based on the value of near shore lands. Normally, determination of the market value of the land losses is based on the value of near shore upland. Near shore upland is sufficiently removed from the shore to lose its significant increment of value because of its proximity to the shore, when compared to adjacent parcels that are more distant from the shore. These parcels have no water frontage or access point to the water as part of any deeded subdivision rights. For this project, near shore land values were estimated by the Army Corps of Engineers Savannah District from samples taken from recent land sales and calculated on cost per square foot and the above criteria applied. Appendix C – Edisto Beach Structure Inventory Analysis has further explanation and clarification on how the value per square foot was calculated for near shore land values. The near shore land value per square foot was determined to be $19.76.

RECREATION

To determine the recreation benefits of a plan, an economic value must be placed on the recreation experience at Edisto Beach. This value can be applied to the visitation which results

from the project to determine the NED recreation benefits. For this report, unit day values (UDV's) are used to determine the economic value of recreation using a point system that takes into account the following factors: recreation experience, availability of opportunity, carrying capacity, accessibility, and environmental (esthetics) quality. Parking at Edisto Beach is sufficient to support recreation for the general public and is reasonably near and accessible to the project beaches. Along with designated parking areas for beach access, public parking along the rights of ways of the Town's streets is permitted. The Town of Edisto Beach has 38 public beach access points that lie along Palmetto Boulevard, Point Street and Yacht Club Road. Each access point is identified with a reflective "Beach Access" sign. The longest distance between the access points is 1,425 feet, still less than one half mile.

REBUILDING

In Beach-*fx*, a triangular distribution (minimum, most likely and maximum) is defined for the number of days required for rebuilding at the damage element (DE) level, meaning that the distribution can be changed for each damage element. At the start of each iteration a value is drawn from the sample, setting the rebuilding time for the damage element for that iteration. The number of times rebuilding could occur was unlimited if there was sufficient room on the lot.

If a DE is damaged to any degree, and has not been "rebuilt" more times than the maximum allowable, then a "rebuilding event" is set at a time in the future corresponding to the random rebuilding time. When the simulation reaches that time the lot on which the DE exists is checked to see if it is buildable. At present, the model makes a simple check based on whether or not the landward toe of the dune has retreated past the center point of the lot. If so, the lot is not buildable, and rebuilding does not take place.

If the lot is rebuildable at the time of rebuilding, then structure and contents values are restored to their initial values at the start of the simulation, such that they are able to be taken as damages again at the next storm event, and the number of times the damage element is rebuilt is incremented by one.

COMBINING DAMAGES – COMPOSITE DAMAGE FUNCTION

Total damage element damages are calculated using a composite damage function that takes into account damages for all damage mechanisms present while avoiding double counting. Because a structure may be damaged by more than one storm damage hazard, a methodology was developed for combining the damages. This methodology was defined during the IWR workshop and is included in Attachment 1 – Coastal Storm Damage Relationships Based on Expert Opinion Elicitation.

6. FUTURE WITHOUT PROJECT CONDITION

In the future without project condition, it has been indicated by the local sponsor that the action taken would be to armor State Road 174 as it becomes increasingly threatened as it is the primary evacuation route, and perform emergency nourishment as necessary. Within Beach-*fx*, a trigger distance was specified at 20 feet from the road, meaning that when the seaward edge of the berm

gets within 20 feet of the road, armoring will occur on an as needed basis. The economic consequences are measured as a range of average annual equivalent damages.

DAMAGES

In determining the future without project damages, Beach-*fx* was simulated for 300 iterations over a 50 year period of analysis to capture the variability of estimated damages with a discount rate of 4% for comparison of alternatives to determine the NED plan. Table 6 displays the summary statistics of damages from Beach-*fx* showing existing average total damages and average annual (AA) damages to structure and content by model reach. Table 6 also shows the average emergency nourishment (EN) cost associated with each reach in the future condition. All alternatives will be compared and measured to the without project values. The benefits for plan comparison will be the reduction in other negative impacts or increases in positive impacts.

Table 6: Without Project Structure and Content Damage Summary Values

Reach	Beach-*fx* Reach	Avg Structure Damage	Avg Content Damage	Avg Total Damage	AA Damages	Avg Emergency Nourishment	AA Emergency Nourishment	Armor Cost	AA Armor Cost
1	I1	$6,318,000	$2,990,000	$9,308,000	$433,000	$0	$0	$0	$0
2	I2	$3,063,000	$1,115,000	$4,177,000	$194,000	$0	$0	$0	$0
3	I3	$718,000	$297,000	$1,015,000	$47,000	$0	$0	$0	$0
4	I4	$1,043,000	$417,000	$1,460,000	$68,000	$0	$0	$0	$0
5	P1	$370,000	$141,000	$511,000	$24,000	$437,000	$20,342	$0	$0
6	P2	$636,000	$272,000	$908,000	$42,000	$1,350,000	$62,843	$0	$0
7	E1	$253,000	$127,000	$379,000	$18,000	$507,000	$23,601	$0	$0
8	E2	$703,000	$289,000	$991,000	$46,000	$854,000	$39,754	$0	$0
9	E3	$848,000	$280,000	$1,129,000	$53,000	$1,320,000	$61,446	$0	$0
10	E4	$1,419,000	$645,000	$2,065,000	$96,000	$727,000	$33,842	$0	$0
11	E5	$1,047,000	$315,000	$1,363,000	$63,000	$665,000	$30,956	$0	$0
12	E6	$336,000	$145,000	$481,000	$22,000	$1,552,000	$72,246	$0	$0
13	E7	$123,000	$55,000	$178,000	$8,000	$645,000	$30,025	$0	$0
14	E8	$1,311,000	$641,000	$1,952,000	$91,000	$1,835,000	$85,420	$383,000	$17,829
15	E9	$1,444,000	$714,000	$2,158,000	$100,000	$743,000	$34,587	$182,000	$8,472
16	E10	$2,151,000	$1,058,000	$3,209,000	$149,000	$951,000	$44,269	$455,000	$21,180
17	E11	$2,196,000	$1,088,000	$3,284,000	$153,000	$626,000	$29,140	$210,000	$9,776
18	E12	$388,000	$184,000	$572,000	$27,000	$504,000	$23,461	$160,000	$7,448
19	E13	$1,113,000	$544,000	$1,656,000	$77,000	$738,000	$34,354	$183,000	$8,519
20	E14	$3,637,000	$1,791,000	$5,428,000	$253,000	$1,284,000	$59,770	$414,000	$19,272
21	E15	$1,482,000	$722,000	$2,204,000	$103,000	$2,757,000	$128,339	$224,000	$10,427
Total		$30,598,000	$13,830,000	$44,429,000	$2,068,000	$17,495,000	$814,396	$2,211,000	$102,922

7. WITH PROJECT CONDITION

NON-STRUCTURAL ALTERNATIVE

A non-structural measure, property acquisition, was considered as a hurricane and storm damage reduction measure. Property acquisition would involve the purchase of the damageable property and relocating the residents. Property acquisition would take place in the northern most reaches only because they are the most erosion- and damage-prone reaches in the study area. The reaches evaluated were E14 and E15, it was determined that additional reaches would be evaluated if these two reaches yielded the highest net benefits.

There were 19 shorefront houses located within reaches E14 and E15. The assumptions made for the non-structural alternative were compliance by the property owners and implementation of the plan at the start of the project. The benefits of the non-structural plan were calculated based on the assumption that the average future without project condition structure and content damages from the future without project condition Beach-*fx* runs as well as emergency renourishment cost avoidance. The average annual benefits totaled $470,100 for reaches E14 and E15.

For project comparison, this plan is considered Alternative 6. Costs for the non-structural plan were based on an acquisition cost using the actual land and structure value taken from the Structure Inventory Analysis (Appendix C) for each structure, and a demolition cost for each structure. In average annual dollars, the total for E-14 and E-15 is $714,940. For simplification, an identical demolition/removal and land value acquisition cost was used for every structure and lot. Based on the average costs of some demolition/removal activities that took place recently at a similar beach project, $100,000 per lot demolition/removal cost was used in this analysis. The net benefits for this plan was -$244,840. Since the alternative had negative benefits, the plan was screened from further analysis.

NOURISHMENT ALTERNATIVES

Beach nourishment and periodic renourishment will meet the study objectives for shoreline erosion protection in the most economically efficient and environmentally acceptable manner. Hard structures would have negative impact on the environment and are forbidden by laws and regulations of the study area.

For the Edisto Beach with project condition, four alternatives were evaluated to compare against the future without project condition. The alternatives were formulated and evaluated on the basis of the most likely conditions expected to exist with implementation of each of the plans identified for analysis. The alternatives were formulated based on past knowledge and performance of what has been determined as the best with project plan. During formulation, alternative measures considered involved soft structures, hard structures and non-structural measures.

The Beach-fx model is used to estimate the benefits and borrow volumes needed for each alternative. However, it should be noted that the costs produced by the model and presented for the alternative screening stage are for comparative purposes only, as they only factor in borrow placement of $11 per cubic yard and mob/demob costs of $1,675,000, but not other miscellaneous costs (monitoring, tilling, walkway replacement, vegetation planting, real estate, administration,

PED, etc). Groin construction costs were also included in the analysis; however, these costs were estimated and incorporated outside of the Beach-*fx* model. The miscellaneous costs will be fairly similar among the various beachfill alternatives, and hence their exclusion would not affect the comparison of alternatives. The total cost depended upon the volume of material placed and the number of times mobilization and demobilization occurred.

Alternative 1 was designed to resemble the dimensions of the 2006 local beach renourishment effort. Alternative 2 was considered to be the smallest practicable beachfill plan. Alternative 3 was considered to be the largest practicable plan. Therefore the minimum and maximum plan was captured in the analysis. Based on the results of the three alternatives, an Alternative 4 was analyzed to bracket the economic benefits. Alternative 4 generally mimics Alternative 1, but incorporates a higher dune feature. In order to maintain the effectiveness of the existing groin field with the designed increases in berm width, all the alternatives would require some lengthening of existing groins. Total groin extensions of 1,090, 360, 1,970 and 1,130 linear ft were used for Alternatives 1, 2, 3 and 4 respectively. Table 7 shows the dimensions of each alternative.

Table 7: Alternative Dimensions

Reach	**Alternative 1**			**Alternative 2**			**Alternative 3**			**Alternative 4**		
	Beach & Dune Fill			Beach & Dune Fill			Beach & Dune Fill			Beach & Dune Fill		
	Berm Width	Dune Height	Dune Width	Berm Width	Dune Height	Dune Width	Berm Width	Dune Height	Dune Width	Berm Width	Dune Height	Dune Width
I1		12	15		10	15		14	15		14	15
I2		12	15		10	15		14	15		14	15
I3		12	15		10	15		14	15		14	15
I4		12	15		10	15		14	15		14	15
P1	Taper	12	15	Taper	10	15	Taper	14	15	Taper	15	15
P2	25	14	15	13	12	15	38	16	15	13	15	15
E1	50	14	15	25	12	15	75	16	15	25	15	15
E2	50	14	15	25	12	15	75	16	15	50	15	15
E3	50	14	15	25	12	15	75	16	15	50	15	15
E4	50	14	15	25	12	15	75	16	15	50	15	15
E5	50	14	15	25	12	15	75	16	15	50	15	15
E6	50	14	15	25	12	15	75	16	15	50	15	15
E7	63	14	15	38	12	15	88	16	15	63	15	15
E8	75	14	15	50	12	15	100	16	15	75	15	15
E9	75	14	15	50	12	15	100	16	15	75	15	15
E10	75	14	15	50	12	15	100	16	15	75	15	15
E11	75	14	15	50	12	15	100	16	15	75	15	15
E12	75	14	15	50	12	15	100	16	15	75	15	15
E13	75	14	15	50	12	15	100	16	15	75	15	15
E14	75	14	15	50	12	15	100	16	15	75	15	15

Reach	Alternative 1			Alternative 2			Alternative 3			Alternative 4		
E15	75	14	15	50	12	15	100	16	15	75	15	15
SP	Taper			Taper			Taper			Taper		

PHYSICAL DAMAGES

Physical damages are expected to occur in the future on Edisto Beach, including structural damages, loss of contents and damages to the street and utility lines. Physical damages are evaluated separately for residential, commercial and road and utilities using different damage curves to estimate damages over the period of analysis. Depreciated replacements cost of the structure and contents are the basis for determining damages. The structure and content values are input as a minimum, maximum and most likely to address uncertainty. The cumulative damage for all the years from life-cycle modeling is presented as average damages and average annual damages equivalent values. Additional structural damages are also captured and include walkovers, pools and gazebos in the structure inventory of the study area. These structures are included in the total damage values.

For comparative analysis of the plans formulated, Beach-*fx* simulated 300 iterations for each alternative to determine the NED plan. Tables 8-11 show the structure and content damage for Alternatives 1-4. Land loss benefits are included in physical damage. In some instances, the with project damages are greater than the without project damages. This occurs because Beach-fx allows rebuilding to occur after each event up to a user specified maximum number in the with project condition. In the without project condition, the lots may or may not be able to be used to build on again and therefore, the damage drivers are not impacting those structures.

The benefits of the four beachfill alternatives were evaluated using the Beach-fx model. The costs produced by the model and presented for the alternative screening stage are for comparative purposes only, as they only factor in borrow placement and mob/demob costs, but not other miscellaneous costs (monitoring, tilling, walkway replacement, vegetation planting, real estate, administration, PED, etc). Groin construction costs were also included in the analysis; however, these costs were estimated and incorporated outside of the Beach-*fx* model. The miscellaneous costs would be fairly similar among the various beachfill alternatives, and hence their exclusion would not affect the comparison of alternatives.

Alternative 1 consists of a 12 foot dune crest elevation and 15 foot dune crest width along the inlet shoreline (Beach-fx reaches I1 through I4 and P1). Along the Atlantic facing shoreline, the design template involves a 14 foot dune crest elevation and 15 foot dune crest width. The design template berm width transitions from 0 feet at Reach P1 to 50 feet at Reach E1. The design template berm width remains at 50 feet through Reach E6 where it then transitions across Reach E7 to a width of 75 feet at Reach E8. The design template berm width remains at a 75 foot width through Reach E15 and transitions to a width of 0 feet north of Groin 1. Groin lengthening for this alternative is 1,090 ft.

Alternative 1 is identified as the 'Medium' plan because it closely resembles the observed added berm widths following the 2006 beach restoration project that has performed for more than seven years since construction.

Table 8: Alternative 1 Physical Damage Benefits

Reach	Beach-*fx*Reach	Structure Damage	Content Damage	Total Damages	AA Damages	AA Damage Reduction	Land Loss Benefits	Total Physical Damages
1	I-1	$4,213,296	$1,993,071	$6,206,366	$288,908	$144,386	$0	$144,386
2	I-2	$1,756,450	$682,710	$2,439,160	$113,543	$80,917	$0	$80,917
3	I-3	$385,767	$171,584	$557,350	$25,945	$21,308	$0	$21,308
4	I-4	$624,051	$273,808	$897,859	$41,795	$26,184	$0	$26,184
5	P-1	$382,121	$138,457	$520,577	$24,233	-$456	$0	-$456
6	P-2	$1,313,875	$627,005	$1,940,880	$90,348	-$48,080	$0	-$48,080
7	E-1	$215,112	$107,761	$322,873	$15,030	$2,630	$1,656	$4,286
8	E-2	$610,672	$276,748	$887,420	$41,310	$4,839	$10,028	$14,867
9	E-3	$661,016	$264,636	$925,652	$43,089	$9,447	$26,358	$35,805
10	E-4	$715,402	$339,438	$1,054,840	$49,103	$47,001	$32,641	$79,641
11	E-5	$564,382	$229,762	$794,144	$36,968	$26,472	$26,950	$53,421
12	E-6	$247,466	$113,815	$361,281	$16,818	$5,566	$34,416	$39,981
13	E-7	$108,938	$54,617	$163,555	$7,614	$685	$20,383	$21,068
14	E-8	$446,931	$214,059	$660,991	$30,769	$60,084	$54,744	$114,828
15	E-9	$828,343	$408,040	$1,236,383	$57,554	$42,910	$23,146	$66,055
16	E-10	$551,284	$269,144	$820,428	$38,191	$111,182	$36,617	$147,799
17	E-11	$379,549	$186,560	$566,109	$26,352	$126,526	$21,289	$147,815
18	E-12	$87,051	$41,836	$128,887	$6,000	$20,636	$19,788	$40,424
19	E-13	$298,210	$144,637	$442,847	$20,615	$56,492	$20,678	$77,169
20	E-14	$945,209	$464,214	$1,409,424	$65,609	$187,073	$47,437	$234,509
21	E-15	$323,046	$155,389	$478,435	$22,271	$80,303	$67,577	$147,880
Total		**$15,658,169**	**$7,157,291**	**$22,815,460**	**$1,062,064**	**$1,006,104**	**$443,705**	**$1,449,809**

Alternative 2 has a design template of a 15 foot dune crest width at a 10 foot NAVD crest elevation along the inlet shoreline. Along the Atlantic facing shoreline the design dune template involved a 15 ft dune crest width at a 12 ft NAVD crest elevation. The design template berm width transitions from 0 ft at Reach P1 to 25 ft at Reach E1. The design template berm width remains at 25 ft through Reach E6 were it transitions across Reach E7 to a width of 50 ft at Reach E8. The design template berm width remains at a 50 ft width through Reach E15 and transitions to a width of 0 ft north of Groin 1. Alternative 2 is referred to as the "Minimum" plan because it is believed that the dimensions of the Alternative 2 design template represent the minimum beach cross-section that would provide measureable storm damage reduction benefits at Edisto Beach. Alternative 2 would require 360 ft of groin lengthening.

Table 9: Alternative 2 Physical Damage Benefits

Reach	Beach-*fx*Reach	Structure Damage	Content Damage	Total Damages	AA Damages	AA Damage Reduction	Land Loss Benefits	Total Physical Damages
1	I-1	$5,995,901	$2,842,965	$8,838,866	$411,451	$21,843	$0	$21,843
2	I-2	$2,847,417	$1,038,815	$3,886,233	$180,905	$13,556	$0	$13,556
3	I-3	$652,608	$271,770	$924,377	$43,030	$4,223	$0	$4,223
4	I-4	$968,426	$397,319	$1,365,745	$63,576	$4,404	$0	$4,404
5	P-1	$448,470	$153,493	$601,963	$28,022	-$4,244	$0	-$4,244
6	P-2	$930,185	$409,709	$1,339,894	$62,372	-$20,104	$0	-$20,104
7	E-1	$278,564	$139,478	$418,042	$19,460	-$1,801	$653	-$1,148
8	E-2	$807,645	$331,313	$1,138,958	$53,019	-$6,870	$3,606	-$3,264
9	E-3	$941,259	$297,382	$1,238,641	$57,659	-$5,123	$15,286	$10,164
10	E-4	$1,474,577	$668,464	$2,143,040	$99,759	-$3,655	$11,847	$8,192
11	E-5	$1,073,400	$316,885	$1,390,285	$64,718	-$1,279	$12,270	$10,991
12	E-6	$360,267	$151,766	$512,033	$23,835	-$1,452	$19,055	$17,603
13	E-7	$129,427	$64,835	$194,262	$9,043	-$745	$13,799	$13,054
14	E-8	$1,016,986	$493,482	$1,510,467	$70,313	$20,541	$40,313	$60,853
15	E-9	$1,527,956	$755,919	$2,283,875	$106,315	-$5,851	$16,234	$10,383
16	E-10	$1,595,008	$783,372	$2,378,380	$110,714	$38,659	$23,231	$61,890
17	E-11	$1,408,339	$695,509	$2,103,848	$97,935	$54,944	$14,095	$69,040
18	E-12	$211,806	$98,942	$310,748	$14,465	$12,171	$13,089	$25,260
19	E-13	$617,182	$298,040	$915,222	$42,604	$34,502	$19,194	$53,696
20	E-14	$2,309,518	$1,138,758	$3,448,276	$160,518	$92,164	$41,603	$133,766
21	E-15	$773,392	$375,404	$1,148,796	$53,477	$49,097	$59,921	$109,019
Total		**$26,368,334**	**$11,723,619**	**$38,091,953**	**$1,773,188**	**$294,980**	**$304,196**	**$599,176**

Alternative 3, identified as the "Maximum" plan, involves a 15 ft dune crest width at a 14 ft NAVD crest elevation along the inlet shoreline. Along the Atlantic facing shoreline the design dune template involve a 15 ft dune crest width at a 16 ft NAVD crest elevation. The design template berm width transitions from 0 ft at Reach P1 to 75 ft at Reach E1. The design template berm width remains at 75 ft through Reach E6 where it transitions across Reach E7 to a width of 100 ft at Reach E8. The design template berm width remains at 100 ft through Reach E15 and transitions to a width of 0 ft north of Groin 1. Alternative 3 is referred to as the "Maximum" plan because it is believed that the dimensions of the Alternative 3 design template are the largest that could be justified through storm damage reduction benefits. For Alternative 3, 1,970 feet of groin lengthening is required.

Table 10: Alternative 3 Physical Damages Benefits

Reach	Beach-*fx*Reach	Structure Damage	Content Damage	Total Damages	AA Damages	AA Damage Reduction	Land Loss Benefits	Total Physical Damages
1	I-1	$2,753,155	$1,310,263	$4,063,418	$189,153	$244,141	$0	$244,141
2	I-2	$983,528	$395,531	$1,379,059	$64,195	$130,265	$0	$130,265
3	I-3	$259,064	$118,341	$377,405	$17,568	$29,684	$0	$29,684
4	I-4	$406,137	$182,193	$588,330	$27,387	$40,593	$0	$40,593
5	P-1	$308,260	$114,313	$422,573	$19,671	$4,106	$0	$4,106
6	P-2	$1,043,389	$512,424	$1,555,813	$72,423	-$30,155	$0	-$30,155
7	E-1	$147,054	$73,781	$220,835	$10,280	$7,379	$1,656	$9,036
8	E-2	$501,977	$239,441	$741,417	$34,513	$11,636	$10,028	$21,664
9	E-3	$478,463	$211,003	$689,466	$32,095	$20,441	$26,358	$46,799
10	E-4	$490,933	$234,809	$725,742	$33,783	$62,320	$51,603	$113,924
11	E-5	$349,645	$147,926	$497,571	$23,162	$40,277	$40,238	$80,515
12	E-6	$141,468	$67,347	$208,815	$9,720	$12,663	$47,637	$60,300
13	E-7	$76,315	$38,259	$114,575	$5,333	$2,965	$26,369	$29,334
14	E-8	$288,301	$139,945	$428,246	$19,935	$70,918	$56,582	$127,500
15	E-9	$405,613	$200,172	$605,785	$28,199	$72,264	$29,428	$101,692
16	E-10	$264,071	$127,316	$391,387	$18,219	$131,154	$49,568	$180,722
17	E-11	$198,282	$96,548	$294,830	$13,724	$139,154	$25,196	$164,351
18	E-12	$47,976	$22,660	$70,635	$3,288	$23,348	$19,788	$43,136
19	E-13	$171,675	$83,364	$255,039	$11,872	$65,234	$20,678	$85,912
20	E-14	$465,053	$228,568	$693,621	$32,288	$220,393	$47,437	$267,830
21	E-15	$165,638	$79,997	$245,635	$11,434	$91,140	$67,577	$158,717
Total		**$9,945,997**	**$4,624,200**	**$14,570,197**	**$678,246**	**$1,389,922**	**$520,144**	**$1,910,066**

Alternatives 1, 2, and 3, were simulated with Beach-fx and based on the results a fourth alternative was developed to optimize the design template to maximize storm damage reduction and minimize project costs. The Alternative 4 design template is smaller than the Alternative 3 (Maximum plan) but slightly larger than the Alternative 1 (Medium plan) design template. Dune crest elevation along the inlet shoreline is 14 ft NAVD, the same as Alternative 3, whereas the dune crest elevation along the Atlantic facing shoreline is 15 ft NAVD, between Alternative 1 and Alternative 3. The design template berm width for Alternative 4 is identical to Alternative 1 except for a longer transition zone at the southern end. The design template berm width transitions from 0 ft at Reach P1 to 50 ft at Reach E2. Alternative 4 requires 1,130 ft of groin lengthening.

Table 11: Alternative 4 Physical Damage Summary

Reach	Beach-*fx*Reach	Structure Damage	Content Damage	Total Damages	AA Damages	AA Damage Reduction	Land Loss Benefits	Total Physical Damages
1	I-1	$2,753,155	$1,310,263	$4,063,418	$189,153	$244,141	$0	$244,141
2	I-2	$983,528	$395,531	$1,379,059	$64,195	$130,265	$0	$130,265
3	I-3	$259,064	$118,341	$377,405	$17,568	$29,684	$0	$29,684
4	I-4	$406,137	$182,193	$588,330	$27,387	$40,593	$0	$40,593
5	P-1	$230,876	$93,296	$324,171	$15,090	$8,687	$0	$8,687
6	P-2	$1,219,561	$593,141	$1,812,702	$84,382	-$42,113	$0	-$42,113
7	E-1	$231,907	$116,181	$348,088	$16,204	$1,456	$1,656	$3,112
8	E-2	$586,254	$270,364	$856,618	$39,876	$6,273	$10,028	$16,301
9	E-3	$604,129	$248,879	$853,008	$39,708	$12,829	$26,358	$39,186
10	E-4	$593,652	$283,899	$877,550	$40,850	$55,254	$35,266	$90,519
11	E-5	$468,267	$201,008	$669,276	$31,155	$32,284	$28,663	$60,948
12	E-6	$207,411	$98,009	$305,420	$14,217	$8,166	$36,409	$44,575
13	E-7	$96,035	$48,160	$144,195	$6,712	$1,586	$21,124	$22,710
14	E-8	$371,020	$178,778	$549,798	$25,593	$65,260	$56,209	$121,469
15	E-9	$648,160	$319,640	$967,800	$45,051	$55,412	$23,847	$79,259
16	E-10	$341,413	$165,789	$507,202	$23,610	$125,763	$38,535	$164,298
17	E-11	$239,574	$117,099	$356,672	$16,603	$136,276	$22,324	$158,599
18	E-12	$60,464	$28,795	$89,260	$4,155	$22,481	$19,788	$42,269
19	E-13	$255,023	$123,910	$378,933	$17,639	$59,467	$20,678	$80,144
20	E-14	$631,156	$310,547	$941,702	$43,836	$208,845	$47,437	$256,282
21	E-15	$241,714	$117,632	$359,346	$16,728	$85,847	$67,577	$153,424
Total		**$11,428,499**	**$5,321,454**	**$16,749,953**	**$779,714**	**$1,288,454**	**$455,898**	**$1,744,352**

EMERGENCY AND ARMOR COST

Emergency nourishment (EN) cost is eliminated when planned nourishment is scheduled in the with project alternatives. However, the Beach-fx modeling could determine the with project condition actually has greater damages in some reaches due to constantly being able to 'rebuild' in the with project condition, as discussed in Section 5. Armoring is triggered when the seaward toe of the dune is found landward of the specified trigger distance and armoring will always occur when this criteria is met. In the with project condition, the emergency nourishment and armoring cost avoided with the placement of planned nourishment become a benefit. Table 12 shows the emergency cost and armoring cost avoidance benefits. There are no land loss benefits for reaches 1-5 because there is not a berm installed as part of the project.

Table 12: Emergency Cost and Armor Cost Avoidance Benefits (Average Annual)

Reach	Alt 1	Alt 2	Alt 3	Alt 4
I-1	$0	$ -	$ -	$ -
I-2	$0	$ -	$ -	$ -
I-3	$0	$ -	$ -	$ -
I-4	$0	$ -	$ -	$ -
P-1	$14,593	$ 14,593	$ 14,593	$ 14,593
P-2	$46,174	$ 46,174	$ 46,174	$ 46,174
E-1	$17,182	$ 17,182	$ 17,182	$ 17,182
E-2	$32,006	$ 32,006	$ 32,006	$ 32,006
E-3	$49,960	$ 49,960	$ 49,960	$ 49,960
E-4	$31,705	$ 31,705	$ 31,705	$ 31,705
E-5	$29,403	$ 29,403	$ 29,403	$ 29,403
E-6	$64,126	$ 64,126	$ 64,126	$ 64,126
E-7	$25,955	$ 25,955	$ 25,955	$ 25,955
E-8	$89,139	$ 73,492	$ 90,060	$ 89,668
E-9	$34,008	$ 29,545	$ 38,005	$ 35,491
E-10	$55,867	$ 41,944	$ 61,238	$ 59,743
E-11	$36,237	$ 28,224	$ 36,882	$ 36,679
E-12	$30,270	$ 28,825	$ 30,308	$ 30,308
E-13	$38,819	$ 37,429	$ 38,819	$ 38,819
E-14	$74,563	$ 70,293	$ 74,563	$ 74,445
E-15	$124,954	$ 124,396	$ 124,954	$ 124,954
Total	**$794,960**	**$ 745,251**	**$ 805,933**	**$ 801,210**

NET BENEFITS

To determine the NED plan, the benefits were reduced by the cost to determine the plan that maximizes net benefits. Tables 13-16 show the net benefits of each alternative. For purposes of plan comparison, the cost included is the placement of planned nourishment, mobilization and demobilization cost and groin lengthening cost are associated with implementation of the plan. The average number of renourishments will differ across alternatives given the mobilization threshold criteria.

Alternative 1 has average annual benefits of $2,244,770 and average annual cost of $907,200 resulting in net benefits of $1,337,570. The alternative requires a total of 1,090 feet of groin lengthening. The cost for the groin lengthening is included in the average annual cost.

Table 13: Alternative 1 Benefits and Costs

Reach	Damage Reduction Benefits	Cost Avoidance Benefits	Total Benefits	AA Costs	Net Benefits
I-1	$144,386	$0	$144,386	$21,918	$122,469
I-2	$80,917	$0	$80,917	$23,359	$57,558
I-3	$21,308	$0	$21,308	$7,152	$14,156
I-4	$26,184	$0	$26,184	$7,077	$19,108
P-1	-$456	$14,593	$14,137	$4,480	$9,658
P-2	-$48,080	$46,174	-$1,906	$12,195	-$14,101
E-1	$4,286	$17,182	$21,467	$17,995	$3,472
E-2	$14,867	$32,006	$46,874	$25,025	$21,848
E-3	$35,805	$49,960	$85,765	$49,450	$36,315
E-4	$79,641	$31,705	$111,346	$29,606	$81,740
E-5	$53,421	$29,403	$82,824	$36,680	$46,145
E-6	$39,981	$64,126	$104,108	$45,175	$58,933
E-7	$21,068	$25,955	$47,023	$29,002	$18,021
E-8	$114,828	$89,139	$203,966	$73,938	$130,028
E-9	$66,055	$34,008	$100,063	$35,738	$64,325
E-10	$147,799	$55,867	$203,666	$67,971	$135,694
E-11	$147,815	$36,237	$184,052	$48,775	$135,277
E-12	$40,424	$30,270	$70,694	$55,471	$15,223
E-13	$77,169	$38,819	$115,988	$55,490	$60,498
E-14	$234,509	$74,563	$309,072	$114,629	$194,443
E-15	$147,880	$124,954	$272,834	$146,075	$126,759
Total	**$1,449,809**	**$794,960**	**$2,244,769**	**$907,201**	**$1,337,568**

Alternative 2 has average annual benefits of $1,344,430 and annual cost of $500,940 resulting in net benefits of $843,490. This alternative requires groin lengthening of 360 feet which is included in the average annual cost.

Table 14: Alternative 2 Benefits and Costs

Reach	Damage Reduction Benefits	Cost Avoidance Benefits	Total Benefits	AA Costs	Net Benefits
I-1	$21,843	$ -	$21,843	$5,961	$15,882
I-2	$13,556	$ -	$13,556	$6,534	$7,021
I-3	$4,223	$ -	$4,223	$1,989	$2,234
I-4	$4,404	$ -	$4,404	$1,988	$2,416

Reach	Damage Reduction Benefits	Cost Avoidance Benefits	Total Benefits	AA Costs	Net Benefits
P-1	-$4,244	$ 14,593	$10,349	$1,273	$9,076
P-2	-$20,104	$ 46,174	$26,070	$3,612	$22,457
E-1	-$1,148	$ 17,182	$16,034	$3,017	$13,017
E-2	-$3,264	$ 32,006	$28,742	$6,272	$22,470
E-3	$10,164	$ 49,960	$60,124	$14,001	$46,123
E-4	$8,192	$ 31,705	$39,897	$11,675	$28,222
E-5	$10,991	$ 29,403	$40,395	$13,147	$27,247
E-6	$17,603	$ 64,126	$81,730	$15,206	$66,524
E-7	$13,054	$ 25,955	$39,009	$17,041	$21,968
E-8	$60,853	$ 73,492	$134,345	$29,912	$104,432
E-9	$10,383	$ 29,545	$39,928	$18,927	$21,001
E-10	$61,890	$ 41,944	$103,834	$33,734	$70,100
E-11	$69,040	$ 28,224	$97,263	$29,669	$67,594
E-12	$25,260	$ 28,825	$54,085	$39,515	$14,570
E-13	$53,696	$ 37,429	$91,125	$44,143	$46,982
E-14	$133,766	$ 70,293	$204,060	$90,872	$113,188
E-15	$109,019	$ 124,396	$233,414	$112,451	$120,963
Total	**$599,176**	**$ 745,251**	**$1,344,427**	**$500,940**	**$843,487**

Alternative 3 requires 1,970 feet of groin lengthening. The length is much greater for Alternative 3 because the berm width is greater for Alternative 3 and a higher dune width. The total average annual benefits are $2,716,000 and average annual cost of $1,183,500 resulting in net benefits of $1,532,500.

Table 15: Alternative 3 Benefits and Costs

Reach	Damage Reduction Benefits	Cost Avoidance Benefits	Total Benefits	AA Costs	Net Benefits
I-1	$244,141	$ -	$244,141	$21,717	$222,424
I-2	$130,265	$ -	$130,265	$22,343	$107,922
I-3	$29,684	$ -	$29,684	$6,864	$22,820
I-4	$40,593	$ -	$40,593	$6,805	$33,788
P-1	$4,106	$ 14,593	$18,699	$4,263	$14,436
P-2	-$30,155	$ 46,174	$16,018	$17,203	-$1,185
E-1	$9,036	$ 17,182	$26,217	$30,953	-$4,736
E-2	$21,664	$ 32,006	$53,670	$42,357	$11,313

Reach	Damage Reduction Benefits	Cost Avoidance Benefits	Total Benefits	AA Costs	Net Benefits
E-3	$46,799	$ 49,960	$96,759	$70,105	$26,654
E-4	$113,924	$ 31,705	$145,629	$47,313	$98,315
E-5	$80,515	$ 29,403	$109,919	$66,087	$43,832
E-6	$60,300	$ 64,126	$124,427	$71,059	$53,368
E-7	$29,334	$ 25,955	$55,289	$41,485	$13,804
E-8	$127,500	$ 90,060	$217,559	$95,861	$121,698
E-9	$101,692	$ 38,005	$139,697	$48,084	$91,613
E-10	$180,722	$ 61,238	$241,961	$96,594	$145,367
E-11	$164,351	$ 36,882	$201,233	$58,296	$142,937
E-12	$43,136	$ 30,308	$73,443	$65,457	$7,986
E-13	$85,912	$ 38,819	$124,730	$65,210	$59,520
E-14	$267,830	$ 74,563	$342,393	$134,569	$207,823
E-15	$158,717	$ 124,954	$283,671	$170,906	$112,765
Total	**$1,910,066**	**$ 805,933**	**$2,715,999**	**$1,183,534**	**$1,532,465**

Alternative 4 requires a total of 1,130 ft of groin lengthening and the cost included in average annual cost. The average annual benefits of Alternative 4 are $2,545,560, the average annual cost are $926,000 resulting in net benefits of $1,619,500.

Table 16: Alternative 4 Benefits and Costs

Reach	Damage Reduction Benefits	Cost Avoidance Benefits	Total Benefits	AA Costs	Net Benefits
I-1	$244,141	$ -	$244,141	$21,717	$222,424
I-2	$130,265	$ -	$130,265	$22,343	$107,922
I-3	$29,684	$ -	$29,684	$6,864	$22,820
I-4	$40,593	$ -	$40,593	$6,805	$33,788
P-1	$8,687	$ 14,593	$23,280	$5,752	$17,528
P-2	-$42,113	$ 46,174	$4,060	$9,405	-$5,344
E-1	$3,112	$ 17,182	$20,294	$10,342	$9,951
E-2	$16,301	$ 32,006	$48,307	$26,330	$21,978
E-3	$39,186	$ 49,960	$89,146	$50,514	$38,632
E-4	$90,519	$ 31,705	$122,224	$28,502	$93,723
E-5	$60,948	$ 29,403	$90,351	$38,745	$51,606
E-6	$44,575	$ 64,126	$108,701	$49,485	$59,216
E-7	$22,710	$ 25,955	$48,665	$32,242	$16,423

Reach	Damage Reduction Benefits	Cost Avoidance Benefits	Total Benefits	AA Costs	Net Benefits
E-8	$121,469	$ 89,668	$211,137	$77,666	$133,471
E-9	$79,259	$ 35,491	$114,749	$38,659	$76,090
E-10	$164,298	$ 59,743	$224,042	$72,653	$151,388
E-11	$158,599	$ 36,679	$195,278	$49,326	$145,952
E-12	$42,269	$ 30,308	$72,576	$56,561	$16,015
E-13	$80,144	$ 38,819	$118,963	$57,217	$61,747
E-14	$256,282	$ 74,445	$330,727	$116,776	$213,951
E-15	$153,424	$ 124,954	$278,378	$148,185	$130,192
Total	**$1,744,352**	**$ 801,210**	**$2,545,562**	**$926,089**	**$1,619,473**

ALTERNATIVE 5: SAND FENCING

Because of the uncertainties regarding how large of a dune would be created by this alternative and how quickly it would be created, several assumptions were made regarding this alternative. First, based on examples of successful sand fencing projects that were implemented at Folly Beach and Myrtle Beach, SC, the creation of a maximum of 2 ft of extra dune via sand capture was considered to be reasonable. This is comparable to the increase in dune height that would be directly added to the Inlet Reach under Alternative 1. Hence, the damage reduction at the Inlet Reach resulting from Alternative 1 was considered the *maximum* damage reduction that could be assumed under the sand fencing alternative. In reality, the damage reduction would likely be less because the dune height increase via windblown sand capture would be much more gradual as compared to directly adding the material through dune construction. Hence, a 90% damage reduction capability as compared to Alternative 1 was initially assumed, although this percentage likely still overestimates the benefit.

This initial screening level evaluation was done only to see how this alternative would generally compare to the other alternatives in reaches I1-I4 only. If this initial evaluation revealed that sand fencing in the Inlet Reach could potentially be part of the NED plan, then additional analysis would need to be conducted to better quantify the potential benefits.

Costs for this alternative were based on constructing 5,293 ft of fencing and assuming it would need to be completely replaced three times during the 50 year project life. The total cost for the initial sand fencing is $93,000. The table below shows the replacement cost of sand fencing at a 4% discount rate.

Initial Fencing	$ 93,038
R1 2028	$ 53,560
R2 2043	$ 30,833
R3 2058	$ 17,750
Total	$ 195,181

The average annual cost of sand fencing for reaches I1-I4 is $9,086 and the average annual benefits are $245,515. The net benefits for the project are $236,430. The net benefits by reach presented in Table 17 shows the sand fencing alternative did not maximize net benefits.

Table 17 shows the summary of net benefit comparison between all the alternatives. As shown, the plan that maximizes net benefits is Alternative 4. Alternative 4 is also bracketed by the net benefits of Alternative 1 which is a smaller plan and Alternative 3 which is a larger plan than Alternative 4. Alternative 5 is sand fencing and Alternative 6 is the non-structural property acquisition. The cost used for the alternatives analysis comparison consisted of a mobilization and demobilization cost of $1,675,000 and cost per cubic yard of $11. The total cost depended upon the volume of material placed and the number of times mobilization and demobilization occurred.

Table 17: Net Benefits for Plan Comparison

Reach	Alternative 1	Alternative 2	Alternative 3	Alternative 4	Alternative 5	Alternative 6
I-1	$122,469	$15,882	$222,424	$222,424	$126,686	
I-2	$57,558	$7,021	$107,922	$107,922	$69,198	
I-3	$14,156	$2,234	$22,820	$22,820	$18,070	
I-4	$19,108	$2,416	$33,788	$33,788	$22,476	
P-1	$9,658	$9,076	$14,436	$17,528		
P-2	-$14,101	$22,457	-$1,185	-$5,344		
E-1	$3,472	$13,017	-$4,736	$9,951		
E-2	$21,848	$22,470	$11,313	$21,978		
E-3	$36,315	$46,123	$26,654	$38,632		
E-4	$81,740	$28,222	$98,315	$93,723		
E-5	$46,145	$27,247	$43,832	$51,606		
E-6	$58,933	$66,524	$53,368	$59,216		
E-7	$18,021	$21,968	$13,804	$16,423		
E-8	$130,028	$104,432	$121,698	$133,471		
E-9	$64,325	$21,001	$91,613	$76,090		
E-10	$135,694	$70,100	$145,367	$151,388		
E-11	$135,277	$67,594	$142,937	$145,952		
E-12	$15,223	$14,570	$7,986	$16,015		
E-13	$60,498	$46,982	$59,520	$61,747		
E-14	$194,443	$113,188	$207,823	$213,951		($226,906)
E-15	$126,759	$120,963	$112,765	$130,192		($17,935)
Total	**$1,337,568**	**$843,487**	**$1,532,465**	**$1,619,473**	**$236,430**	

Periodic nourishment is placement of suitable material on a beach at appropriate intervals of time to maintain the design template. Beach-*fx* examines all reaches to be nourished to determine if mobilization is warranted. The existing reach profile is compared to the design template, and a nourishment volume is determined. If the total nourishment volume for all reaches exceeds a user-defined threshold, then mobilization and nourishment take place. If nourishment is required, then nourishment time is determined based on placement rates. The cost of nourishment,

including mobilization and placement costs, is calculated based on nourishment volumes and user-defined cost-related parameters.

Once the NED plan was determined, Beach-*fx* was used to optimize the renourishment cycle for the NED plan. Two year increments were analyzed for 4, 6, 8, 10,12, 14 and 16 years. Table 18 shows the average annual costs, benefits and net benefits for each of the renourishment cycles for comparison of the optimized renourishment interval. The FY13 discount rate of 3.75% was used over a 50 year period of analysis for this comparison.

Table 18: Average Annual Net Benefits for Renourishment Cycles

Cycle (yrs)	AA Benefits	AA Placement Cost	AA Mob cost	AA Groin Cost	Total AA Cost	AA Net Benefits
4	$ 2,529,665	$ 453,637	$ 694,910	$ 65,747	$ 1,214,294	$ 1,315,371
6	$ 2,502,654	$ 448,241	$ 480,104	$ 65,747	$ 994,092	$ 1,508,562
8	$ 2,478,624	$ 445,727	$ 372,991	$ 65,747	$ 884,465	$ 1,594,158
10	$ 2,406,228	$ 422,585	$ 313,473	$ 65,747	$ 801,805	$ 1,604,424
12	$ 2,402,784	$ 432,214	$ 266,456	$ 65,747	$ 764,417	$ 1,638,366
14	$ 2,377,453	$ 429,477	$ 248,682	$ 65,747	$ 743,906	$ 1,633,547
16	$ 2,351,072	$ 425,004	$ 213,761	$ 65,747	$ 704,512	$ 1,646,560

Based on the optimization results, the 16 year renourishment cycle returns the highest net benefits.

A final Beach-fx modeling run was completed using the FY2014 discount rate of 3.5% for the 16 year renourishment cycle. Table 19 shows the average annual benefits.

Table 19: Average Annual Benefits at FY14 3.5%

Average Annual Benefits	
Storm Damage Reduction	$1,485,798
EN* Cost Avoided	$778,931
Armor Cost Reduction	$94,246
Land Loss Benefits	$535,052
Total AA Benefits	**$2,894,027**
***Emergency Nourishment (EN)	

8. PROJECT COST

Once the NED plan was determined a more detailed project cost was conducted. The total project cost summary was prepared for Edisto Beach and the first cost of the project for initial construction and the renourishment cost were used to compare to project benefits to compute final net benefits and the benefit to cost ratio. The renourishment cost for each 16 year interval was discounted to the present value. The initial construction cost of the project is $21,129,000 and the renourishment cost that is expected to occur every 16 years is $10,914,000, with the present value

totaling $16,030,800. The interest during construction is approximately $106,800. Estimated annual cost for operations and maintenance, including beachfill monitoring over the 50 year project, are $83,000 and would cover semiannual beach profile surveys through the depth of closure, aerial photography, and an annual monitoring report. The total average annual cost is presented in Table 20. Parse

Table 20: NED Cost

Initial Construction	$	21,129,000
1st Renourishment	$	6,294,200
2nd Renourishment	$	3,629,900
3 Renourishment	$	2,093,400
Total First Cost	$	33,146,400
Interest During Construction	$	106,800
Total Project Cost	$	33,252,800
Average Annual First Cost	$	1,418,000
O&M	$	83,000
Total Average Annual Cost	**$**	**1,501,000**

9. CONSTRUCTIBLE NED PLAN

The FY14 initial construction costs are $21,129,000 and a single renourishment cost is $10,914,000. Renourishment costs are discounted using the FY14 discount rate of 3.5% to present worth each renourishment. Total project first cost including Interest During Construction (IDC) for this plan is $33,252,800. The annualized cost of Operation and Maintenance (O&M) is $83,000. The annualized benefits are $2,894,027 for coastal storm damage reduction benefits. The benefit-to-cost ratio (BCR) is 1.93 to 1 which yields net benefits of about $1,393,000.

For the NED analysis, the quantity of material was significantly less among the alternatives. Since the determination of the construction baseline needed to be moved seaward upon refinement of the NED plan, there was a significant cost increase with the additional material. However, the seaward movement of the construction line would have impacted all alternatives in the same manner and no new analysis of the NED plan was necessary. Tables 20 and 21 reflect a revised project that extends the construction baseline seaward and these costs were not part of the NED analysis.

Table 21 summarizes the costs, benefits and other pertinent information on project justification for the NED Plan without recreation benefits.

Table 21: NED Summary of Benefits without Recreation Benefits

Average Annual CSDR Benefits	$	2,894,000
Total Average Annual Cost	$	1,501,000
Benefit-to-Cost Ratio		1.93
Net Benefits	$	1,393,000

10. RECREATION BENEFITS

The evaluation procedure used for this report is the Unit Day Value method (UDV). This method relies on expert or informed opinion and judgment to estimate the average willingness to pay of recreational users. Unit Day Value (UDV) method was selected as the evaluation procedure because there are no specialized recreation activates for the area and the annual visits expected do not exceed 750,000. The recreational analysis can be found in Attachment 2.

In 2012, the Town of Edisto Beach area had approximately 371,000 beach visitors. Traffic counts combined with estimated rentals determine expected visitors per year. This estimate is based on data provided by the Town of Edisto Beach. Visitation is generally constrained by availability of beach area only during peak days and is not limited at other times of the year. The peak recreation season is Memorial Day through Labor Day. Recreational visitation reaches a peak four times a year. These times are Spring Break, Memorial Day, Independence Day and Labor Day.

PARKING

Edisto Beach provides sufficient parking for the general public. The parking lots at the access points provide for over 150 cars. The other access points have parking along the streets that are permitted by the town. The State of South Carolina recognizes that in order participate in beach nourishment projects public access is a must and therefore protects and promotes public access to the state's beaches. Parking is a reasonable walking distance to the beach.

ACCESS

According to ER1105-2-100, reasonable access is access approximately every one-half mile or less. According to the Town of Edisto Beach Local Comprehensive Beach Management Plan, the Town has 38 public access points that lie along Palmetto Boulevard, Point Street and Yacht Club Road. Each access point is identified with "Beach Access" signs. The 38 access points are exclusive of the State Park. The average width of each access point is approximately 50 feet with an average distance between each access point of 400 ft. Provisions of reasonable public access rights of ways are present in Edisto Beach.

The following table shows the beach access location and facilities at each location.

Table 22: Parking & Access

	PARKING & ACCESS								
Location	Feet Between Access Points	Sign Number	Pedestrian Only	Boardwalk	Walkover	Off-Street Parking	On-Street Parking	Handicapped Access	Signage
Coral St	842	1					x		x
Fenwick St	807	1a	x				x		x
Mary St	829	2	x				x		x

	PARKING & ACCESS								
Location	Feet Between Access Points	Sign Number	Pedestrian Only	Boardwalk	Walkover	Off-Street Parking	On-Street Parking	Handicapped Access	Signage
Whaley St	791	3	x				x		x
Matilda St	797	4	x				x		x
Cupid St	787	5	x				x		x
Atlantic St	802	6	x				x		x
Portia St	797	7	x				x		x
Dawhoo St	300	8				6	x		x
Cheehaw St	288	9				11	x		x
Osceola St	290	10				8	x		x
Byrd St	300	11	x				x		x
Nancy St	302	12				5	x		x
Thistle St	317	13				11	x	x	x
Chancellor St	300	14	x				x		x
Dorothy St	300	15	x				x		x
Marianne St	284	16				10	x	x	x
Lybrand St	300	17		x	x	10	x	x	x
Catherine St	300	18	x	x			x		x
Mitchell St	303	19			x	15	x	x	x
Baynard St	300	20	x		x	2	x	x	x
Edings St	300	21		x	x	7	x	x	x
Jenkins St	300	22				4	x	x	x
Seabrook St	300	23				10	x	x	x
Murray St	300	24				10	x	x	x
Holmes St	308	25				10	x	x	x
Loring St	300	26				10	x	x	x
Laroche St	300	27				10	x	x	x
Neptune St	907	28	x				x	x	x
Billow St	300	29	x	x			x		x
White Cap St	350	30				9	x	x	x
Edisto St.	387	31				6	x	x	x
Mikell St.	599	32		x		2	x	x	x
Townsend St.	1249	33	x				x		x
Louise St.	600	34	x	x			x		x
Ebb Tide St.	1425	35		x	x	4	x	x	x
Yacht Club Rd.	865	36	x	x			x		x
Yacht Club Rd.		37		x		2	x		x

WITH AND WITHOUT PROJECT VALUES

To determine the recreation benefits of the tentatively selected plan, an economic value must be placed on the recreation experience at Edisto Beach. The value can then be applied to the expected visitation experience that results from the project to determine NED recreation benefits.

The UDV are determined using a point system that takes into account the following factors: recreation experience, availability of opportunity, carrying capacity, accessibility, and environmental (esthetics) quality. A good deal of judgment is required in the assessment of point values. A group of planning professionals and experts of the study area made independent judgments of the UDV values which were averaged. The differences in the values were applied to the estimated visitation. The difference in the Without and With project values of recreation determine the NED recreation benefits. The source of the value of recreation is obtained from the Economic Guidance Memorandum, 13-03, Unit Day Values for Recreation for Fiscal Year 2013. Table 24 shows the without project and with project points and their associated dollar values.

Table 23: UDV Project Points and Values

Criteria	W/O Project Points	W/ Project Points
Recreation Experience	16	28
Availability of Opportunity	16	18
Carrying Capacity	13	13
Accessibility	13	13
Environment (Esthetics)	4	15
Total Points	62	85
General Recreation Value	$9.02	$10.57

The UDV point totals convert to a recreation value of $9.02 in the Without project condition and the $10.57 in the With project condition. The difference in the Without Project condition and the With Project condition recreation value is $1.55.

Because Edisto Beach is already a public beach, it is not anticipated that public visitation numbers will change as a result of the Federal project. It is assumed that the 2012 visitation is indicative of future visitation given that the Edisto Island beach front is almost fully developed and generally no more room for parking areas. However, it is recognized that visitation could be much higher than reported due to the homes and vacation rentals being in walking distance from the beach and spillover from the State Park. Applying the unit day values of $9.02 in the Without project condition of 62 total points and $10.57 for the With project condition of 85 points results in annual recreation benefits of approximately $573,200.

Table 24 summarizes the costs, benefits and other pertinent information on project justification for the NED plan with recreation benefits.

Table 24: NED Plan Benefits with Recreation Benefits

Average Annual CSDR Benefits	$2,894,000
Average Annual Recreation Benefits	$573,200
Total Average Annual Benefits	$3,467,200
Total Average Annual Cost	$1,501,000
Benefit-to-Cost Ratio	2.3
Net Benefits	$1,966,200

11. RECOMMENDED PLAN

The Recommended Plan was calculated at the Federal discount rate of 3.5% for a 50 year period of analysis. The total expected average annual coastal storm damage reduction benefits for the Recommended Plan are $2,894,000. The recreation benefits for the Recommended Plan are estimated to be $573,200, totaling $3,467,200 average annual benefits. The average annual cost is $1,501,000. Net benefits are $1,966,200 and the benefit-to-cost ratio is 2.3 to 1.

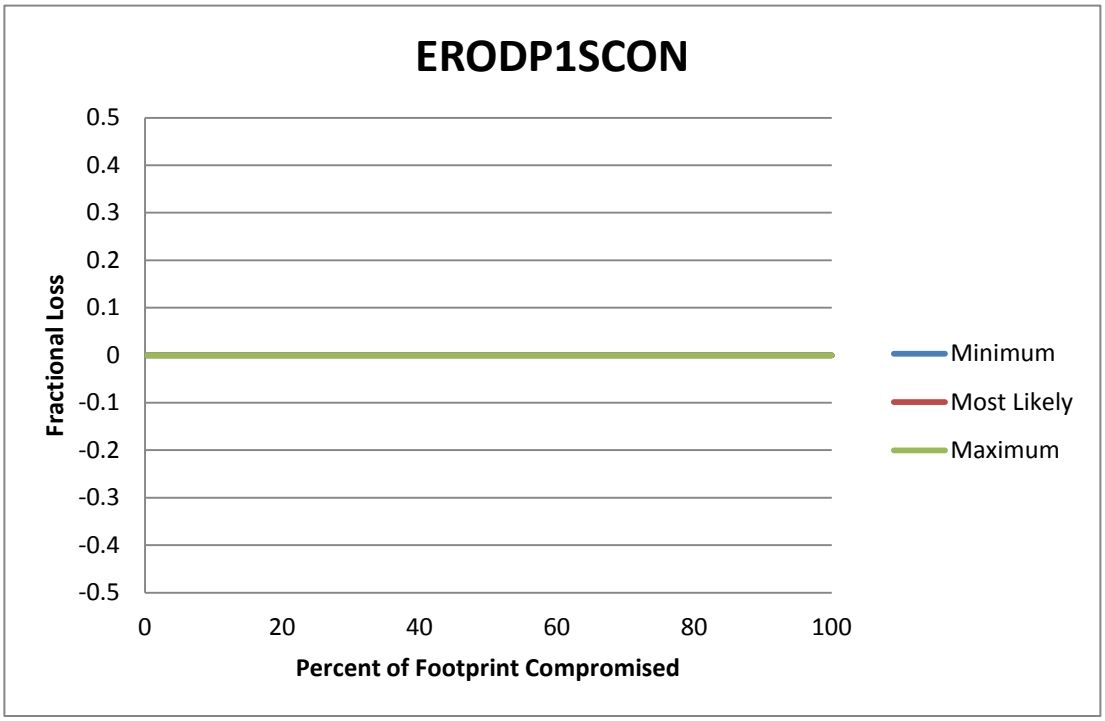
Attachment 1: Coastal Storm Damage Relationships for Edisto Beach

EDISTO BEACH DAMAGE FUNCTIONS

Erosion/Contents/Deep Piles

Multi-Family and Single Family

% of Footprint Compromised	Minimum	Most Likely	Maximum
0	0	0	0
10	0	0	0
20	0	0	0
30	0	0	0
40	0	0	0
50	0	0	0
60	0	0	0
70	0	0	0
80	0	0	0
90	0	0	0
100	0	0	0

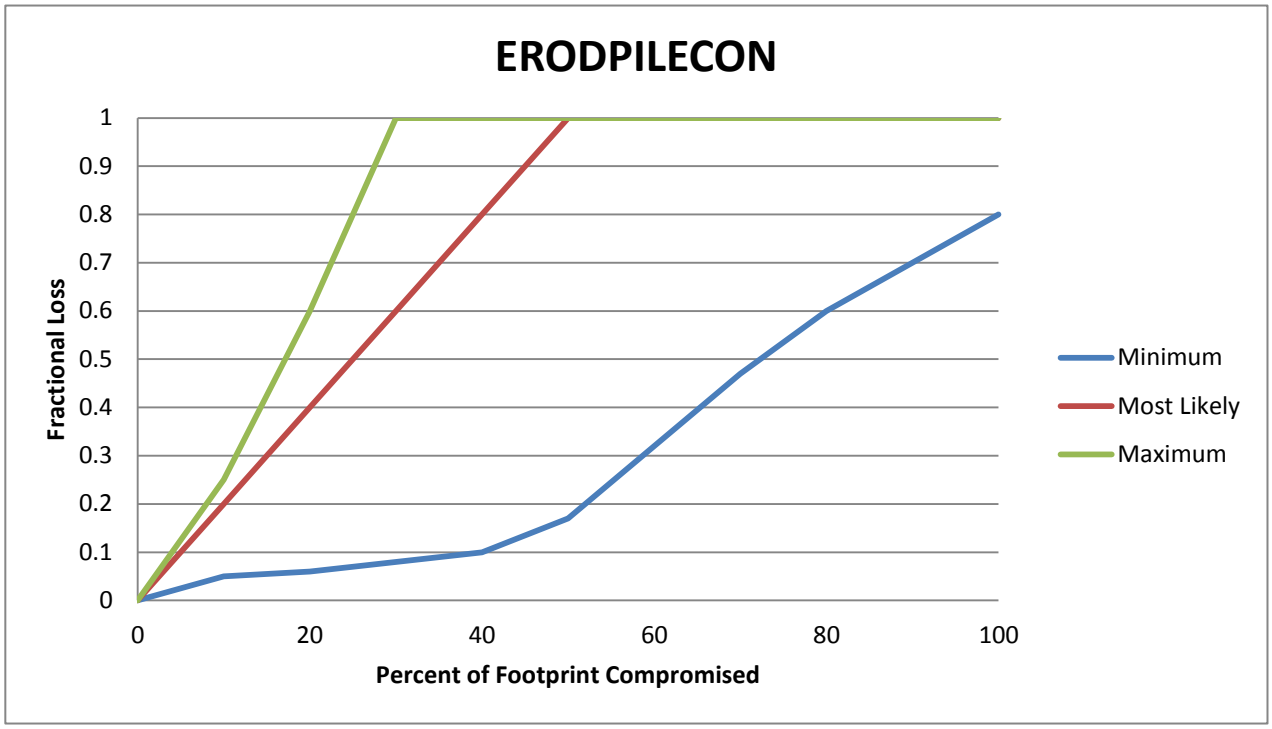


Erosion/Contents/Piles

Single Family and Walkovers

% of Footprint Compromised	Minimum	Most Likely	Maximum
0	0	0	0
10	0.05	0.2	0.25
20	0.06	0.4	0.6
30	0.08	0.6	1
40	0.1	0.8	1
50	0.17	1	1
60	0.32	1	1
70	0.47	1	1
80	0.6	1	1
90	0.7	1	1

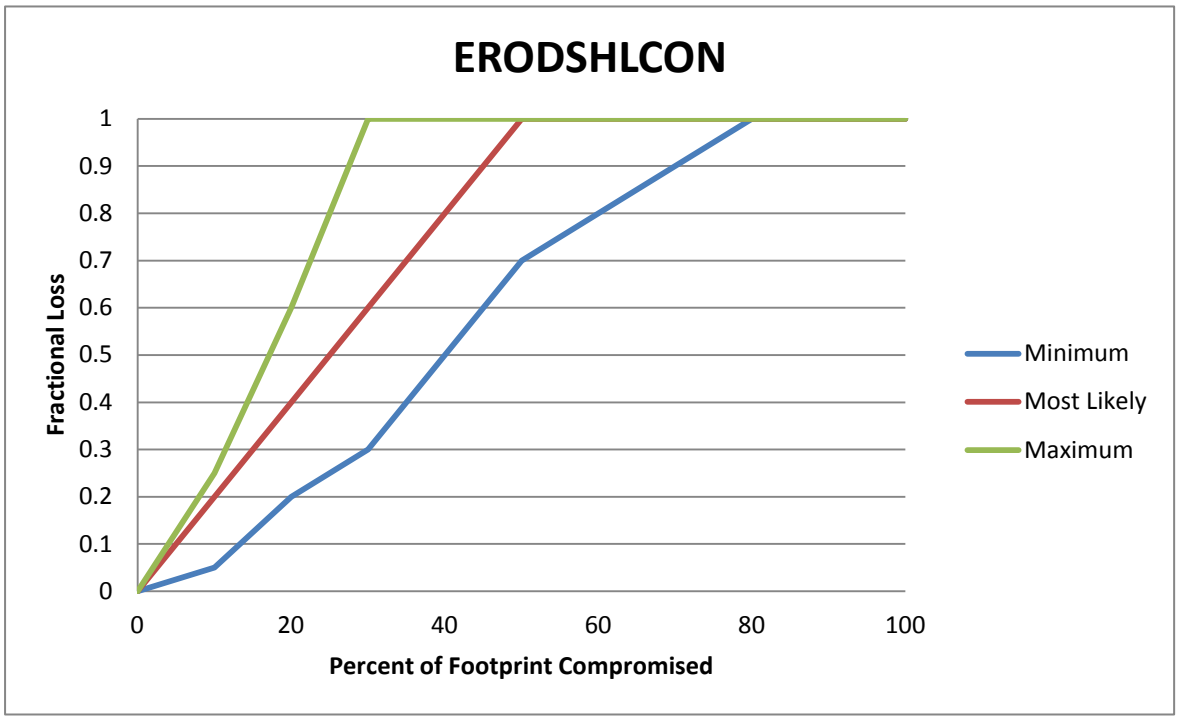
% of Footprint Compromised	Minimum	Most Likely	Maximum
100	0.8	1	1



Erosion/Contents Shallow Foundation

Single Family and Walkovers

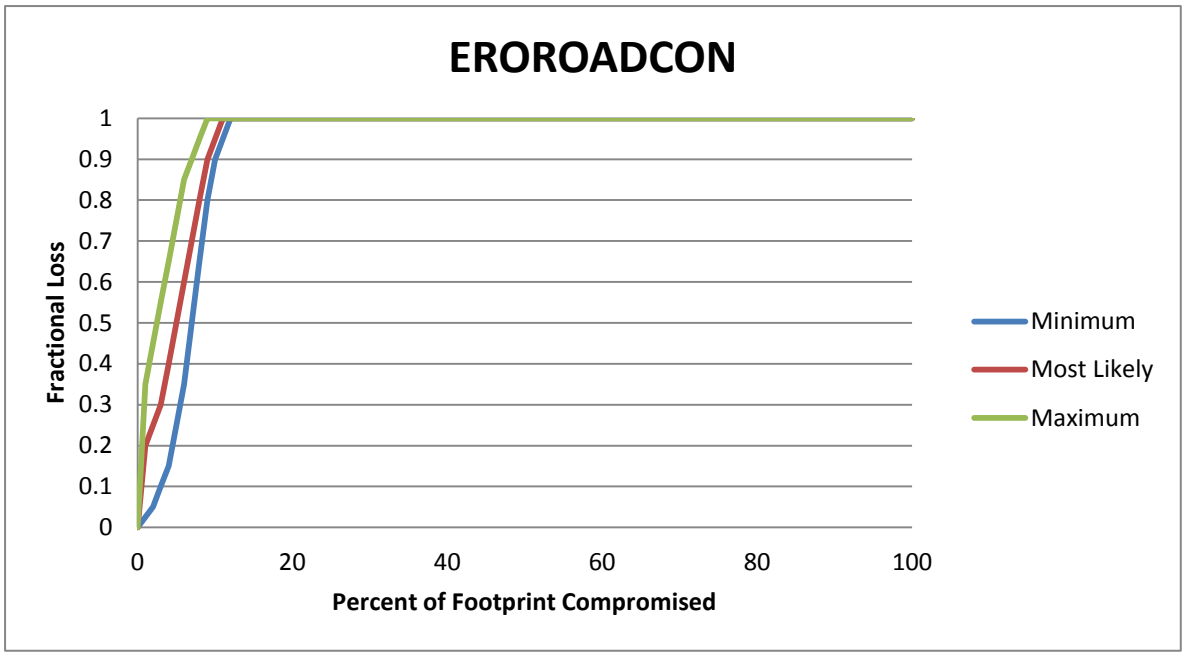
% of Footprint Compromised	Minimum	Most Likely	Maximum
0	0	0	0
10	0.05	0.2	0.25
20	0.2	0.4	0.6
30	0.3	0.6	1
40	0.5	0.8	1
50	0.7	1	1
60	0.8	1	1
70	0.9	1	1
80	1	1	1
90	1	1	1
100	1	1	1



Erosion/Contents (Water Main Adjacent to Road)

% of Footprint Compromised	Minimum	Most Likely	Maximum
0	0	0	0
1	0.025	0.2	0.35
2	0.05	0.25	0.45
3	0.1	0.3	0.55
4	0.15	0.4	0.65
5	0.25	0.5	0.75

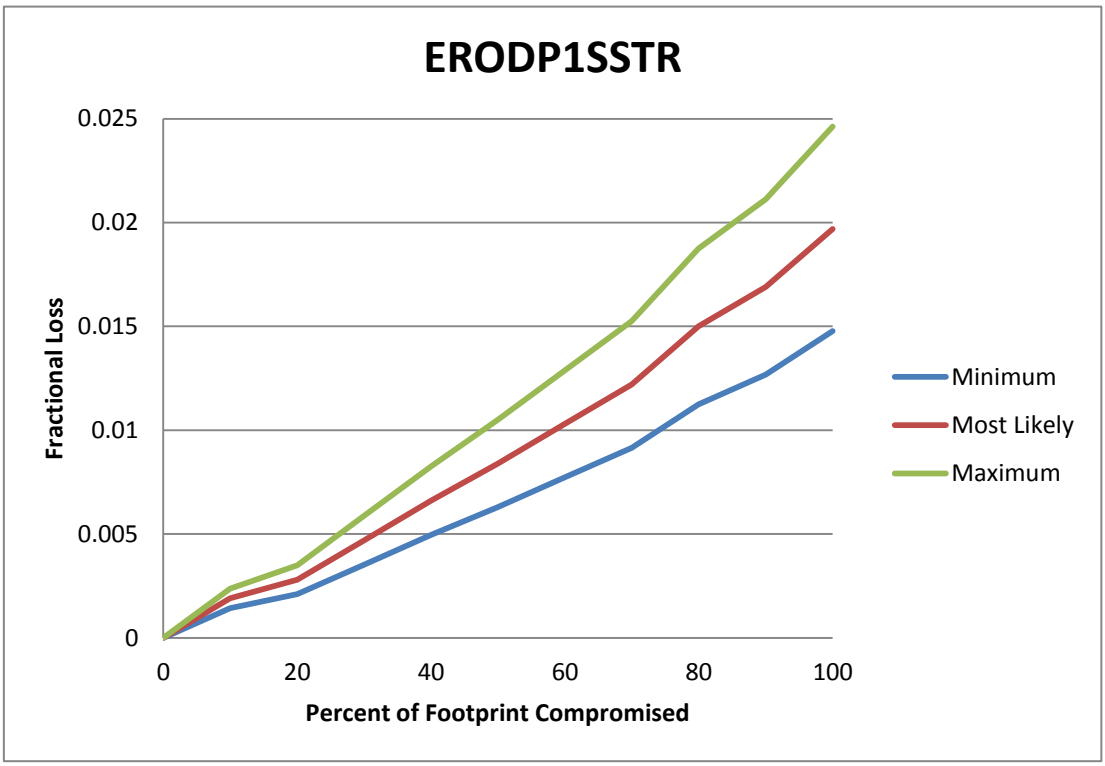
% of Footprint Compromised	Minimum	Most Likely	Maximum
6	0.35	0.6	0.85
7	0.5	0.7	0.9
8	0.65	0.8	0.95
9	0.8	0.9	1
10	0.9	0.95	1
11	0.95	1	1
12	1	1	1
100	1	1	1



Erosion/ Structure Deep Piles

Multi-Family and Single Family Dwelling

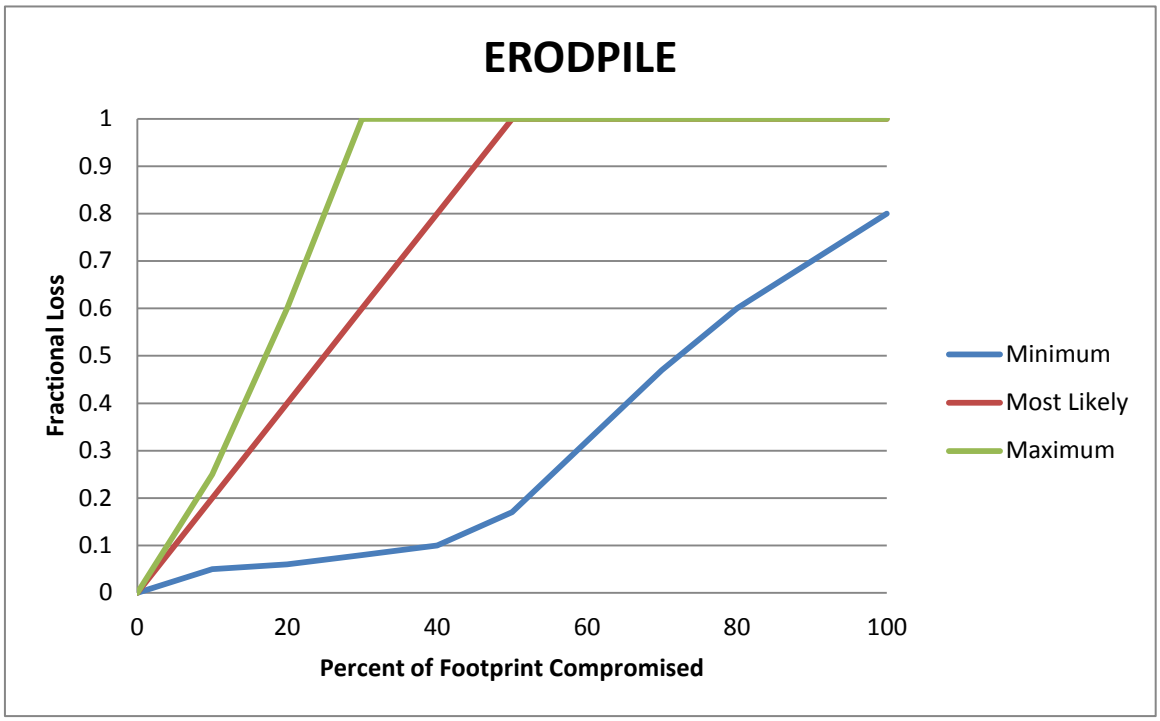
% of Footprint Compromised	Minimum	Most Likely	Maximum
0	0	0	0
10	0.001425	0.0019	0.002375
20	0.0021	0.0028	0.0035
30	0.003525	0.0047	0.005875
40	0.00495	0.0066	0.00825
50	0.0063	0.0084	0.0105
60	0.007725	0.0103	0.012875
70	0.00915	0.0122	0.01525
80	0.01125	0.015	0.01875
90	0.012675	0.0169	0.021125
100	0.014775	0.0197	0.024625


ERODP1SSTR
0.025
0.02
0.015
0.01
0.005
0
Fractional Loss
0
20
40
60
80
100
Percent of Footprint Compromised
Minimum
Most Likely
Maximum

Erosion/Structure Piles

Single Family Dwelling and Walkovers

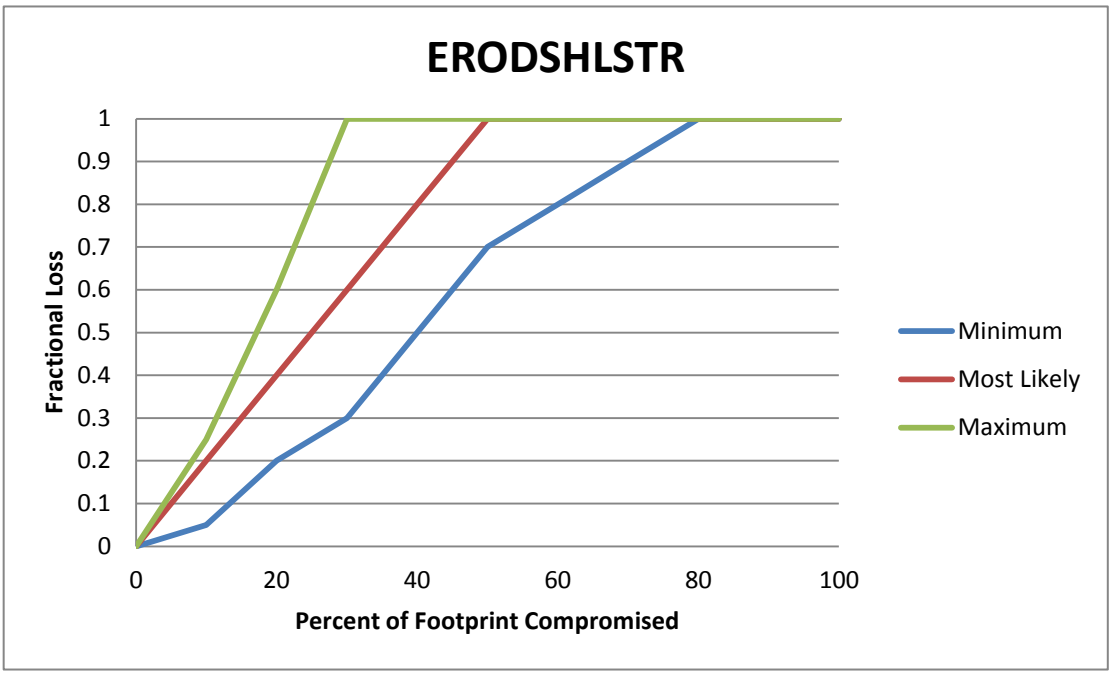
% of Footprint Compromised	Minimum	Most Likely	Maximum
0	0	0	0
10	0.05	0.2	0.25
20	0.06	0.4	0.6
30	0.08	0.6	1
40	0.1	0.8	1
50	0.17	1	1
60	0.32	1	1
70	0.47	1	1
80	0.6	1	1
90	0.7	1	1
100	0.8	1	1


ERODPILE
Fractional Loss
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
0
20
40
60
80
100
Percent of Footprint Compromised
Minimum
Most Likely
Maximum

Erosion/Structure Shallow Foundation

Single Family Dwelling and Walkovers

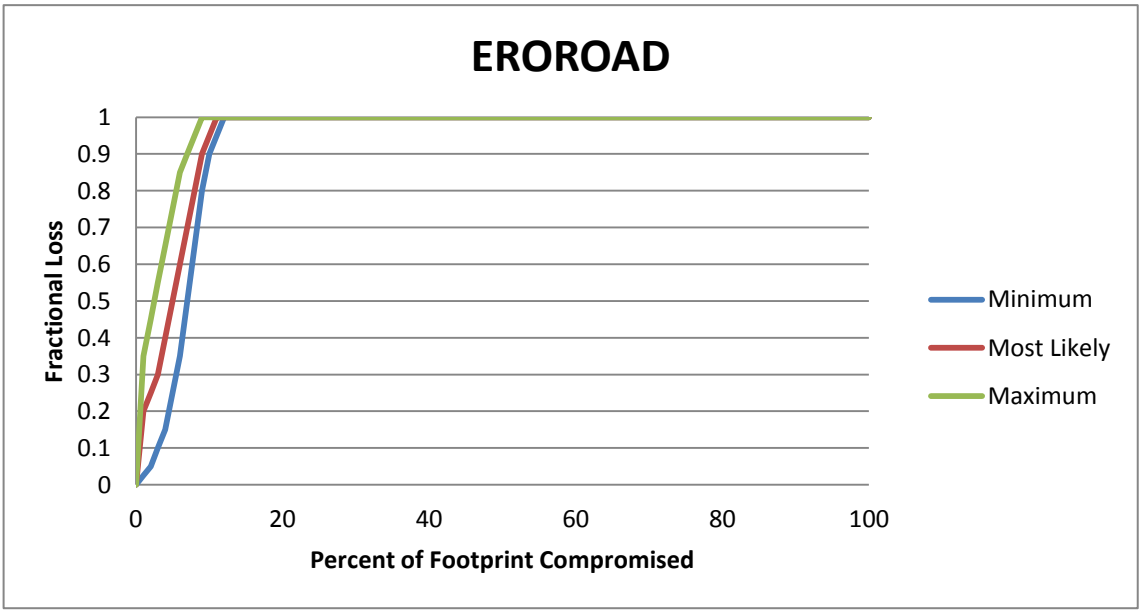
% of Footprint Compromised	Minimum	Most Likely	Maximum
0	0	0	0
10	0.05	0.2	0.25
20	0.2	0.4	0.6
30	0.3	0.6	1
40	0.5	0.8	1
50	0.7	1	1
60	0.8	1	1
70	0.9	1	1
80	1	1	1
90	1	1	1
100	1	1	1



Erosion/ Structure Road

% of Footprint Compromised	Minimum	Most Likely	Maximum
0	0	0	0
1	0.025	0.2	0.35
2	0.05	0.25	0.45
3	0.1	0.3	0.55

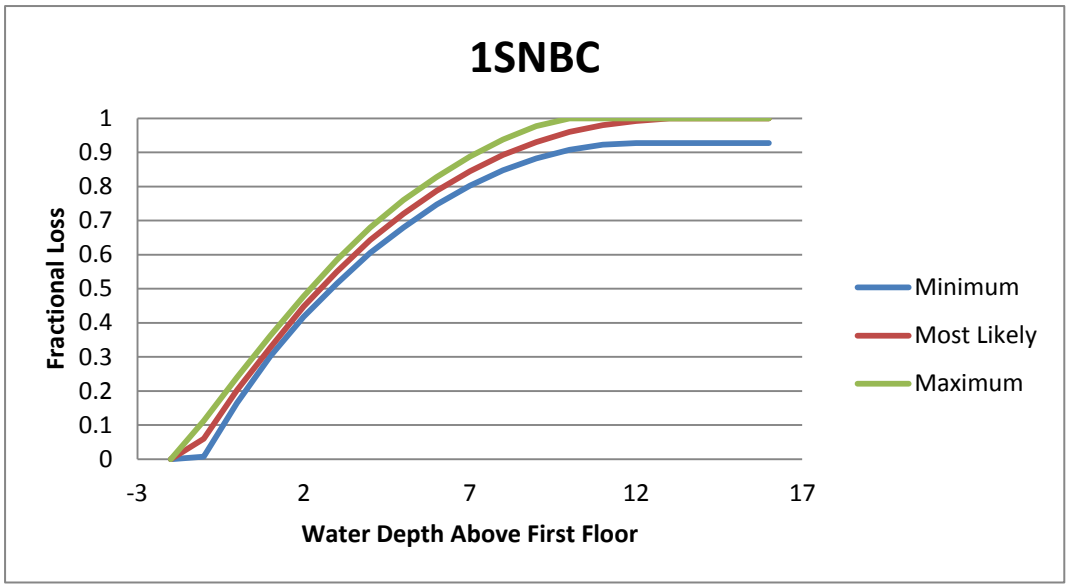
% of Footprint Compromised	Minimum	Most Likely	Maximum
4	0.15	0.4	0.65
5	0.25	0.5	0.75
6	0.35	0.6	0.85
7	0.5	0.7	0.9
8	0.65	0.8	0.95
9	0.8	0.9	1
10	0.9	0.95	1
11	0.95	1	1
12	1	1	1
100	1	1	1



Inundation/Contents All Foundations

Multi-family and Single Family Dwellings

Water Depth Above 1st Floor	Minimum	Most Likely	Maximum
-2	0	0	0
-1	0.0075	0.06	0.1125
0	0.165	0.2025	0.24
1	0.3025	0.3275	0.3625
2	0.4175	0.4475	0.4775
3	0.515	0.55	0.585
4	0.605	0.6425	0.68
5	0.68	0.72	0.76
6	0.7475	0.7875	0.8275
7	0.8025	0.845	0.8875
8	0.8475	0.8925	0.9375
9	0.8825	0.93	0.9775
10	0.9075	0.96	1
11	0.9225	0.98	1
12	0.9275	0.9925	1
13	0.9275	1	1
14	0.9275	1	1
15	0.9275	1	1
16	0.9275	1	1

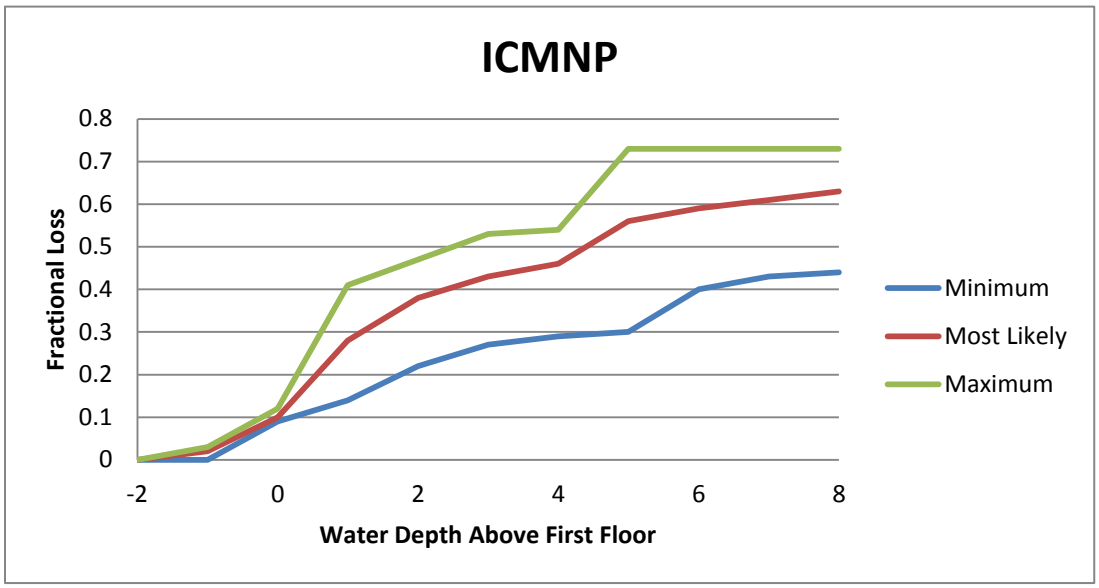


Inundations/Structure Shallow Foundation/Masonry

Single Family Dwelling

Water Depth Above 1st Floor	Minimum	Most Likely	Maximum
-2	0	0	0
-1	0	0.02	0.03
0	0.09	0.1	0.12
1	0.14	0.28	0.41
2	0.22	0.38	0.47
3	0.27	0.43	0.53
4	0.29	0.46	0.54
5	0.3	0.56	0.73
6	0.4	0.59	0.73

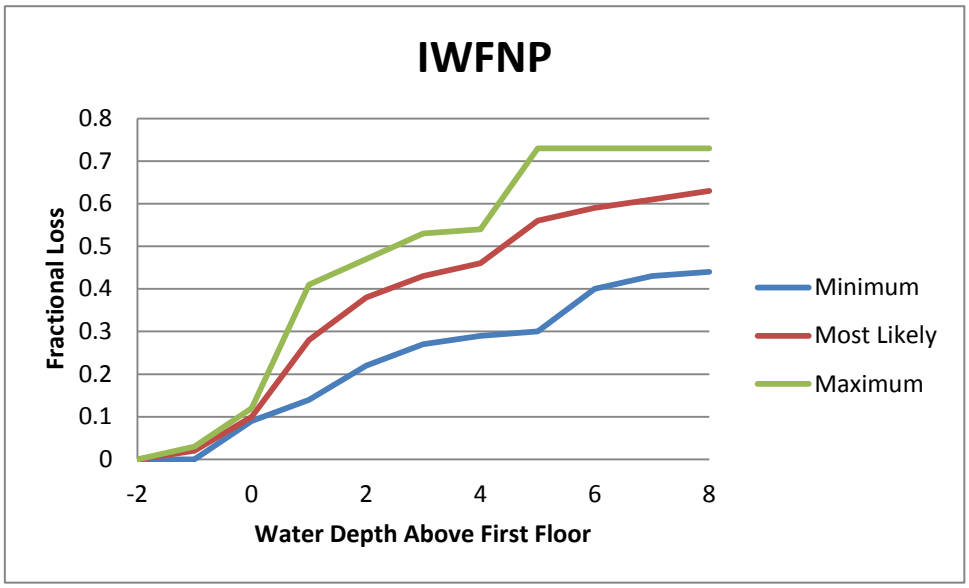
Water Depth Above 1st Floor	Minimum	Most Likely	Maximum
7	0.43	0.61	0.73
8	0.44	0.63	0.73



Inundation/Structure/Shallow Foundation/Wood

Single Family Dwelling

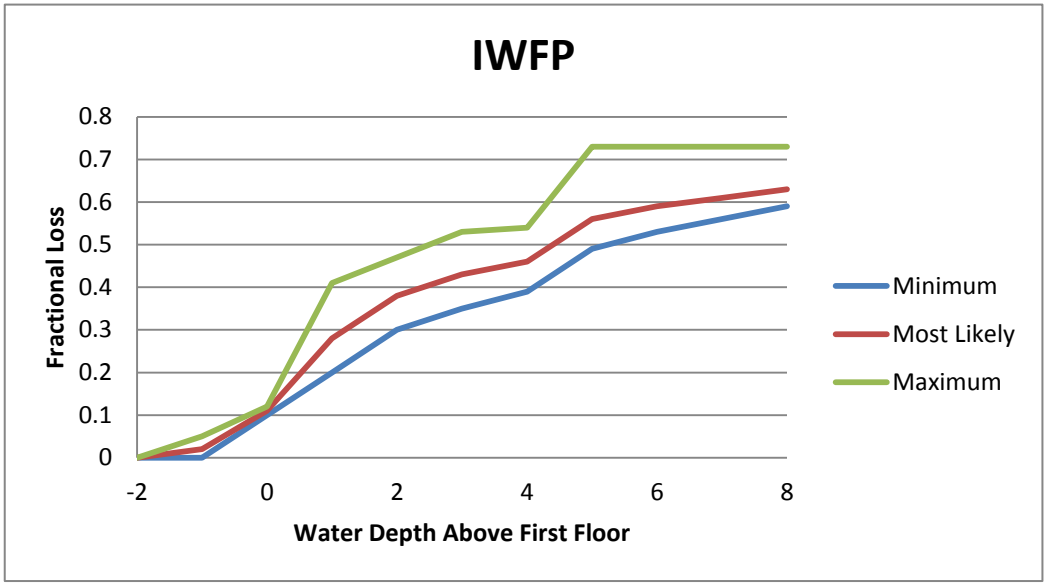
Water Depth Above 1st Floor	Minimum	Most Likely	Maximum
-2	0	0	0
-1	0	0.02	0.03
0	0.09	0.1	0.12
1	0.14	0.28	0.41
2	0.22	0.38	0.47
3	0.27	0.43	0.53
4	0.29	0.46	0.54
5	0.3	0.56	0.73
6	0.4	0.59	0.73
7	0.43	0.61	0.73
8	0.44	0.63	0.73



Inundation/Structure All Piles

Single Family and Multi-Family Dwelling

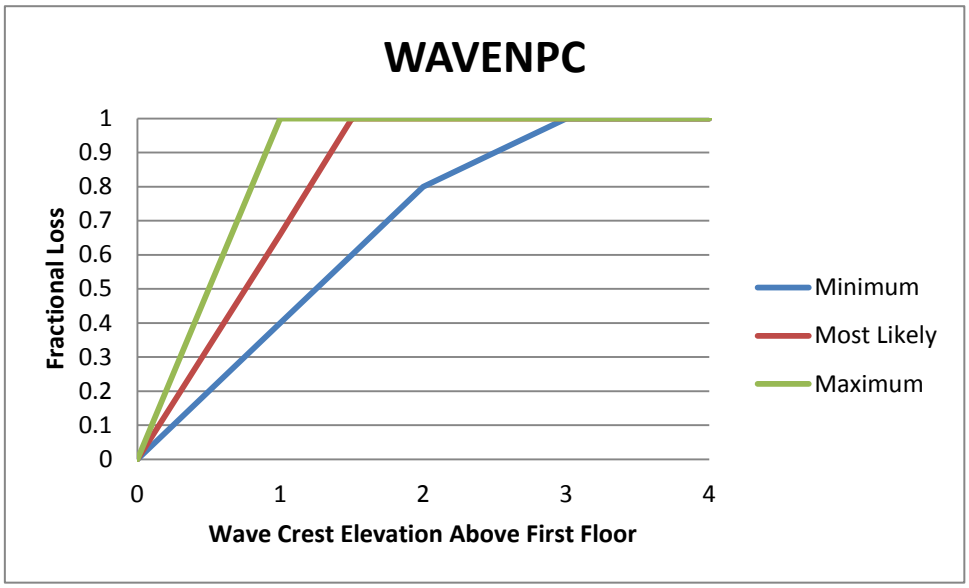
Water Depth Above 1st Floor	Minimum	Most Likely	Maximum
-2	0	0	0
-1	0	0.02	0.05
0	0.1	0.11	0.12
1	0.2	0.28	0.41
2	0.3	0.38	0.47
3	0.35	0.43	0.53
4	0.39	0.46	0.54
5	0.49	0.56	0.73
6	0.53	0.59	0.73
7	0.56	0.61	0.73
8	0.59	0.63	0.73


IWFP
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
Fractional Loss
-2
0
2
4
6
8
Water Depth Above First Floor
Minimum
Most Likely
Maximum

Wave/Contents/Shallow Foundation

Single Family Dwelling

Wave Crest Elevation Above 1st Floor	Minimum	Most Likely	Maximum
0	0	0	0
0.5	0.2	0.33	0.5
1	0.4	0.66	1
1.5	0.6	1	1
2	0.8	1	1
2.5	0.9	1	1
3	1	1	1
3.5	1	1	1
4	1	1	1

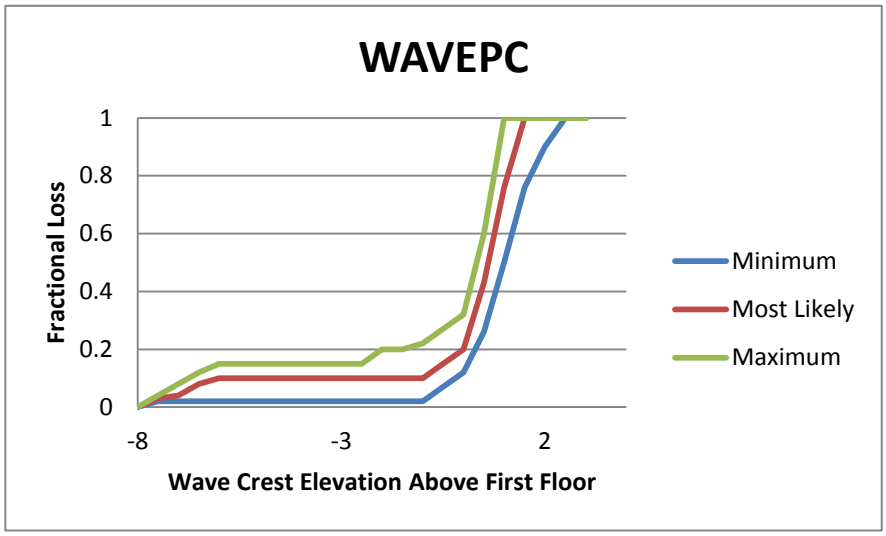

WAVENPC
Fractional Loss
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
0
1
2
3
4
Wave Crest Elevation Above First Floor
Minimum
Most Likely
Maximum

Wave/Contents Pile Foundation

Single Family Dwelling, Multi-family Dwelling and Walkovers

Wave Crest Elevation Above 1st Floor	Minimum	Most Likely	Maximum
-8	0	0	0
-7.5	0.02	0.03	0.04
-7	0.02	0.04	0.08
-6.5	0.02	0.08	0.12
-6	0.02	0.1	0.15
-5.5	0.02	0.1	0.15
-5	0.02	0.1	0.15
-4.5	0.02	0.1	0.15
-4	0.02	0.1	0.15
-3.5	0.02	0.1	0.15
-3	0.02	0.1	0.15
-2.5	0.02	0.1	0.15
-2	0.02	0.1	0.2
-1.5	0.02	0.1	0.2
-1	0.02	0.1	0.22
-0.5	0.07	0.15	0.27
0	0.12	0.2	0.32
0.5	0.26	0.43	0.6
1	0.5	0.76	1
1.5	0.76	1	1
2	0.9	1	1

Wave Crest Elevation Above 1st Floor	Minimum	Most Likely	Maximum
2.5	1	1	1
3	1	1	1

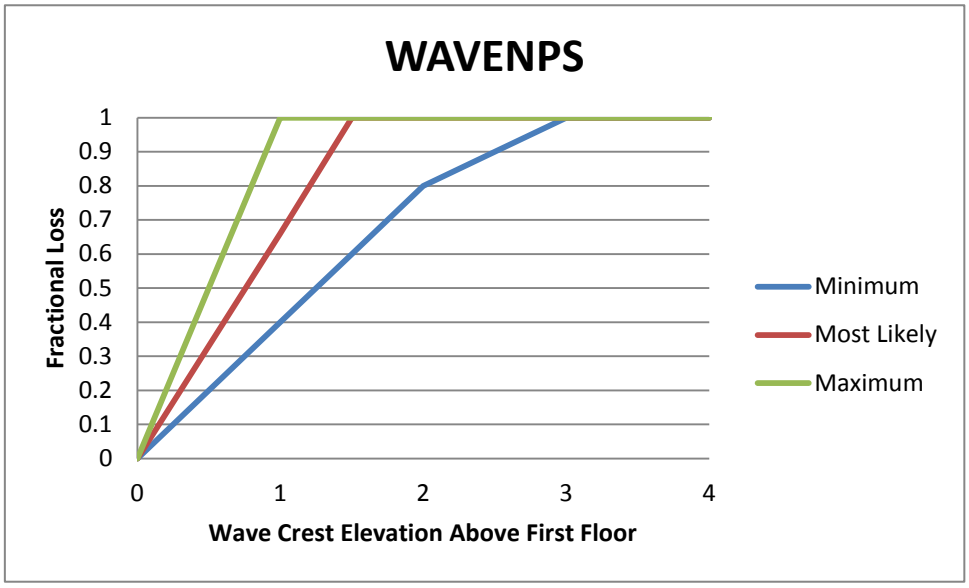


Wave/Structure/Shallow Foundation

Single Family Dwelling

Wave Crest Elevation Above 1st Floor	Minimum	Most Likely	Maximum
0	0	0	0
0.5	0.2	0.33	0.5
1	0.4	0.66	1
1.5	0.6	1	1
2	0.8	1	1
2.5	0.9	1	1
3	1	1	1
3.5	1	1	1

Wave Crest Elevation Above 1st Floor	Minimum	Most Likely	Maximum
4	1	1	1

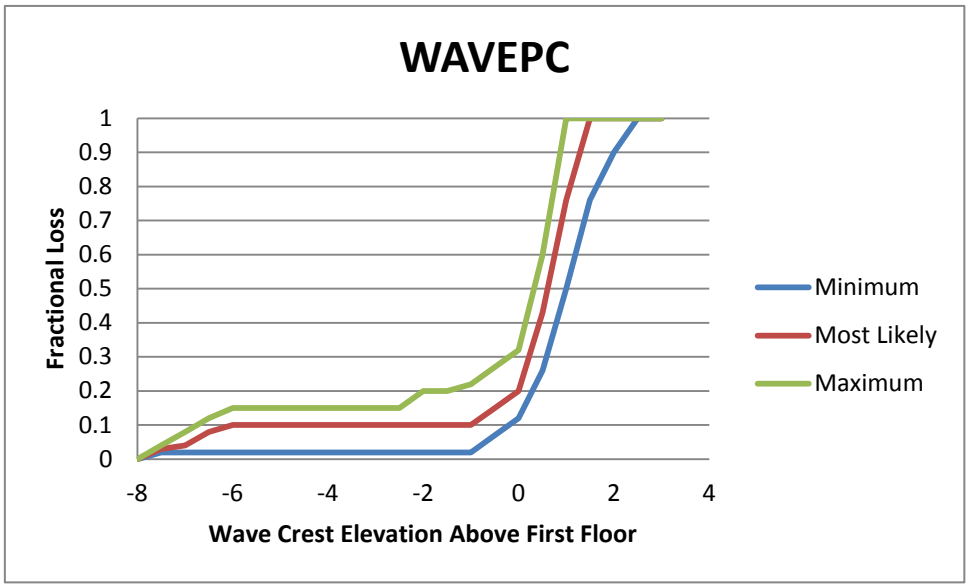


Wave/Contents/Pile Foundation

Single Family Dwelling, Multi-Family Dwelling and Walkovers

Wave Crest Elevation Above 1st Floor	Minimum	Most Likely	Maximum
-8	0	0	0
-7.5	0.02	0.03	0.04
-7	0.02	0.04	0.08
-6.5	0.02	0.08	0.12
-6	0.02	0.1	0.15
-5.5	0.02	0.1	0.15
-5	0.02	0.1	0.15
-4.5	0.02	0.1	0.15
-4	0.02	0.1	0.15
-3.5	0.02	0.1	0.15
-3	0.02	0.1	0.15
-2.5	0.02	0.1	0.15
-2	0.02	0.1	0.2
-1.5	0.02	0.1	0.2
-1	0.02	0.1	0.22
-0.5	0.07	0.15	0.27
0	0.12	0.2	0.32
0.5	0.26	0.43	0.6
1	0.5	0.76	1
1.5	0.76	1	1
2	0.9	1	1

Wave Crest Elevation Above 1st Floor	Minimum	Most Likely	Maximum
2.5	1	1	1
3	1	1	1



Attachment 2: Edisto Beach Recreation Benefits Analysis

Table of Contents

INTRODUCTION:

The purpose of this section is to estimate National Economic Development (NED) recreation benefits that will accrue as a result of implementing the tentatively selected coastal storm damage reduction plan on Edisto Beach. It is noted that the tentatively selected plan is not formulated for recreation benefits. They are considered incidental to the primary project purpose of storm damage reduction. NED benefits are economic benefits which accrue to the nation as a whole. They should not be confused with regional economic benefits which include localized impacts that are primarily transfers from a national perspective.

Currently, there are no private beaches in the project area, they are all for public use. Edisto Beach provides parking for the general public, either in parking lots or on the street parking. The State of South Carolina recognizes that in order participate in beach nourishment projects public access is a must and therefore protects and promotes public access to the state's beaches. Parking is a reasonable walking distance to the beach.

EVALUATION PROCEDURE:

The evaluation procedure used for this report is the Unit Day Value method (UDV). This method relies on expert or informed opinion and judgment to estimate the average willingness to pay of recreational users. Unit Day Value (UDV) method was selected as the evaluation procedure because there are no specialized recreational activities for the area and the annual visits expected do not exceed 750,000.

LOCATION:

The Town of Edisto Beach (the Town) and Edisto Beach State Park are part of Edisto Island located in South Carolina. The Town of Edisto Beach occupies the central and southern portions of the island and is generally separated from Edisto Beach State Park by State Highway 174. Its beachfront extends approximately 4.5 miles between Highway 174 and the South Edisto River/St. Helena Sound. The town has been developed as a permanent and seasonal residential area with limited commercial development. Edisto Beach State Park occupies approximately 1,255 acres of the island and is structured around a dense live oak and maritime forest. It offers ocean and marsh side camping sites, as well as cabins, picnic areas, and nature and hiking trails. The park had approximately 312,640 recorded visitors in 2012. Its beachfront extends approximately 1.5 miles between Jeremy Inlet and Highway 174.

COMPETING RESOURCES:

Edisto Beach provides a variety of recreational activities including sunbathing, swimming, beachcombing, walking/jogging, cycling, fishing, surfing, sand sculpting, beach games and has become increasingly popular for weddings, parties and receptions. The Town has 4.67 miles of bike/walking trails integrated throughout the town that provide recreational activities for the public. Competing resources are other beaches such as Isle of Palms, Hilton Head, Sullivan Beach, Kiawah Island and Folly Beach. However, Edisto Beach is one of the few remaining un-commercialized, family-oriented beaches on the coast of South Carolina.

BENEFIT EVALUATION:

In order to determine the recreation benefits of the tentatively selected plan an economic value must be placed on the recreation experience at the Edisto Beaches. By applying a unit day value to estimated use, an approximation is obtained that will be used to estimate project recreation benefits. For this analysis, general unit day values (UDV) are used to determine the economic value of recreation at Edisto Beach. UDV are administratively determined values which represent the NED recreation values for typical types of recreation. Guidance for their use is provided by Engineering Regulation 1105-2-100.

CURRENT VISITATION:

In 2012, the Town of Edisto Beach area had approximately 371,000 beach visitors. Traffic counts combined with estimated rentals determine expected visitors per year. This estimate is based on data provided by the Town of Edisto Beach. Visitation is generally constrained by availability of beach area only during peak days and is not limited at other times of the year. The peak recreation season is Memorial Day through Labor Day. Recreational visitation reaches a peak four times a year. These times are Spring Break, Memorial Day, Independence Day and Labor Day. Table 1 shows annual visitation from 2009 to 2012.

Table 25: Edisto Beach Annual Visitation

Year	Visitation
2009	245,000
2010	297,500
2011	350,000
2012	371,000

PARKING AND ACCESS:

Public parking along the right of way in the Town of Edisto's streets is permitted by the Town. There are 113 on street parking spaces. There are 24 public access points that provide an additional 206 parking spaces. There are two private parking areas that provide additional parking; Pavilion Pier and the facility at the Wyndham Resort. The State Park also provides some parking for those visitors who park at the State Park and recreate on the Edisto Beaches outside of the park limits due capacity constraints at the park. Some of the remaining beach capacity could be used by the public dropping visitors off without parking, and residence and vacationers of Edisto Beach.

There are a total of 38 public access points, excluding the State Park, in Edisto Beach that lie along Palmetto Boulevard, Point Street and Yacht Club Road. Each access is marked with a highly reflective blue sign and numbered 1 thought 38 for notification of where the accesses are located. The average width of each access is 50 feet with an average distance between each access point of 400ft. Maintenance is performed on an annual basis at each access point by

volunteer groups and town personnel. There is a private access area that serves Wyndham Resorts, but the right of way leading to the facility is owned by the Town. This facility is accessible to the public and contains a drop off area for a tram shuttle, concessions, showers, restrooms, handicap access, among other amenities.

According to ER1105-2-100, reasonable access is access approximately every one-half mile or less. Each access point is identified with "Beach Access" signs. The 38 access points are exclusive of the State Park. Provisions of reasonable public access rights of ways are present in Edisto Beach. The following table shows the beach access location and facilities at each location.

Table 26: Edisto Beach Parking and Access

	PARKING & ACCESS								
Location	Feet Between Access Points	Sign Number	Pedestrian Only	Boardwalk	Walkover	Off-Street Parking	On-Street Parking	Handicapped Access	Signage
Coral St	842	1				6	x		x
Fenwick St	807	1a	x				x		x
Mary St	829	2	x				x		x
Whaley St	791	3	x				x		x
Matilda St	797	4	x				x		x
Cupid St	787	5	x				x		x
Atlantic St	802	6	x				x		x
Portia St	797	7	x				x		x
Dawhoo St	300	8				6	x		x
Cheehaw St	288	9				10	x		x
Osceola St	290	10				8	x		x
Byrd St	300	11	x				x		x
Nancy St	302	12				6	x		x
Thistle St	317	13				11	x	x	x
Chancellor St	300	14	x			12	x		x
Dorothy St	300	15	x				x		x
Marianne St	284	16				10	x	x	x
Lybrand St	300	17		x	x	10	x	x	x
Catherine St	300	18	x	x			x		x
Mitchell St	303	19			x	15	x	x	x
Baynard St	300	20	x		x	10	x	x	x
Edings St	300	21		x	x	7	x	x	x
Jenkins St	300	22				6	x	x	x
Seabrook St	300	23				10	x	x	x
Murray St	300	24				10	x	x	x
Holmes St	308	25				10	x	x	x
Loring St	300	26				10	x	x	x
Laroche St	300	27				10	x	x	x

	PARKING & ACCESS								
Location	Feet Between Access Points	Sign Number	Pedestrian Only	Boardwalk	Walkover	Off-Street Parking	On-Street Parking	Handicapped Access	Signage
Neptune St	907	28	x			12	x	x	x
Billow St	300	29	x	x			x		x
White Cap St	350	30				9	x	x	x
Edisto St.	387	31				6	x	x	x
Mikell St.	599	32		x		2	x	x	x
Townsend St.	1249	33	x				x		x
Louise St.	600	34	x	x			x		x
Ebb Tide St.	1425	35		x	x	4	x	x	x
Yacht Club Rd.	865	36	x	x			x		x
Yacht Club Rd.		37		x		6	x		x

BEACH AREA AND CAPACITY:

Beach area acts as a constraint on the number of visitors that will visit the Edisto Beaches during peak days. To measure the beach capacity of the existing condition, the existing condition beach profile was used to calculate the total area that can be used for recreation. The total length of the project in which beach visitors can recreation on the existing berm is 27,128 feet. The length is then multiplied by the berm width of the given reach to determine the total area of that reach. The total area of all reaches in which recreation occurs for the Without project condition is 944,965 square ft. It is assumed that each visitor will require 100 square feet of beach each day. In the Without project condition, Edisto Beach parking areas are capable of supporting 9,450 users per day. In the With Project condition, the total beach area is 956,371and the beach is capable of supporting 9,565 visitors per day. Assuming an average of 4 persons per automobile and a turnover rate of 1.5 cars per parking space per day because some visitors spend only part of the day at the beach, the 319 parking spaces will support visitation of about 1,914. Besides the parking spaces and spill over from the State Park, Edisto Beach has the potential to receive many more visitors. The entire Town of Edisto has the capability of walking to the beach. The structures are located such that the distance for a walk to the beach on the island is a half mile or less. There are about 2,400 residences in walking distance to the beach.

WITHOUT AND WITH PROJECT VALUES:

The UDV are determined using a point system that takes into account the following factors: recreation experience, availability of opportunity, carrying capacity, accessibility, and environmental (esthetics) quality. A good deal of judgment is required in the assessment of point values. A group of five planning professionals and experts of the study area made independent judgments of the UDV values which were averaged. The differences in the values were applied to the estimated visitation. The difference in the Without and With project values of recreation

determine the NED recreation benefits. The source of the value of recreation is obtained from the Economic Guidance Memorandum, 13-03, Unit Day Values for Recreation for Fiscal Year 2013.

Point System:

Recreation Experience. Under the Without project condition, Edisto beaches have several general recreation activities including swimming, boating, picnicking, crabbing, shrimping, kayaking and sunbathing, providing a recreation experience equivalent to 16 points out of 30. In the With project condition, it is assumed the beach area will provide for a better recreation experience due to the beach area being increased and the project being maintained to a certain template and received a rating of 28.

Availability of Opportunity. Availability of opportunity is considered high because there are not similar beaches within 30 minutes to one hour driving time. Edisto Beach is rare because it remains one of the few family-oriented, gently developed beaches in South Carolina. Because there are not a large number of competing recreation opportunities, this category was 16 points out of 18 in the Without project condition and 18 points in the With project condition.

Carrying Capacity. The carrying capacity of the facilities is considered adequate to conduct recreation during peak demand days, although facilities can certainly be strained at those times. The carrying capacity is the same in the Without and With project condition and a rating of 13 out of 14 was given to both conditions.

Accessibility. The project is considered very accessible, with high quality roads to the site and 38 access points within the site. This equates to 13 points out of a total of 18 both for the With and Without project conditions since the conditions will not change.

Environment. A rating of 4 out of a total of 20 points was awarded because the current aesthetic value is of average quality. Under the With project condition, it was felt that the additional beach width would result in an increase in esthetic value during peak days. It is expected the aesthetic quality of the beach will be enhanced as a result of the project and will not degrade over time due to erosion as would occur in some areas in the Without project condition and a With project condition value of 15 is applied.

The UDV point totals convert to a recreation value of $9.02 in the Without project condition and the $10.57 in the With project condition per Economics Guidance Memorandum, 13-03, Unit Day Values for Recreation, Fiscal Year 2013. The difference in the Without and With project conditions general recreation values is $1.55. The dollar values for UDV scores of 62 and 85 were obtained by interpolating between 60 and 70 in the Without project condition and 80 and 90 in the With project condition. Table 3 shows the UDV for Edisto Beach.

Table 27: UDV for Edisto Beach

Criteria	W/O Project Points	W/ Project Points

Criteria	W/O Project Points	W/ Project Points
Recreation Experience	16	28
Availability of Opportunity	16	18
Carrying Capacity	13	13
Accessibility	13	13
Environment (Esthetics)	4	15
Total Points	62	85
General Recreation Value	$9.02	$10.57

Because Edisto Beach is already a public beach, there will be no new visitation based on the beach becoming accessible to the general public due to a Federal project. It is assumed that the 2012 visitation is indicative of future visitation given that the Edisto Island beach front is almost fully developed and generally there is no more room for parking areas. However, it is recognized that visitation could be much higher than reported due to the homes and vacation rentals being in walking distance from the beach and spill over from the State Park. Applying the unit day values of $9.02 in the Without project condition of 62 total points and $10.57 for the With project condition of 85 points results in annual recreation benefits of approximately $573,200. Table 4 shows the benefit to cost ratio analysis with recreation benefits.

Table 28: Summary of Benefits and Cost

Average Annual CSDR Benefits	$ 2,894,000
Average Annual Recreation Benefits	$ 573,200
Total Average Annual Benefits	$ 3,467,200
Total Average Annual Cost	$ 1,501,000
Benefit-to-Cost Ratio	2.3
Net Benefits	$ 1,966,200