US Army Corps of Engineers
Philadelphia District

Delaware Department of
Natural Resources and
Environmental Control

Delaware Beneficial Use of Dredged Material for the Delaware River

Feasibility Report and Integrated Environmental Assessment
Technical Appendices

Volume II

03/16/2018

Volume II

Appendix A – Economic Analysis

Appendix B – Real Estate Plan

Appendix A – Economic Analysis

Beneficial Use of Dredged Material for the Delaware River

Delaware

Coastal Storm Risk Management Project

Integrated Feasibility Study and Environmental Assessment

Appendix A

Economics

March 2018

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Executive Summary

The Delaware Beneficial Use of Dredged Material Study consists of eight sites along the Delaware Bay coastline. This includes, from North to South, Pickering Beach, Kitts Hummock, Bowers Beach, South Bowers Beach, Big Stone Beach, Slaughter Beach, Prime Hook Beach, and Lewes Beach. In total, these eight sites include over 6,500ft of shoreline along the Delaware Bay within Kent and Sussex counties.

This study is undertaken to assess the feasibility of providing Federal Coastal Storm Risk Management measures to each of the eight target sites. Coastal damage for each of the alternatives at each site is evaluated using the appropriate and certified USACE model Beach-fx version 1.1. This model employs event-based Monte Carlo life cycle simulation software to estimate erosion, wave, and inundation damages in the With- and Without-Project conditions. Benefits and costs are stated in FY2018 price level and are discounted using the FY2018 Project Evaluation and Formulation Rate (Discount Rate) of 2.75%.

Following preliminary screenings and a detailed study evaluation, the project delivery team has determined the National Economic Development (NED) plan for reducing coastal storm damage and reasonably maximizing net benefits. The NED plan includes construction across seven project sites (Big Stone Beach is screened from the final NED plan). The evaluation covers a 50-year period of analysis with a base year of 2020. Plan Formulation uses the Intermediate Relative Sea Level Change (RSLC) curve as calculated by the USACE Sea Level Change Curve Calculator. RSLC sensitivity analysis also includes the Low (Historic) and High RSLC Curves. Shown below are the NED specifications and results:

Table 1: National Economic Development (NED) Plan Dune and Berm Templates

Site	Dune Height	Dune Width	Berm Width
Pickering	BERM ONLY	BERM ONLY	100
Kitts Hummock	BERM ONLY	BERM ONLY	100
Bowers	12	25	75
South Bowers	12	25	100
Slaughter Beach	8.5	25	50
Prime Hook	12	25	50
Lewes Beach	12	25	50

Table 2: Average Annual Net Benefits and Benefit-Cost Ratio

Site	Total NPV Cost	AAC	AAB	AANB	BCR
Pickering	$26,618,408	$985,970	$1,774,745	$788,775	1.8
Kitts Hummock	$22,605,790	$837,339	$1,405,476	$568,136	1.7
Bowers	$25,891,094	$959,030	$1,294,511	$335,481	1.4
South Bowers	$23,273,474	$862,071	$963,384	$101,313	1.1
Slaughter Beach	$39,747,856	$1,472,297	$2,739,456	$1,267,159	1.9
Prime Hook	$36,281,939	$1,343,916	$2,430,049	$1,086,133	1.8
Lewes Beach	$33,095,900	$1,225,903	$1,623,942	$398,039	1.3
Total Project	**$207,514,463**	**$7,686,527**	**$12,231,562**	**$4,545,036**	**1.6**

With avoided erosion, inundation, and wave attack damages to coastal infrastructure along with Federal disposal costs foregone and Land Loss Prevention benefits, the NED Plan has Average Annual Net Benefits (AANB) of $4,545,036 with a Benefit-Cost Ratio (BCR) of 1.6.

TABLE OF CONTENTS

List of Figures

List of Tables

INTRODUCTION

This appendix presents the economics methodology, assumptions, and resulting analysis for managing coastal storm risk along the Delaware coastline. The report will detail each step of the Beach-fx modeling process and describe the relevant inputs and results for each study site. The assessment is conducted at a Feasibility level and covers eight Delaware project sites:

Figure 1: Beneficial Use of Dredged Material - Delaware - Study Area

BEACH-FX ANALYSIS SOFTWARE DESCRIPTION

Beach-fx certified modeling software was developed by researchers at the Engineering Research and Development Center (ERDC) Coastal and Hydraulics Laboratory and the US Army Engineer Institute for Water Resources (IWR) as a tool for accurately evaluating the physical performance and economic benefits and costs of shore protection projects. The software employs an event-based Monte Carlo life cycle simulation to measure the impact of future hurricane and storm damages over the project life while accounting for risk and uncertainty in the analysis. The software evaluates shoreline change and economic consequences associated with three damage drivers: inundation, erosion, and wave attack.

This study utilizes an individual Beach-fx model for each of the eight project locations. All Economic inputs were developed by the project development team Economist and all morphology inputs, including profile determination and SBEACH modeling, were developed by engineering (see Engineering Appendix).

Model Elements

Beach-fx is divided into three levels of socioeconomic inputs: Reaches, Lots, and Damage Elements. Reaches are contiguous stretches of the shoreline that share a common morphological makeup with a particular beach Profile. They are the broadest category and are used to organize damage results, periodic nourishment volumes, and other model outputs. Lots are organizational containers within the model to more efficiently evaluate Damage Elements. The effects of morphology changes are transferred to individual Damage Elements via Lots. Damage Elements themselves are the most specific item within the Beach-fx structure inventory and represent any structure where damages can be incurred. This includes residential houses, commercial buildings, public structures, and other elements. Damage Elements include the following variables to evaluate inundation, erosion, and wave attack damages:

- Representative geographical reference (Delaware State Plane Projected Coordinate System)
- Usage or Type (Residential Single-Family, Residential Multi-Family, Commercial, Apartment)
- Alongshore length and cross shore width
- Number of floors
- Foundation type
- First Floor Elevation (Ground Elevation plus Foundation Height)
- Depreciated Replacement Value of Structure
- Depreciated Replacement Value of Contents
- Number of Rebuilds (Maximum number of repairs over project life)
- Rebuild Time (Length of time to complete each structure repair)

This appendix will cover each site individually and explain the methodology and assumptions behind each of the inputs used in their respective Beach-fx models. All aerial imagery was supplied by Esri, DigitalGlobe, NOAA Digital Coast, and Google Earth Pro.

SITE OVERVIEW

Pickering Beach (Dover, Kent County, DE)

Pickering Beach is a small, beach community with a study area that includes 39 unique Damage Elements with three Lots and three Reaches:

Figure 2: Pickering Beach Inventory

Kitts Hummock (Dover, Kent County, DE)

Kitts Hummock is another beach community on the outskirts of Dover, DE. In total, the study area includes 74 unique Damage Elements with eleven Lots and seven Reaches:

Figure 3: Kitts Hummock Inventory

Bowers Beach (Bowers, Kent County, DE)

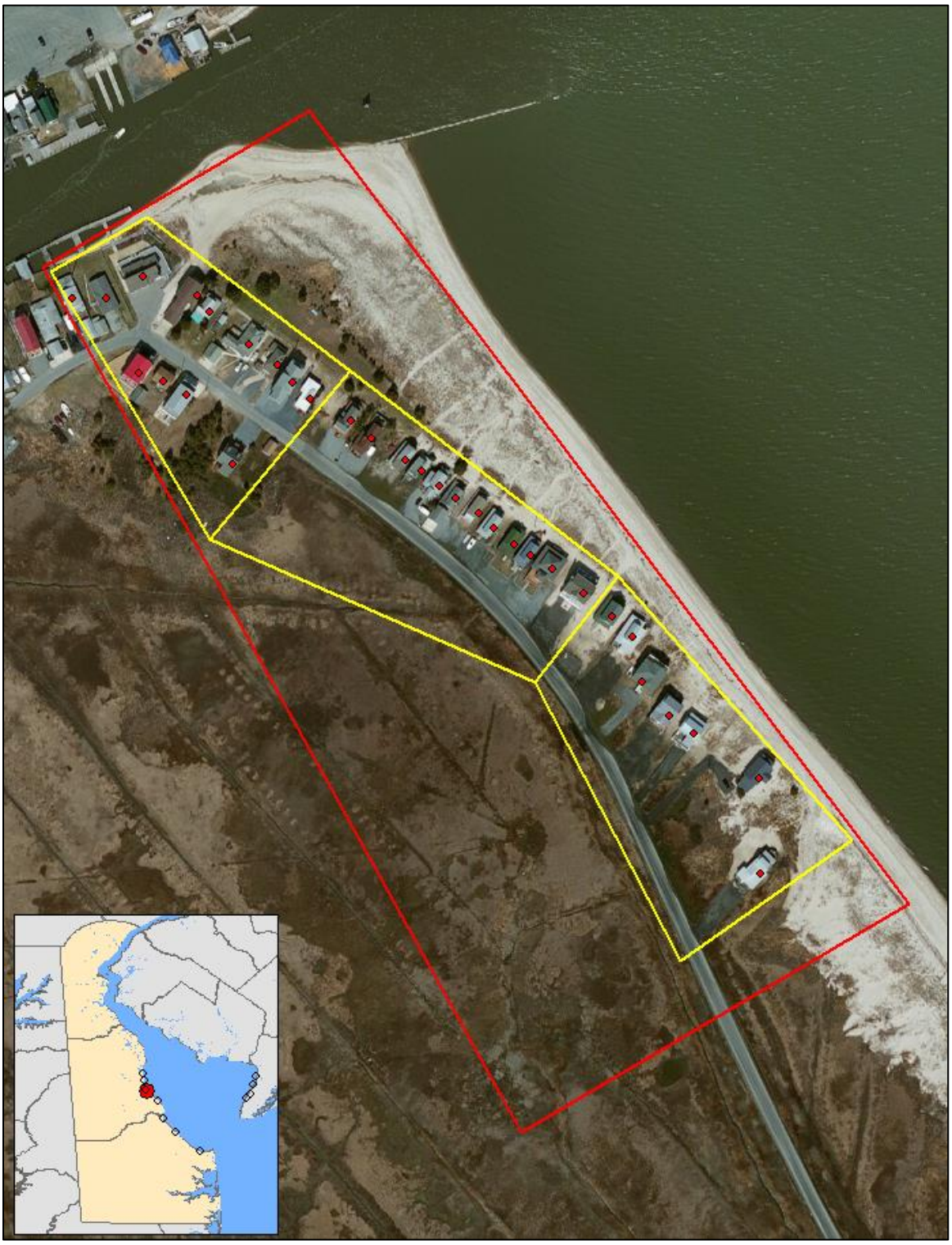
Bowers Beach is the shorefront community component of the larger Bowers Township. The study area contains 84 Damage Elements, five Lots, and three Reaches.

Figure 4: Bowers Beach Inventory

South Bowers Beach (Bowers, Kent County, DE)

South Bowers Beach is the beach community across Murderkill River from Bowers Beach. The study area includes 32 Damage Elements, three Lots, and one Reach.

Figure 5: South Bowers Beach Inventory



Big Stone Beach (Milford, Kent County, DE)

Big Stone Beach is a small community on the coast of Milford Township. The study area includes 11 Damage Elements, one Lot, and one Reach.

Figure 6: Big Stone Beach Inventory

Slaughter Beach (Milford, Sussex County, DE)

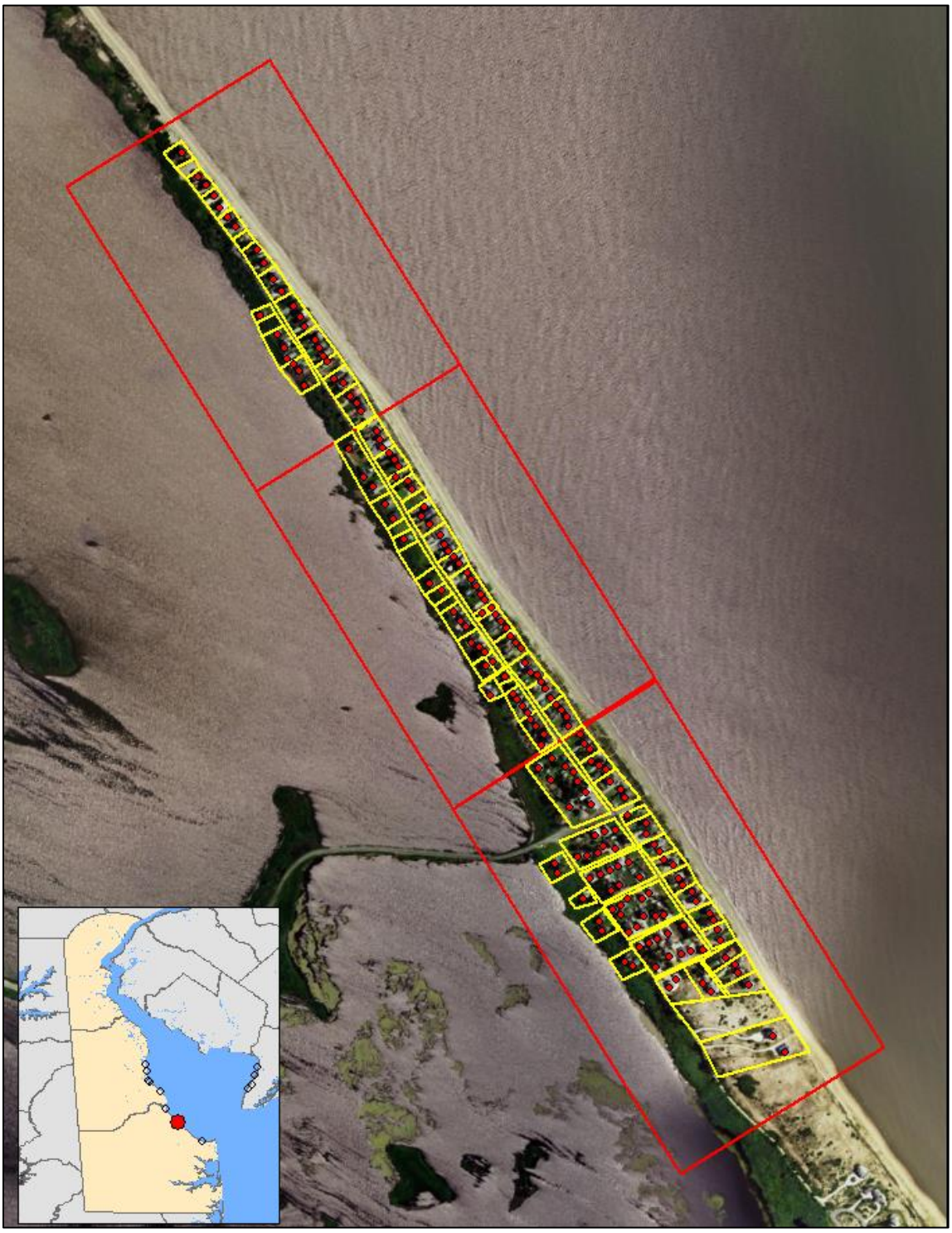
Slaughter Beach is large beach community within Milford Township with a considerable number of structures built close to the coastline. The study area includes 259 Damage Elements, fifteen Lots, and seven Reaches.

Figure 7: Slaughter Beach Inventory

Prime Hook (Milton, Sussex County, DE)

Prime Hook is a large beach community on the coast of Milton Township. The study area includes 183 Damage Elements, seventy-seven Lots, and three Reaches.

Figure 8: Prime Hook Beach Inventory



Lewes Beach (Lewes, Sussex County, DE)

Lewes Beach is the coastal community of the larger Lewes Township. The study area includes 525 Damage Elements, fifty-one Lots, and nine Reaches.

However, the Damage Elements, Lots, and Reaches within 1,400ft of the Lewes and Rehoboth Canal North Inlet are excluded from Beach-fx analysis. This section of Lewes Beach is excluded due to the existing Delaware Bay Coastline DE &NJ Roosevelt Inlet – Lewes Beach, DE Federal Project authorized in Title I, Section 101 (a) (13) of WRDA 1999 and constructed in Dec. 2004. This Federal Project includes a dune and berm extending 900ft southeast of the inlet with a 500ft taper.

With this exclusion, the total analyzed study area becomes 471 Damage Elements, forty-five Lots, and eight Reaches.

Additionally, the shoreline for the three easternmost reaches (R7 to R9) is actually accreting beach material. For this reason, those reaches are included in With- and Without-Project Condition analysis, but are not scheduled to receive any additional beachfill during Initial Construction or Periodic Nourishment. In effect, the With- and Without-Project Condition is identical for R7 to R9, but their values are recorded to correctly estimate overall Residual Risk at the study site.

Figure 9: Lewes Beach Inventory

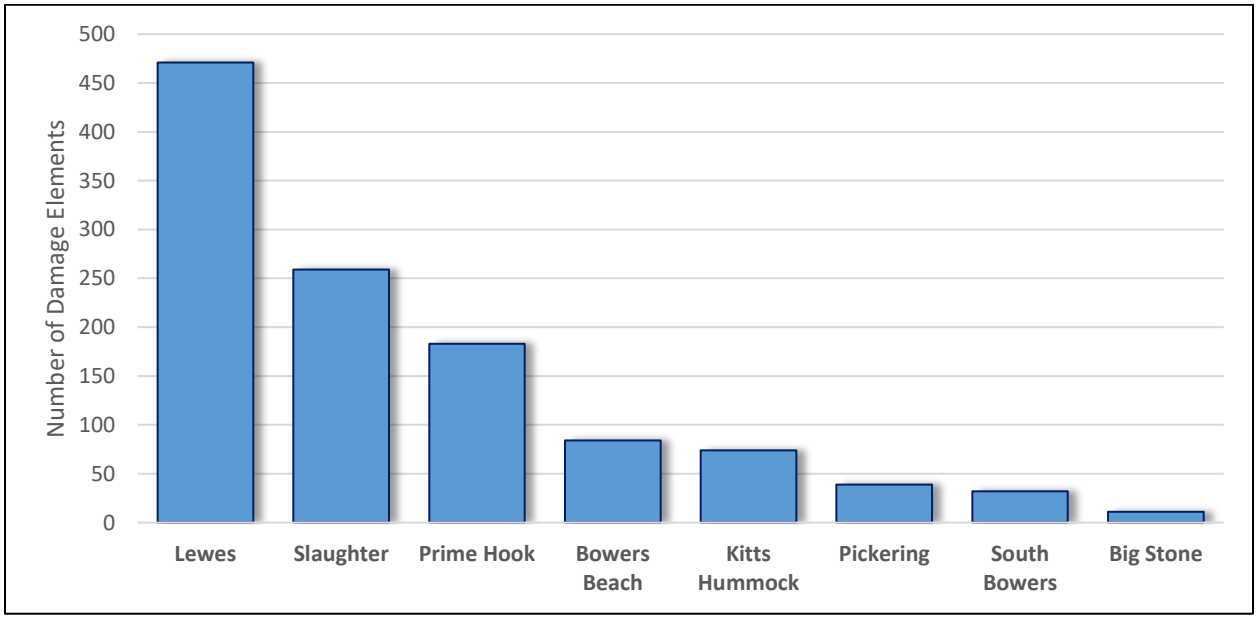
Total Study Area Inventory

Table 3: Complete Study Area Inventory

Site	Reaches	Lots	Damage Elements
Pickering Beach	3	3	39
Kitts Hummock	7	11	74
Bowers Beach	3	5	84
South Bowers Beach	1	3	32
Big Stone Beach	1	1	11
Slaughter Beach	7	15	259
Prime Hook	3	77	183
Lewes Beach	8	45	471
Total	**33**	**160**	**1,153**

Total Study Inventory stands at 1,153 structures spread over 33 study reaches along approximately 6,500ft of Delaware shoreline.

Figure 10: Complete Study Area Inventory



It is important to reiterate that the reaches contained within each site are driven by technical modeling requirements such as model resolution necessary to capture the curvature of the shoreline or variability in existing beach conditions. From a project performance perspective, these reaches are not separable elements as removing the dune or berm from one reach will negatively impact the performance of an adjacent reach.

EXISTING CONDITIONS

Kent County, DE has an estimated permanent population of 173,533 (U.S. Census Bureau Population Estimates Program (PEP)) with populations centered in the City of Dover, Smyrna Township, and the City of Milford. The county has grown its population by 6.9% over the past 5 years. In total, Kent County has an estimated 68,692 housing units with 59,142 of those being individual households (U.S. Census Bureau American Community Survey (ACS)). Median value of owner-occupied housing units stands at $200,200 with a median household income of $55,169. Per capita income is $25,259 with 14.1% of persons in poverty. Demographically, the county is predominantly Caucasian (62.8%) and African-American (25.5%) with Hispanics (7.0%), Asians (2.3%), and Other (2.4%) comprising the remainder of the county population. By value of sales, Kent County's largest business sectors are Retail Trade, Manufacturing, and Health Care.

Sussex County, DE has an estimated permanent population of 215,622 with populations centered in the City of Milford, the City of Seaford, and Georgetown. The county population has grown even faster than Kent County at 9.4% over the past 5 years. Sussex County has an estimated 131,418 housing units with 78,361 designated as individual households. The median value of owner-occupied housing units is higher than Kent County at $231,400 with a median household income of $53,505. Per capita income is $27,748 with 13.9% of persons in poverty. Demographically, Sussex County is more homogenous with a higher Caucasian population at 75.6%. The remaining population is divided among African-Americans (12.7%) and Hispanics (8.6%). Asians and Other comprise the remaining 3.1% of the population. Sussex County's largest business sectors are also include Manufacturing, Retail Trade, and Health Care.

Data Collection and Beach-fx Methodology

The structure inventory for each of the study sites was created using materials supplied by the Delaware Department of Natural Resources and Environmental Control (DNREC), the Kent County GIS Division, the Sussex County Council GIS Department, National Oceanic and Atmospheric Administration (NOAA) Digital Coast, and DigitalGlobe. Software used to construct the inventory includes ArcGIS 10.5.1, Marshall & Swift Residential Estimator 7, Marshall & Swift Commercial / Agricultural Estimator, Google Earth Pro, and Palisades DecisionTools Suite.

As stated earlier in the Appendix, Beach-fx requires a comprehensive structure inventory comprised of Reaches, Lots, and Damage Elements for each project site. Forming each of the model inputs was an iterative process and is accompanied by a series of model assumptions.

Structure Inventory Creation

DNREC supplied building footprint Esri shapefiles for each of structures within the study area. The building footprint shapefiles contain information on street address, building type code, building dimensions and square footage, first floor elevation, foundation type, and parcel identification numbers. The attributes of the building footprint are transferred to a single internal centroid and provided a Northing and Easting coordinate point using Delaware State Plane Projected Coordinate System (US Feet).

The Kent County GIS Division and the Sussex County Council GIS Department supplied the Kent County and Sussex County parcel map overlays, respectively. This parcel map overlay includes parcel identification numbers, county tax assessment values (stated as improvement values), and other county

tax list attributes. Using a spatial join to associate the building centroids with their tax parcels, attributes for Owner Name, Improvement Value, and Street Address were added to the inventory.

All Damage Elements are assigned a foundation type (slab or pile) and usage type (single-family residential one story (SFR1), single-family residential multi story (SFRM), commercial or hotel (COMM), or condominium / apartment complex (APT)).

Tax Assessment Improvement Values were used as the basis for Depreciated Replacement Value in compliance with EM 1110-2-1619 Risk-Based Analysis for Flood Damage Reduction Studies. The tax assessment values, identified per structure by the GIS parcel overlay, were weighted using Marshall & Swift Residential Estimator 7 and Marshall & Swift Commercial / Agricultural Estimator results.

For each site, a 10% stratified random sample of correlated zones within the inventory was evaluated using the estimator tools. The resulting Depreciated Replacement Values calculated by the Marshall & Swift estimator software were then compared to the stated tax assessment value to formulate a weighting factor. The average weight factor for each correlated area was then applied across the entire population. This process was applied for each site independently. Each structure value was then converted to a triangle distribution using Palisades @Risk software and added to the inventory.

Figures 11 and 12 show an example structure Depreciated Replacement Value triangle distribution and an example Marshall & Swift Standard Report, respectively:

Figure 11: Structure Inventory Triangle Distribution Example (@Risk)

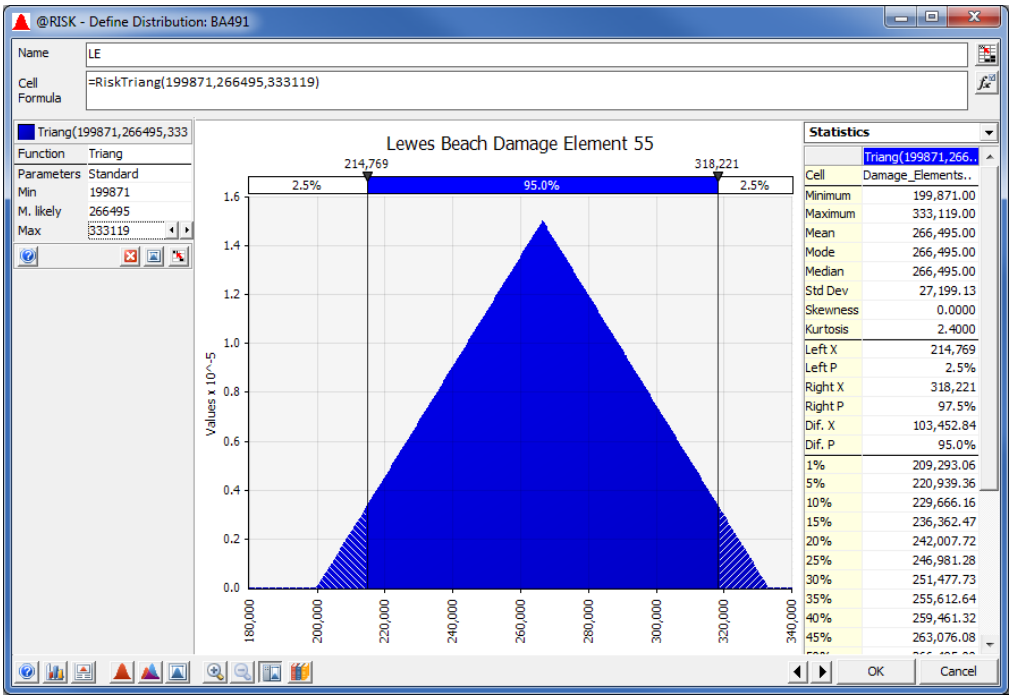


Figure 12: Marshall & Swift Residential Estimator 7 Report – Lewes Beach Damage Element 55

Standard Report

Estimate ID:		Lewes_Beach_DE_55	
Property Owner:		[redacted]	
Address:			
City:		Lewes	
State/Province:		Delaware	
ZIP/Postal Code:		19958	
Surveyed By:		Preston Oakley	
Survey Date:		10/7/2016	
Single-family Residence		Floor Area:	4,000 Square Feet
Effective Age:	20	Quality:	3 Average
Cost as of:	September, 2015	Condition:	3 Average
Style:	Two Story		
Exterior Wall:	Frame, Siding, Vinyl 100%		
Plumbing Fixtures:	8		

	Units	Cost	Total
Base Cost	4,000	50.01	200,040
Plumbing Fixtures	8	1,446.50	11,572
Comp. Shingle or Built-up Rock	4,000	1.29	5,160
Raised Subfloor	4,000	9.01	36,040
Floor Cover Allowance	4,000	4.17	16,680
Forced Air Furnace	4,000	3.93	15,720
Plumbing Rough-ins	1	583.00	583
Appliance Allowance	1	3,685.00	3,685
Basic Structure Total Cost	4,000	72.37	289,480
Built-in Garage	2,000	20.69	41,380
Subtotal Garage			41,380
Wood Deck	500	12.95	6,475
Subtotal Extras			6,475
Replacement Cost New	4,000	84.33	337,335
Physical + Functional Depreciation 21.0%			70,840
Total Depreciated Cost			266,495
Total			$266,495

Cost data by Marshall & Swift/Boeckh, LLC and its licensors.

Remarks

Inventory Structure and Content Value

The economic value of the existing study structure inventory represents the depreciated replacement costs of damageable structures and their associated contents. The total study inventory of all 1,156 damage elements has an estimated value of $227,618,620. Content values were established using a Content-to-Structure Value Ratio (CSVR) depending upon the type of structure in accordance with EM 1110-2-1619 Risk-Based Analysis for Flood Damage Reduction Studies. Tables 4 through 6 provide a summary of the study area inventory:

Table 4: Distribution of Structures and Structure Value by Site

Site	Damage Elements	Structure Value	Content Value	Total Value	% Total Value	Avg Per Struc
Pickering	39	$6,543,500	$3,977,165	$10,520,665	4.62%	$269,761
Kitts Hummock	74	$7,301,152	$3,063,242	$10,364,394	4.55%	$140,059
Bowers	84	$8,849,967	$3,652,409	$12,502,376	5.49%	$148,838
South Bowers	32	$5,183,694	$2,110,973	$7,294,667	3.20%	$227,958
Big Stone	11	$1,054,720	$457,748	$1,512,468	0.66%	$137,497
Slaughter Beach	259	$40,870,863	$16,867,310	$57,738,173	25.37%	$222,927
Prime Hook	183	$25,549,141	$10,531,352	$36,080,493	15.85%	$197,161
Lewes Beach	471	$65,339,059	$26,266,325	$91,605,384	40.25%	$194,491
Total	**1153**	**$160,692,096**	**$66,926,524**	**$227,618,620**	**100.00%**	**$197,414**

Table 5: Distribution of Structure Type by Site

Site	Damage Elements	RES	APT	COMM	% RES	% Non-Res
Pickering	39	39	0	0	100.00%	0.00%
Kitts Hummock	74	74	0	0	100.00%	0.00%
Bowers	84	84	0	0	100.00%	0.00%
South Bowers	32	32	0	0	100.00%	0.00%
Big Stone	11	11	0	0	100.00%	0.00%
Slaughter Beach	259	256	0	3	98.84%	1.16%
Prime Hook	183	183	0	0	100.00%	0.00%
Lewes Beach	471	450	3	18	95.54%	4.46%
Total	**1153**	**1129**	**3**	**21**	**97.92%**	**2.08%**

Table 6: Distribution of Structure and Structure Value per Reach by Site

Reach	Damage Elements	Structure Value	Content Value	Total Value	% Total Value	Avg Per Struc
Pickering R-1	21	$3,842,780	$2,259,545	$6,102,325	58.00%	$290,587
Pickering R-2	10	$1,351,989	$905,990	$2,257,979	21.46%	$225,798
Pickering R-3	8	$1,348,731	$811,630	$2,160,361	20.53%	$270,045
Total	**39**	**$6,543,500**	**$3,977,165**	**$10,520,665**	**100.00%**	**$269,761**

Reach	Damage Elements	Structure Value	Content Value	Total Value	% Total Value	Avg Per Struc
Kitts Hummock R-1	12	$1,451,369	$627,278	$2,078,647	20.06%	$173,221
Kitts Hummock R-2	9	$889,977	$368,456	$1,258,433	12.14%	$139,826
Kitts Hummock R-3	12	$1,130,969	$466,344	$1,597,313	15.41%	$133,109
Kitts Hummock R-4	12	$1,645,847	$692,316	$2,338,163	22.56%	$194,847
Kitts Hummock R-5	13	$1,014,120	$411,434	$1,425,554	13.75%	$109,658
Kitts Hummock R-6	14	$907,113	$383,811	$1,290,924	12.46%	$92,209
Kitts Hummock R-7	2	$261,757	$113,603	$375,360	3.62%	$187,680
Total	**74**	**$7,301,152**	**$3,063,242**	**$10,364,394**	**100.00%**	**$140,059**

Reach	Damage Elements	Structure Value	Content Value	Total Value	% Total Value	Avg Per Struc
Bowers R-1	2	$494,278	$198,700	$692,978	5.54%	$346,489
Bowers R-2	37	$4,875,222	$2,008,556	$6,883,778	55.06%	$186,048
Bowers R-3	45	$3,480,467	$1,445,153	$4,925,620	39.40%	$109,458
Total	**84**	**$8,849,967**	**$3,652,409**	**$12,502,376**	**100.00%**	**$148,838**

Reach	Damage Elements	Structure Value	Content Value	Total Value	% Total Value	Avg Per Struc
South Bowers R-1	32	$5,183,694	$2,110,973	$7,294,667	100.00%	$227,958
Total	**32**	**$5,183,694**	**$2,110,973**	**$7,294,667**	**100.00%**	**$227,958**

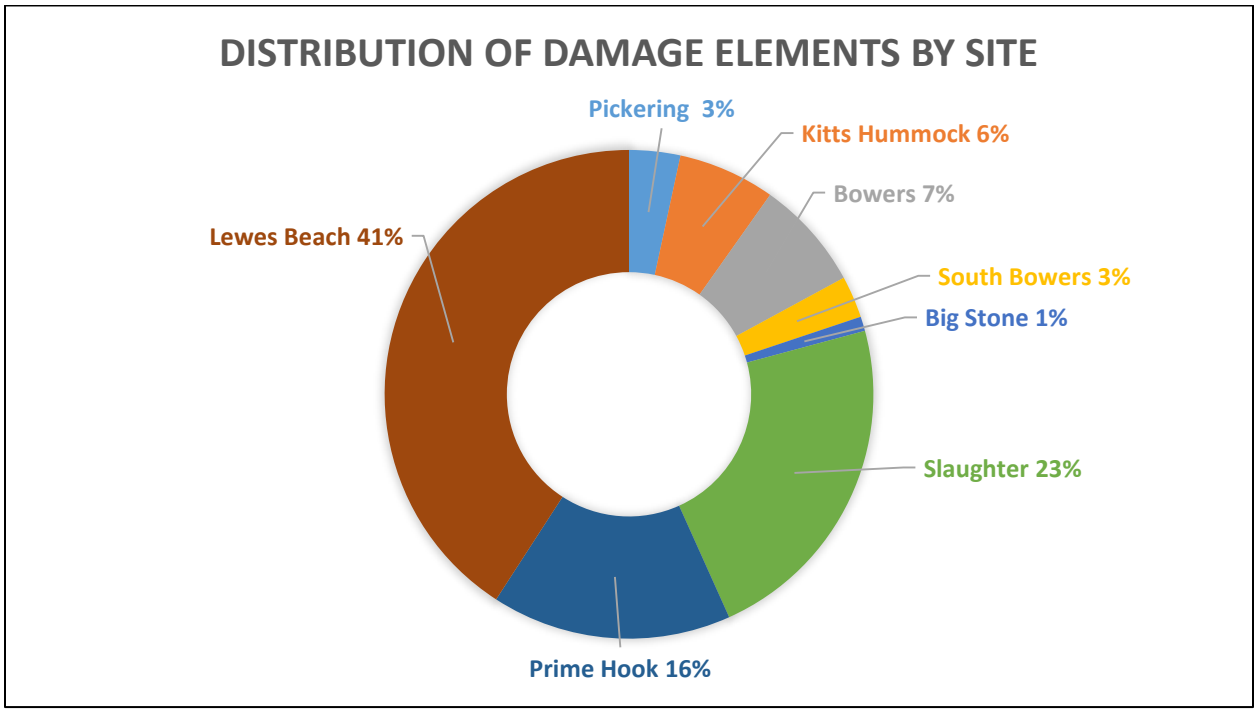
Reach	Damage Elements	Structure Value	Content Value	Total Value	% Total Value	Avg Per Struc
Big Stone R-1	11	$1,054,720	$457,748	$1,512,468	100.00%	$137,497
Total	**11**	**$1,054,720**	**$457,748**	**$1,512,468**	**100.00%**	**$137,497**

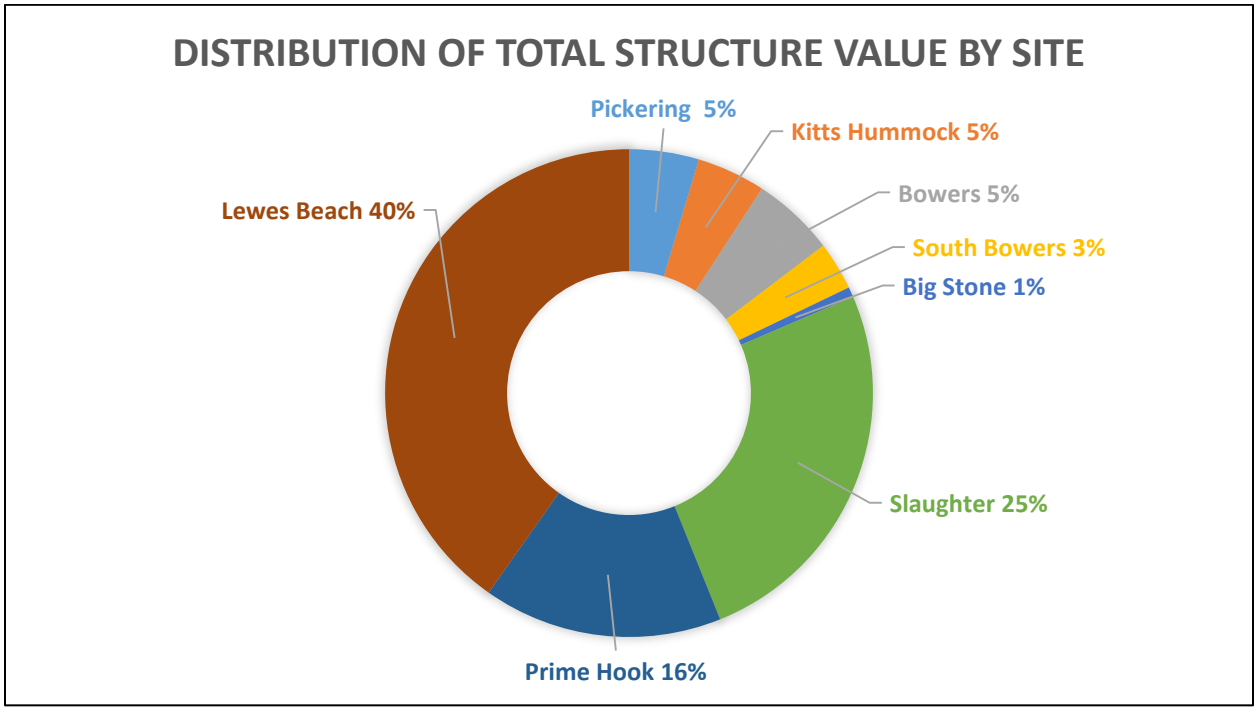
Reach	Damage Elements	Structure Value	Content Value	Total Value	% Total Value	Avg Per Struc
Slaughter Beach R-1	8	$2,074,177	$890,940	$2,965,117	5.14%	$370,640
Slaughter Beach R-2	21	$4,009,072	$1,667,767	$5,676,839	9.83%	$270,326
Slaughter Beach R-3	10	$2,184,222	$895,772	$3,079,994	5.33%	$307,999
Slaughter Beach R-4	54	$11,124,042	$4,585,938	$15,709,980	27.21%	$290,926
Slaughter Beach R-5	57	$6,445,356	$2,705,278	$9,150,634	15.85%	$160,537
Slaughter Beach R-6	42	$4,593,851	$1,867,352	$6,461,203	11.19%	$153,838
Slaughter Beach R-7	67	$10,440,143	$4,254,263	$14,694,406	25.45%	$219,319
Total	**259**	**$40,870,863**	**$16,867,310**	**$57,738,173**	**100.00%**	**$222,927**

Reach	Damage Elements	Structure Value	Content Value	Total Value	% Total Value	Avg Per Struc
Prime Hook R-1	30	$5,461,753	$2,220,006	$7,681,759	21.29%	$256,059
Prime Hook R-2	66	$8,207,665	$3,385,319	$11,592,984	32.13%	$175,651
Prime Hook R-3	87	$11,879,723	$4,926,027	$16,805,750	46.58%	$193,170
Total	**183**	**$25,549,141**	**$10,531,352**	**$36,080,493**	**100.00%**	**$197,161**

Reach	Damage Elements	Structure Value	Content Value	Total Value	% Total Value	Avg Per Struc
Lewes R-2	33	$6,306,300	$2,535,135	$8,841,435	9.65%	$267,922
Lewes R-3	82	$14,362,184	$5,773,600	$20,135,784	21.98%	$245,558
Lewes R-4	71	$9,240,400	$3,714,642	$12,955,042	14.14%	$182,465
Lewes R-5	50	$6,185,075	$2,486,400	$8,671,475	9.47%	$173,430
Lewes R-6	75	$8,448,050	$3,396,125	$11,844,175	12.93%	$157,922
Lewes R-7	127	$15,726,108	$6,321,904	$22,048,012	24.07%	$173,606
Lewes R-8	9	$1,320,800	$530,962	$1,851,762	2.02%	$205,751
Lewes R-9	24	$3,750,142	$1,507,557	$5,257,699	5.74%	$219,071
Total	**471**	**$65,339,059**	**$26,266,325**	**$91,605,384**	**100.00%**	**$194,491**

Figure 13: Structure Value and Damage Element Distribution by Site





As Figure 13 shows, the distribution of structure value to damage element count is relatively close. This is expected with the similar type of structures (predominantly Single-Family Residential) found throughout the study area.

FUTURE WITHOUT-PROJECT CONDITION (FWOP)

As stated earlier, Beach-fx is an event-based Monte Carlo life cycle simulation that uses historic storms to calculate damages over the course of a project life cycle. The model links the predictive capability of coastal evolution modeling with project area infrastructure information, structure and content damage functions, and economic valuations to estimate the costs and total damages under various shore protection alternatives while accounting for risk and uncertainty. The model output can then be used to determine the net benefits of each project alternative. Storm damage is defined as the monetary loss to contents and structures incurred as a direct result of wave attack, erosion, and inundation caused by a storm of a given magnitude and probability. The model also computes permanent shoreline reductions necessary for land loss calculations. These damages and associated costs are calculated over the project period of analysis based on storm probabilities, tidal cycle, tidal phase, beach morphology, and many other factors. Data on historic storms, beach survey profiles, and beach reactions to specific storm events can be found in the Engineering Appendix.

For the Future Without-Project (FWOP) Condition and Future With-Project (FWP) Condition, the structure inventory and assigned values are the same as the existing condition barring any structure that is deemed condemned by Beach-fx over the period of analysis. This conservative approach neglects any increase in value accrued from future development even though Kent County and Sussex County have seen population density and structure assessment values increase in recent years. Use of the existing inventory is preferable due to uncertainty and limitations in projecting future development.

The FWOP damages are used as the base condition and potential project alternatives are measured against this base to evaluate effectiveness and CSRM damages reduced. Once damages reduced (benefits) are calculated they will be compared to alternative costs to calculate Net Benefits. Dividing the annualized benefits by annualized costs yields the Benefit-to-Cost Ratio (BCR). The ratio must be greater than 1.0 to be deemed justified and implementable. The National Economic Development (NED) Plan is the plan that reasonably maximizes net economic development benefits.

Future Without-Project Condition Model Assumptions

In addition to the series of inputs relating to the Coastal Morphology and Structure Inventory, Beach-fx also requires a number of assumptions to compute the FWOP damages. These assumptions were reached after careful discussion within the PDT and after consulting outside experts. All Data Definitions are taken from the Beach-fx User's Manual: Version 1.0.

Start Year – 2018
Base Year – 2020
Period of Analysis – 50 years
FY2018 Federal Discount Rate – 2.75%
Damage Element Condemnation Ratio – 50% – maximum damage a Damage Element can receive from a single storm event before becoming condemned and temporarily removed from the inventory. Once a Damage Element is removed from the inventory, it can no longer receive further damages until rebuilt.
Number of Rebuilds – 50 – maximum number of repairs a Damage Element can undergo during the project life cycle. For clarification, a rebuild does not refer to a total rebuild event (100% of structure value), but rather to a repair event. A repair is to remove any previously sustained damage, even exceptionally low damages, from a Damage Element. The number of rebuilds is limited to prevent overstating CSRM damages. If a structure uses the full 50 rebuilds allotment, they are no longer rebuilt in that life cycle.

Time to Rebuild – 182 days, 365 days, 547 days – a triangle distribution denoting time necessary to complete a structure rebuild.
Control Line Offset – negative 1000ft – this variable controls the threshold distance in feet measured from the centroid of the Lot to the seaward toe of the dune at which Lots in the Reach will be marked condemned and prohibit any further rebuilding of Damage Elements in the entire Lot. Due to high erosion rates at the project sites, Lots were condemned in the model at a much earlier time and rate than expected when comparing to historic data. Adjusting the control line offset prevents Lots from being condemned earlier than expected due to erosion, but allows for individual Damage Elements to still be condemned and temporarily removed from the inventory if their damages reached 50% or greater from a single storm event or permanently condemned if they exceed their Number of Rebuilds over the project life cycle.

Applied Erosion Rates – Profile specific –used to calibrate model to the expected historic erosion rate

Site	Model-Induced	Applied	Historic
Pickering Beach	-1.825	-3.075	-4.9
Kitts Hummock	-1.226	-3.074	-4.3
Bowers Beach	0.594	-3.094	-2.5
South Bowers Beach	-2.769	-0.231	-3.0
Slaughter Beach	-3.461	1.561	-1.9
Prime Hook Beach	-3.081	2.381	-0.7
Lewes Beach	-2.533	-0.467	-3.0

Berm Width Recovery Factor – 95% - percent of storm-induced berm width change that is restored due to post-storm recovery processes
Storm Recovery Period – 21 days – number of days before post-storm recovery processes are applied
Lot Armor – None – refers to seawalls, bulkheads, etc.
Back Bay Flooding – On – Inundation flooding from low lying surrounding areas
Iterations – 300 iterations – sufficient for model results to reach equilibrium

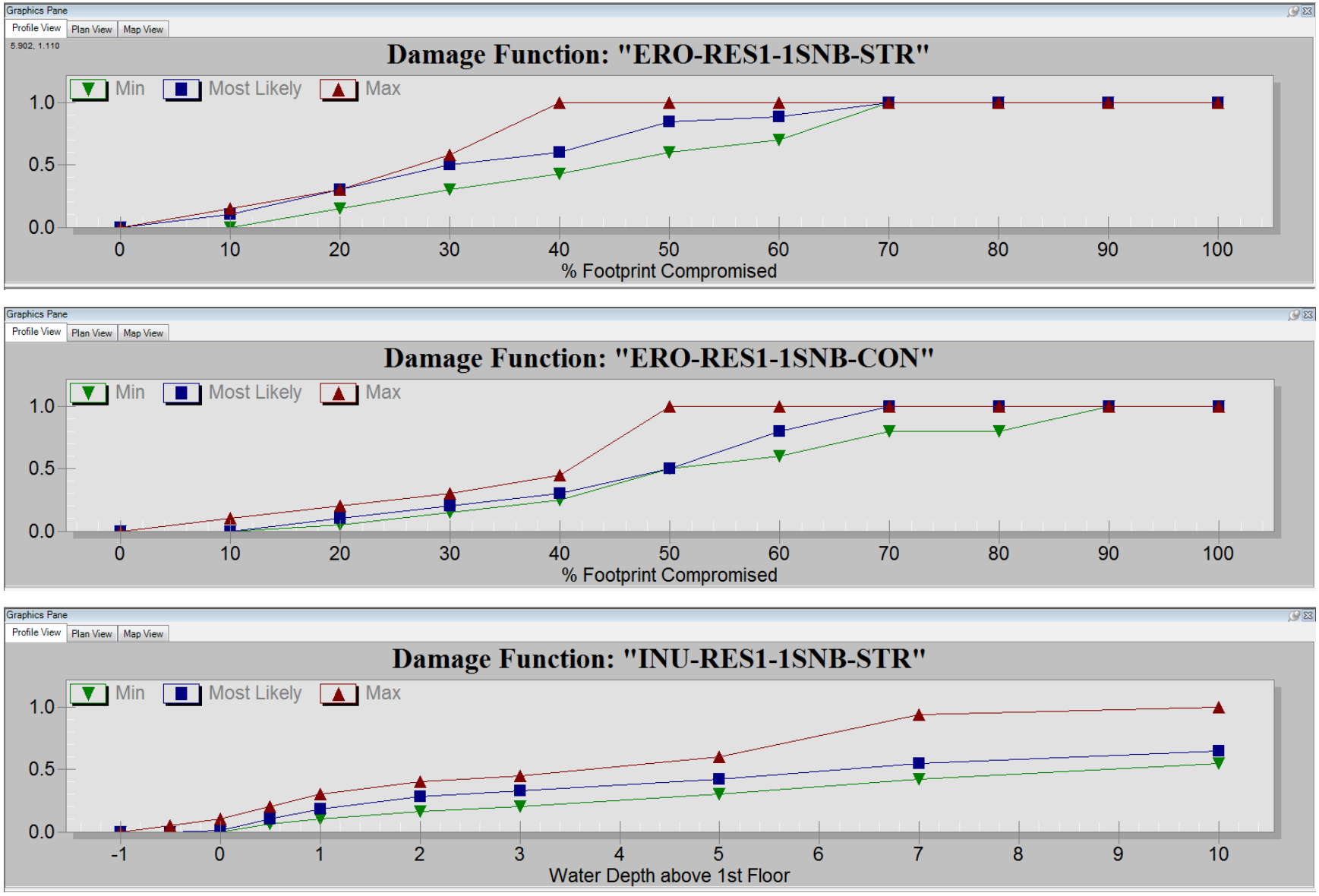
Damage Functions

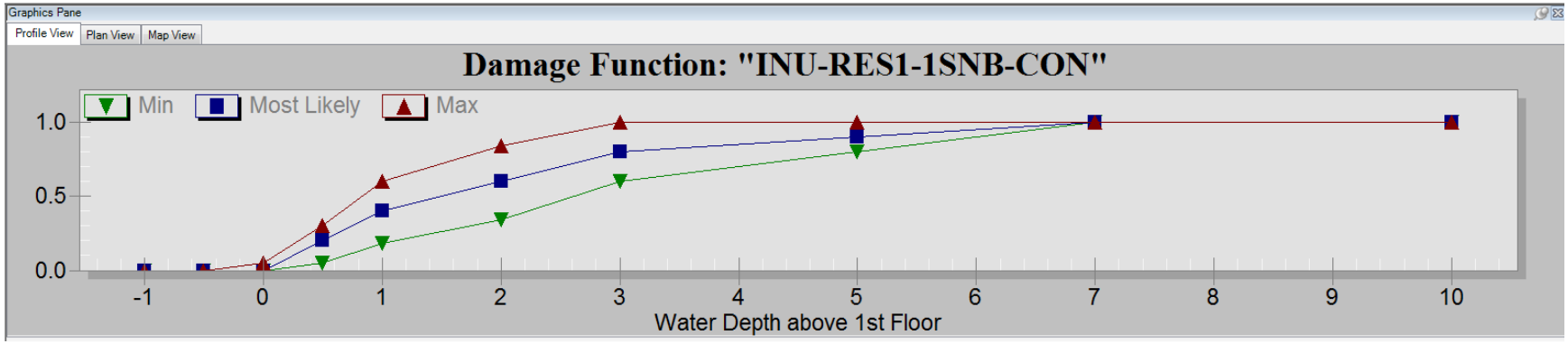
Damage functions are user-defined curves that are applied within the model to determine the extent of storm-induced damages attributable to any specific combination of damage element type and foundation type,. There are six types of damage functions which include erosion, inundation, and wave attack for both structure and content. For example, there is a specific set of six damage functions for single-family residential one story Damage Elements with a slab foundation and a separate, unique set of damage functions for single-family residential one story Damage Elements with a pile foundation. This analysis used a total of 48 damage functions to calculate storm-induced damages.

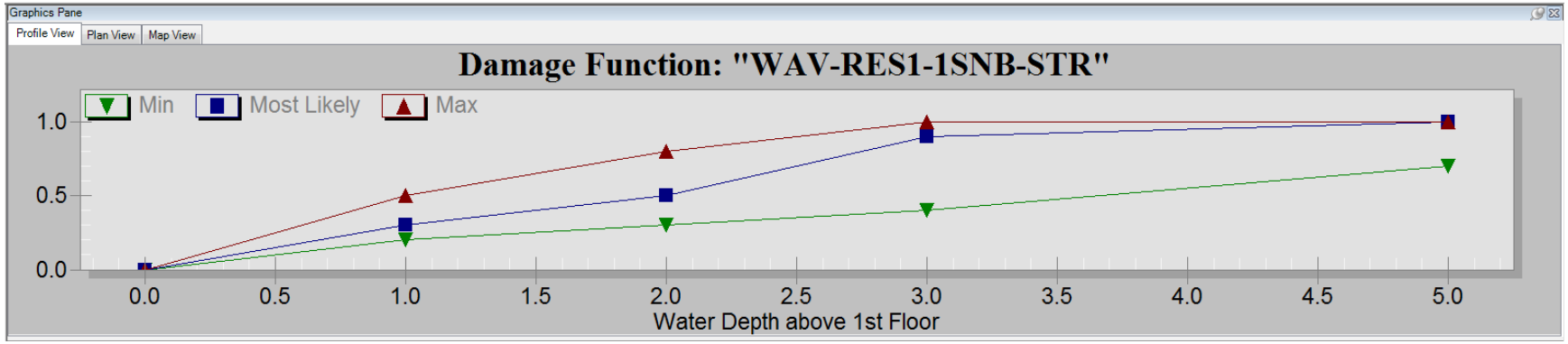
Damage is determined as a percentage of overall structure or content value using a triangle distribution of values. For erosion functions, damage is dependent upon the extent to which a structure's footprint has been compromised and for inundation and wave attack functions, damage is determined by the storm-surge heights in excess of first-floor elevation.

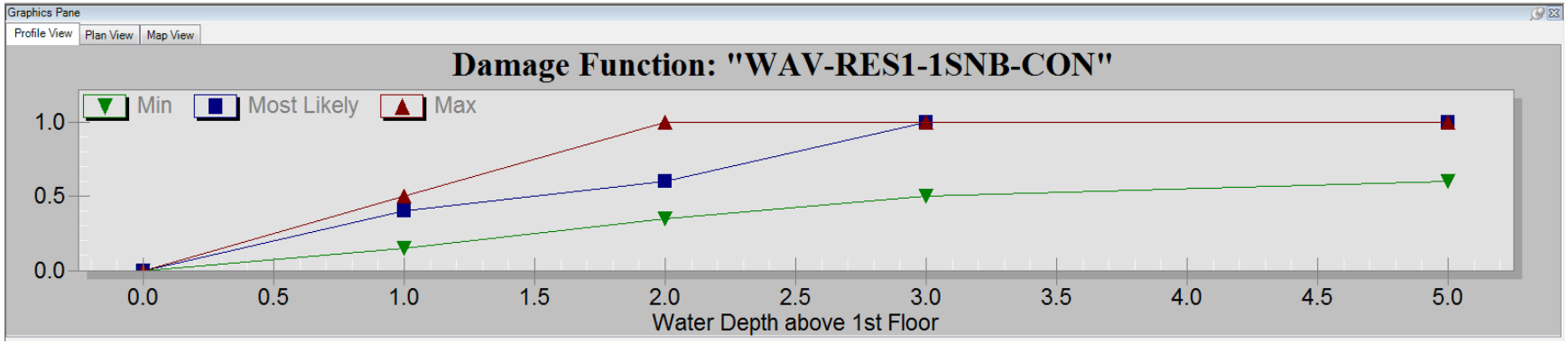
Damage Functions were developed using the North Atlantic Coast Comprehensive Study (NACCS) Resilient Adaption to Increasing Risk: Physical Depth Damage Function Summary Report. As an example, the set of six damage functions for a single-family residential one story structure on piles (no basement) is shown in Figure 14.

Figure 14: Erosion, Inundation, and Wave Attack Damage Functions for Structure and Content




Graphics Pane
Profile View
Plan View
Map View
Damage Function: "INU-RES1-1SNB-CON"
Min
Most Likely
Max
1.0
0.5
0.0
-1
0
1
2
3
4
5
6
7
8
9
10
Water Depth above 1st Floor


Graphics Pane
Profile View
Plan View
Map View
Damage Function: "WAV-RES1-1SNB-STR"
Min
Most Likely
Max
1.0
0.5
0.0
0.0
0.5
1.0
1.5
2.0
2.5
3.0
3.5
4.0
4.5
5.0
Water Depth above 1st Floor


Graphics Pane
Profile View
Plan View
Map View
Damage Function: "WAV-RES1-1SNB-CON"
Min
Most Likely
Max
1.0
0.5
0.0
0.0
0.5
1.0
1.5
2.0
2.5
3.0
3.5
4.0
4.5
5.0
Water Depth above 1st Floor

Preliminary Screening and Optimization Results

During the preliminary screening and optimization of alternatives for each potential project location, Big Stone Beach failed to show promising data in either Average Annual Net Benefits or Benefit-Cost Ratio. With only eleven structures at the study site, the potential damage pool was not sufficient to justify the cost of a beachfill operation.

Screening and optimization results in Figure 15 below differ from the final NED results in the rest of the document as certain Beach-fx parameters and inputs were updated during refinement of the model. This includes updating price level, federal discount rate, cost engineering inputs, and other model settings. These improvements were made to increase model accuracy and limit study uncertainty/risk.

Figure 15: Preliminary Screening and Optimization Beach-fx Results

Pickering Beach - Dredge Material Utilization Study - Delaware - Beachfx Model Results (100 Iterations) - Dune Optimization - Intermediate RSLC										
Alternative	Berm Width Change Rate	Category	Damages		Damages Prevented	Total Project Cost	AAB	AAC	AANB	BCR
			Without Project	With Project						
8' Dune	-2ft/yr	Structure	$39,368,941	$2,560,670						
		Content	$22,558,679	$1,412,558						
		Total	$61,927,619	$3,973,228	$57,954,392	$24,654,835	$2,199,258	$935,604	$1,263,654	2.35
10' Dune	-6.7ft/yr	Structure	$39,368,941	$1,630,837						
		Content	$22,558,679	$941,224						
		Total	$61,927,619	$2,572,061	$59,355,558	$31,960,385	$2,252,430	$1,212,835	$1,039,594	1.86
12' Dune	-9.4ft/yr	Structure	$39,368,941	$1,292,656						
		Content	$22,558,679	$768,265						
		Total	$61,927,619	$2,060,921	$59,866,698	$34,500,478	$2,271,827	$1,309,227	$962,600	1.74
14' Dune	-12ft/yr	Structure	$39,368,941	$979,751						
		Content	$22,558,679	$591,713						
		Total	$61,927,619	$1,571,464	$60,356,155	$36,970,291	$2,290,401	$1,402,952	$887,449	1.63

Kitts Hummock - Dredge Material Utilization Study - Delaware - Beachfx Model Results (100 Iterations) - Dune Optimization - Intermediate RSLC										
Alternative	Berm Width Change Rate	Category	Damages		Damages Prevented	Total Project Cost	AAB	AAC	AANB	BCR
			Without Project	With Project						
8' Dune	-3.2ft/yr	Structure	$39,337,622	$9,334,664						
		Content	$16,155,230	$3,927,747						
		Total	$55,492,852	$13,262,411	$42,230,441	$31,778,522	$1,602,564	$1,205,934	$396,630	1.33
10' Dune	-6.3ft/yr	Structure	$39,337,622	$5,500,098						
		Content	$16,155,230	$2,525,816						
		Total	$55,492,852	$8,025,914	$47,466,938	$41,874,769	$1,801,279	$1,589,067	$212,212	1.13
12' Dune	-7.9ft/yr	Structure	$39,337,622	$3,853,957						
		Content	$16,155,230	$1,896,526						
		Total	$55,492,852	$5,750,482	$49,742,369	$45,656,358	$1,887,628	$1,732,571	$155,056	1.09
14' Dune	-9.5ft/yr	Structure	$39,337,622	$3,668,418						
		Content	$16,155,230	$1,830,690						
		Total	$55,492,852	$5,499,107	$49,993,745	$50,486,779	$1,897,167	$1,915,877	-$18,710	0.99

Bowers - Dredge Material Utilization Study - Delaware - Beachfx Model Results (100 Iterations) - Dune Optimization - Intermediate RSLC										
Alternative	Berm Width Change Rate	Category	Damages		Damages Prevented	Total Project Cost	AAB	AAC	AANB	BCR
			Without Project	With Project						
9' Dune	-2.8ft/yr	Structure	$32,194,476	$8,527,054						
		Content	$12,339,772	$3,330,237						
		Total	$44,534,247	$11,857,291	$32,676,956	$23,637,241	$1,240,028	$896,988	$343,040	1.38
10' Dune	-3.8ft/yr	Structure	$32,194,476	$6,415,776						
		Content	$12,339,772	$2,541,173						
		Total	$44,534,247	$8,956,949	$35,577,298	$24,958,212	$1,350,090	$947,116	$402,974	1.43
12' Dune	-5.0ft/yr	Structure	$32,194,476	$4,072,044						
		Content	$12,339,772	$1,661,107						
		Total	$44,534,247	$5,733,151	$38,801,096	$25,795,709	$1,472,427	$978,898	$493,530	1.50
14' Dune	-6.3ft/yr	Structure	$32,194,476	$3,526,857						
		Content	$12,339,772	$1,447,599						
		Total	$44,534,247	$4,974,456	$39,559,791	$26,953,541	$1,501,218	$1,022,835	$478,383	1.47

South Bowers - Dredge Material Utilization Study - Delaware - Beachfx Model Results (100 Iterations) - Dune Optimization - Intermediate RSLC										
Alternative	Berm Width Change Rate	Category	Damages		Damages Prevented	Total Project Cost	AAB	AAC	AANB	BCR
			Without Project	With Project						
7' Dune	-5.6ft/yr	Structure	$21,347,174	$7,204,593						
		Content	$8,062,748	$2,875,044						
		Total	$29,409,923	$10,079,636	$19,330,286	$22,566,172	$733,547	$856,343	-$122,796	0.86
10' Dune	-6.8ft/yr	Structure	$21,347,174	$3,963,058						
		Content	$8,062,748	$1,717,190						
		Total	$29,409,923	$5,680,248	$23,729,674	$25,369,512	$900,496	$962,724	-$62,229	0.94
12' Dune	-9.0ft/yr	Structure	$21,347,174	$2,961,873						
		Content	$8,062,748	$1,361,907						
		Total	$29,409,923	$4,323,780	$25,086,143	$26,550,301	$951,971	$1,007,533	-$55,562	0.94
14' Dune	-11.3ft/yr	Structure	$21,347,174	$2,751,133						
		Content	$8,062,748	$1,286,391						
		Total	$29,409,923	$4,037,524	$25,372,399	$28,406,778	$962,834	$1,077,983	-$115,149	0.89

Big Stone - Dredge Material Utilization Study - Delaware - Beachfx Model Results (100 Iterations) - Dune Optimization - Intermediate RSLC										
Alternative	Berm Width Change Rate	Category	Damages		Damages Prevented	Total Project Cost	AAB	AAC	AANB	BCR
			Without Project	With Project						
8' Dune	-24.7ft/yr	Structure	$12,571,614	$5,052,574						
		Content	$5,206,673	$1,984,694						
		Total	$17,778,286	$7,037,268	$10,741,018	$31,395,214	$407,601	$1,191,388	-$783,787	0.34
10' Dune	-27.8ft/yr	Structure	$12,571,614	$3,508,727						
		Content	$5,206,673	$1,339,970						
		Total	$17,778,286	$4,848,696	$12,929,590	$39,904,772	$490,653	$1,514,310	-$1,023,657	0.32
12' Dune	-30.9ft/yr	Structure	$12,571,614	$2,598,371						
		Content	$5,206,673	$998,967						
		Total	$17,778,286	$3,597,338	$14,180,949	$43,581,588	$538,140	$1,653,838	-$1,115,698	0.33
14' Dune	-34ft/yr	Structure	$12,571,614	$1,784,188						
		Content	$5,206,673	$688,167						
		Total	$17,778,286	$2,472,355	$15,305,931	$45,756,895	$580,831	$1,736,387	-$1,155,556	0.33
16' Dune	-37.1ft/yr	Structure	$12,571,614	$1,209,029						
		Content	$5,206,673	$470,097						
		Total	$17,778,286	$1,679,126	$16,099,161	$46,052,395	$610,932	$1,747,600	-$1,136,668	0.35
18' Dune	-40.1ft/yr	Structure	$12,571,614	$990,288						
		Content	$5,206,673	$385,509						
		Total	$17,778,286	$1,375,797	$16,402,489	$47,828,131	$622,443	$1,814,986	-$1,192,543	0.34

Slaughter Beach - Dredge Material Utilization Study - Delaware - Beachfx Model Results (100 Iterations) - Dune Optimization - Intermediate RSLC										
Alternative	Berm Width Change Rate	Category	Damages		Damages Prevented	Total Project Cost	AAB	AAC	AANB	BCR
			Without Project	With Project						
8.5' Dune	-1.2ft/yr	Structure	$97,213,401	$31,067,911						
		Content	$44,916,152	$19,972,656						
		Total	$142,129,553	$51,040,567	$91,088,986	$43,088,094	$3,456,653	$1,635,111	$1,821,542	2.11
10' Dune	-0.6ft/yr	Structure	$97,213,401	$31,423,828						
		Content	$44,916,152	$20,059,431						
		Total	$142,129,553	$51,483,259	$90,646,294	$45,722,315	$3,439,853	$1,735,074	$1,704,779	1.98
12' Dune	-1.1ft/yr	Structure	$97,213,401	$27,736,956						
		Content	$44,916,152	$18,875,717						
		Total	$142,129,553	$46,612,673	$95,516,880	$53,570,909	$3,624,683	$2,032,913	$1,591,769	1.78
14' Dune	-1.6ft/yr	Structure	$97,213,401	$27,110,326						
		Content	$44,916,152	$18,679,905						
		Total	$142,129,553	$45,790,231	$96,339,322	$63,074,344	$3,655,893	$2,393,551	$1,262,342	1.53

Prime Hook - Dredge Material Utilization Study - Delaware - Beachfx Model Results (100 Iterations) - Dune Optimization - Intermediate RSLC										
Alternative	Berm Width Change Rate	Category	Damages		Damages Prevented	Total Project Cost	AAB	AAC	AANB	BCR
			Without Project	With Project						
10' Dune	-5ft/yr	Structure	$120,371,991	$103,993,725						
		Content	$47,897,531	$41,424,093						
		Total	$168,269,522	$145,417,818	$22,851,704	$22,706,908	$867,178	$861,684	$5,495	1.01
12' Dune	-1.9ft/yr	Structure	$80,862,188	$16,904,489						
		Content	$32,382,321	$8,612,603						
		Total	$113,244,508	$25,517,092	$87,727,416	$35,432,672	$3,329,088	$1,344,602	$1,984,485	2.48
14' Dune	-2.6ft/yr	Structure	$80,862,188	$15,965,349						
		Content	$32,382,321	$8,274,784						
		Total	$113,244,508	$24,240,132	$89,004,376	$41,414,447	$3,377,546	$1,571,599	$1,805,947	2.15
16' Dune	-3.3ft/yr	Structure	$80,862,188	$14,646,796						
		Content	$32,382,321	$7,797,764						
		Total	$113,244,508	$22,444,560	$90,799,948	$45,577,073	$3,445,684	$1,729,563	$1,716,122	1.99

Lewes Beach - Dredge Material Utilization Study - Delaware - Beachfx Model Results (100 Iterations) - Dune Optimization - Intermediate RSLC										
Alternative	Berm Width Change Rate	Category	Damages		Damages Prevented	Total Project Cost	AAB	AAC	AANB	BCR
			Without Project	With Project						
8' Dune	-0.0ft/yr	Structure	$50,923,614	$27,414,263						
		Content	$19,756,903	$10,811,560						
		Total	$70,680,517	$38,225,823	$32,454,695	$15,053,950	$1,231,594	$571,269	$660,325	2.16
10' Dune	-0.0ft/yr	Structure	$50,923,614	$19,395,770						
		Content	$19,756,903	$8,005,759						
		Total	$70,680,517	$27,401,529	$43,278,989	$22,317,432	$1,642,355	$846,904	$795,451	1.94
12' Dune	-0.1ft/yr	Structure	$50,923,614	$12,272,134						
		Content	$19,756,903	$5,856,017						
		Total	$70,680,517	$18,128,150	$52,552,367	$29,557,015	$1,994,262	$1,121,632	$872,630	1.78
15' Dune	-0.7ft/yr	Structure	$50,923,614	$10,134,575						
		Content	$19,756,903	$5,156,096						
		Total	$70,680,517	$15,290,671	$55,389,846	$37,805,472	$2,101,939	$1,434,645	$667,293	1.47
16' Dune	-0.9ft/yr	Structure	$50,923,614	$9,849,365						
		Content	$19,756,903	$5,060,835						
		Total	$70,680,517	$14,910,200	$55,770,318	$40,768,076	$2,116,377	$1,547,070	$569,306	1.37

As mentioned earlier, for the seven study locations where Beach-fx results showed the potential for project justification, additional efforts were made to improve model accuracy by understanding, and when possible mitigating, the knowledge uncertainty surrounding the model inputs and results. Updating certain parameters such as number of iterations, back bay flooding, and condemnation rates was also implemented to improve the model's representation of actual study area conditions.

Improved model assumptions, cost estimates, distribution outputs, and sensitivity tests resulted in the NED Plan results and are detailed in this Appendix.

Future Without-Project Condition Damages

The FWOP net present value damages in Table 7 are a combination of the CSRM damages experienced at each individual project site. Damages are measured by both structure and content and averaged over 300 iterations. Values are in Present Worth using the FY2018 Federal Discount Rate. Results are shown at the Intermediate Relative Sea Level Change (RSLC) rate.

The model was designed to address all storm impacts from the Current Year to Base Year through to the end of the period of analysis in 2070. Damages incurred before the Base Year in 2020 are identical in the With- and Without-Project Conditions and are not counted towards CSRM benefits calculations.

Table 7: Future Without-Project Condition Damages by Site

Site	Structure	Content	Total	% Total
Pickering Beach	$27,419,614	$15,291,644	$42,711,258	10.75%
Kitts Hummock	$29,727,908	$12,111,928	$41,839,836	10.53%
Bowers Beach	$24,075,077	$9,053,449	$33,128,526	8.34%
South Bowers Beach	$16,084,121	$5,989,754	$22,073,876	5.56%
Slaughter Beach	$79,662,970	$37,536,540	$117,199,509	29.50%
Prime Hook Beach	$61,061,268	$24,452,633	$85,513,901	21.53%
Lewes Beach	$39,596,911	$15,162,187	$54,759,098	13.79%
TOTAL ESTIMATE	**$277,627,869**	**$119,598,135**	**$397,226,004**	**100.00%**

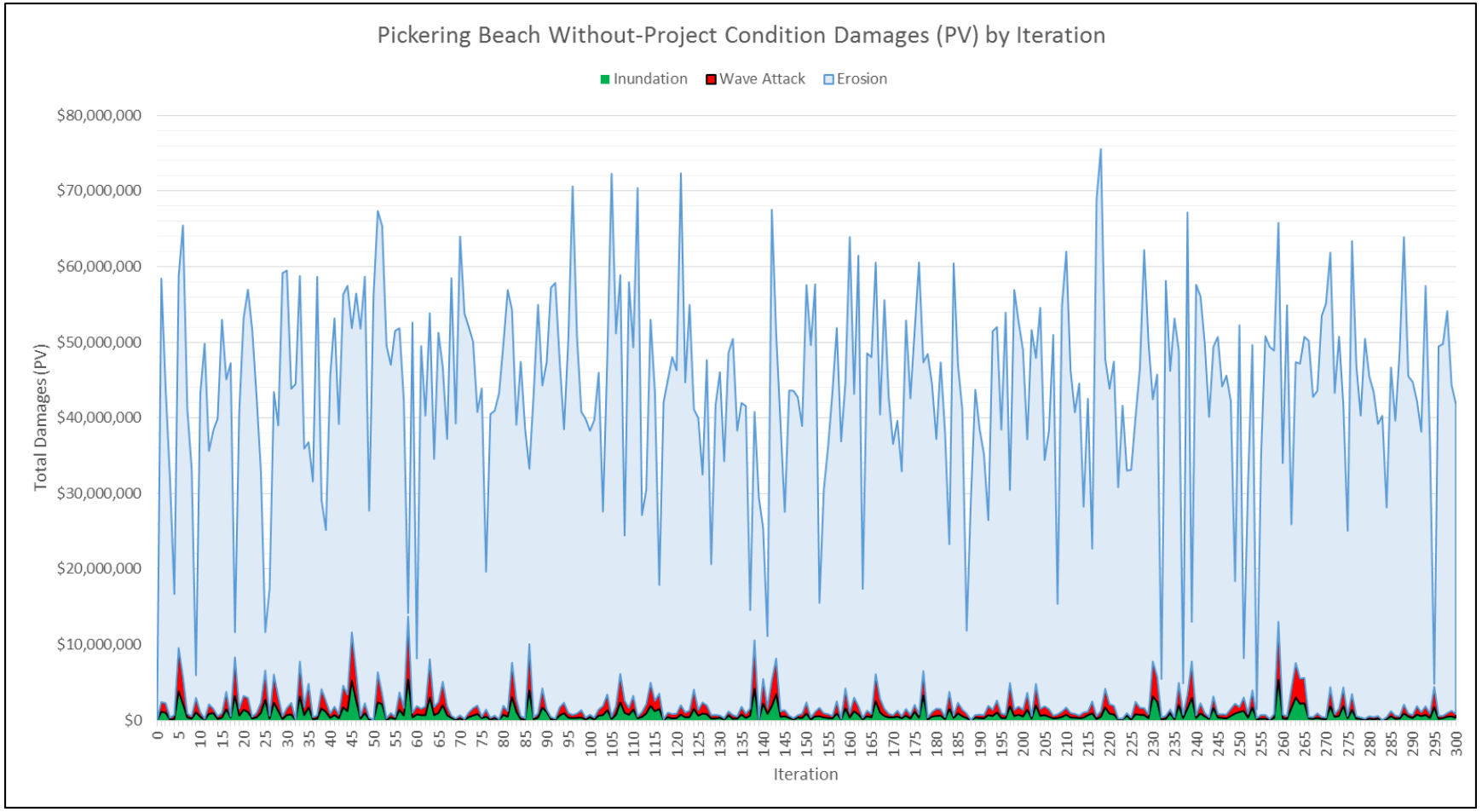
Table 8: Future Without-Project Condition Damages by Site by Damage Driver

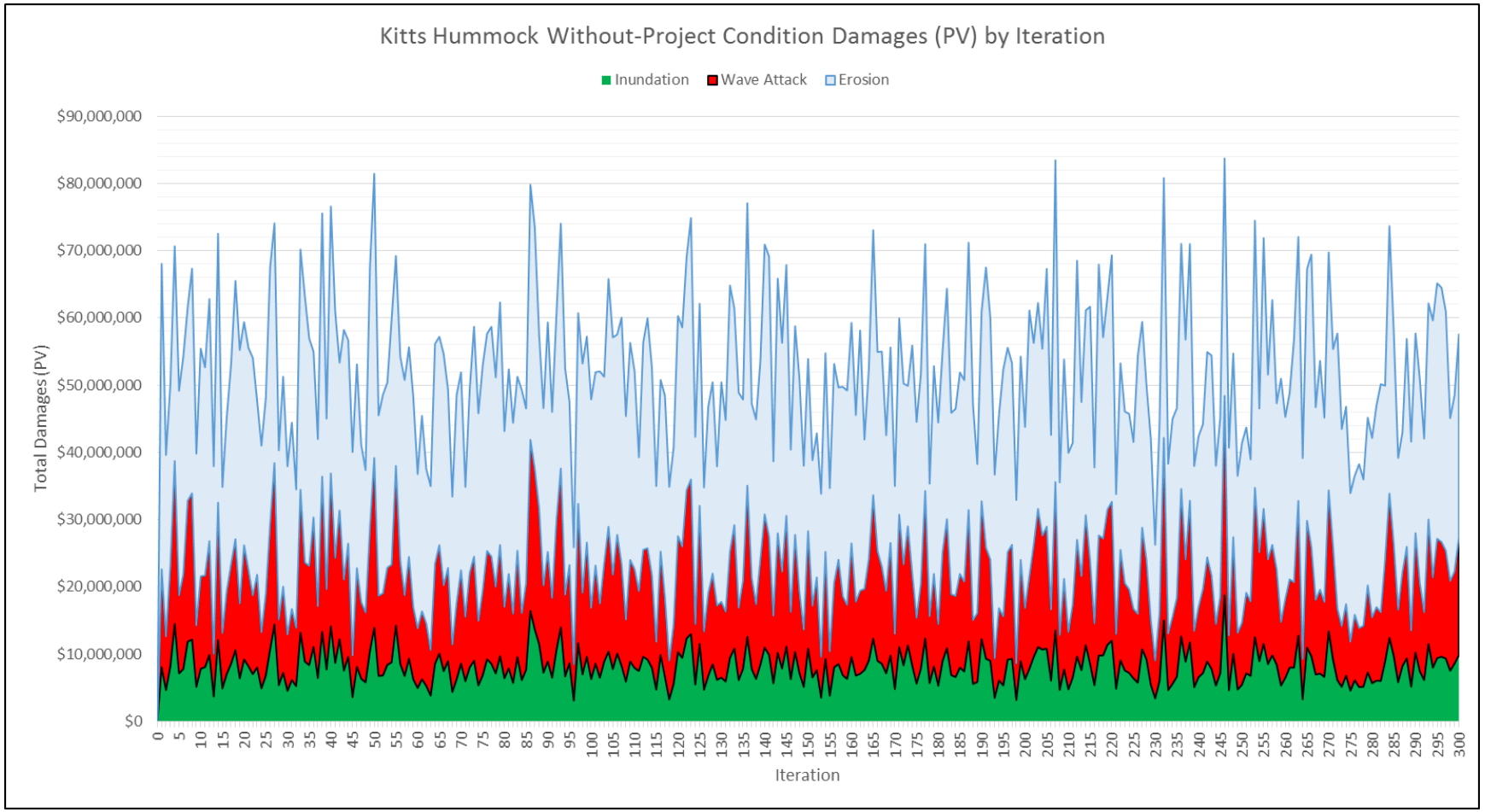
Site	Inun.	Wave	Erosion	Total	Inun.	Wave	Erosion
Pickering	$800,018	$1,164,228	$40,747,011	$42,711,258	1.87%	2.73%	95.40%
Kitts Hummock	$6,501,041	$11,219,747	$24,119,048	$41,839,836	15.54%	26.82%	57.65%
Bowers	$2,437,796	$3,495,436	$27,195,293	$33,128,526	7.36%	10.55%	82.09%
South Bowers	$2,694,226	$4,020,244	$15,359,406	$22,073,876	12.21%	18.21%	69.58%
Slaughter Beach	$46,038,718	$45,130,355	$26,030,436	$117,199,509	39.28%	38.51%	22.21%
Prime Hook	$14,471,104	$13,656,610	$57,386,187	$85,513,901	16.92%	15.97%	67.11%
Lewes Beach	$11,942,317	$4,769,452	$38,047,330	$54,759,098	21.81%	8.71%	69.48%
TOTAL ESTIMATE	**$84,885,221**	**$83,456,072**	**$228,884,711**	**$397,226,004**	**21.37%**	**21.01%**	**57.62%**

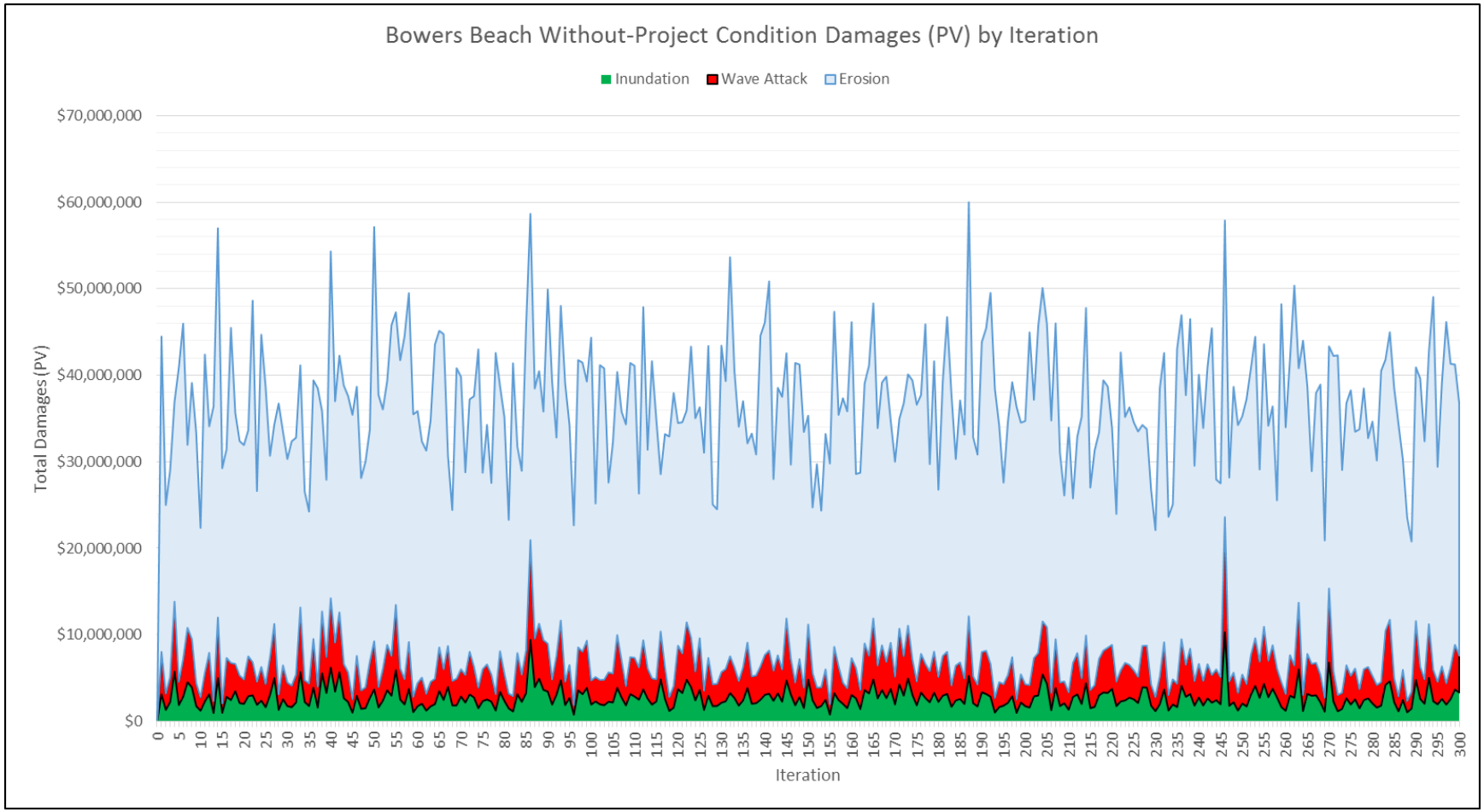
The distributions shown in Figure 16 show the contribution of each Damage Driver (Inundation, Wave Attack, Erosion) per Iteration.

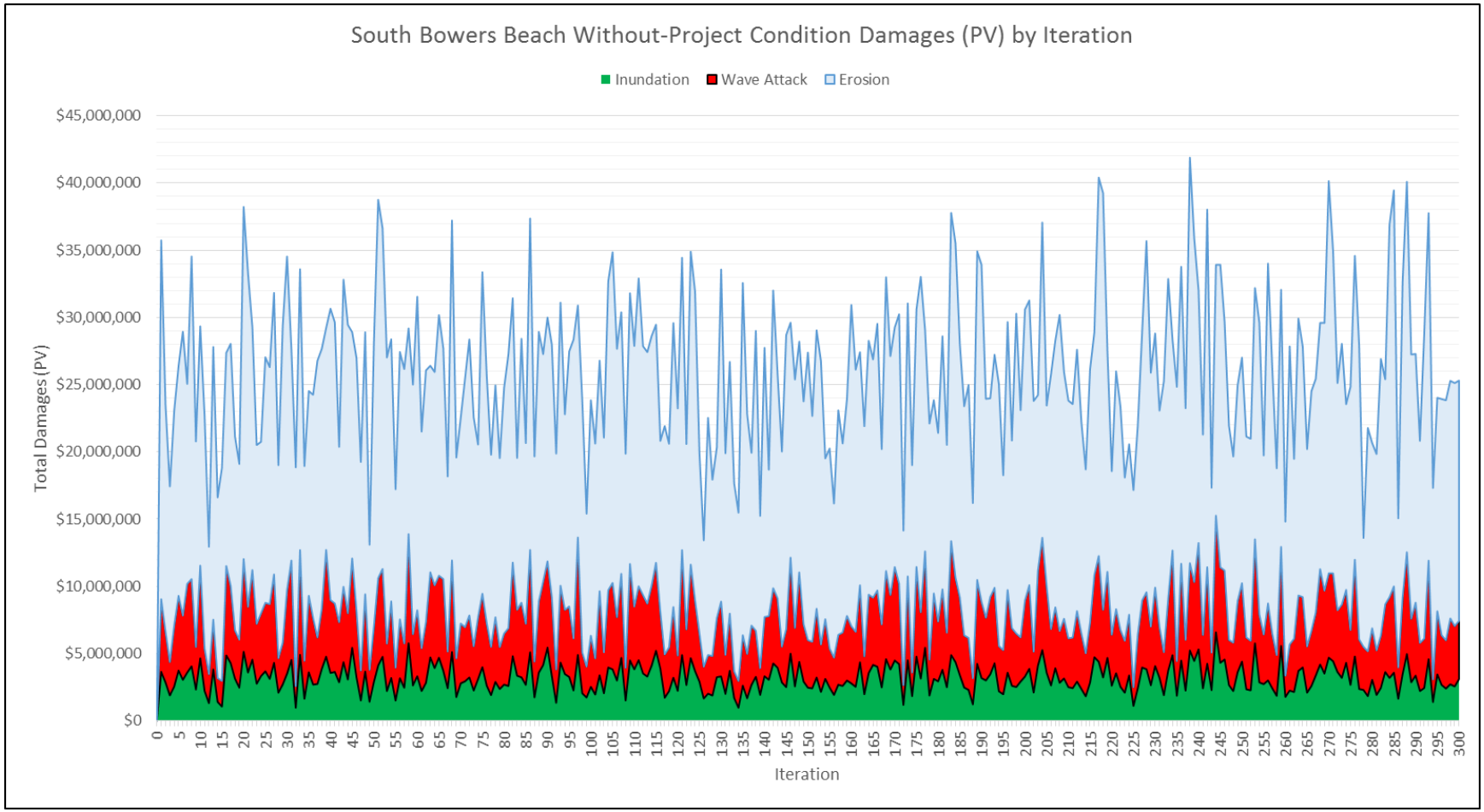
As mentioned earlier, the Without-Project Condition scenario was generated over 300 iterations, each with a 50 year period of analysis, to provide 15,000 years of simulated storm events per site. Each iteration has a unique, random selection of storm events to provide a wide range of results.

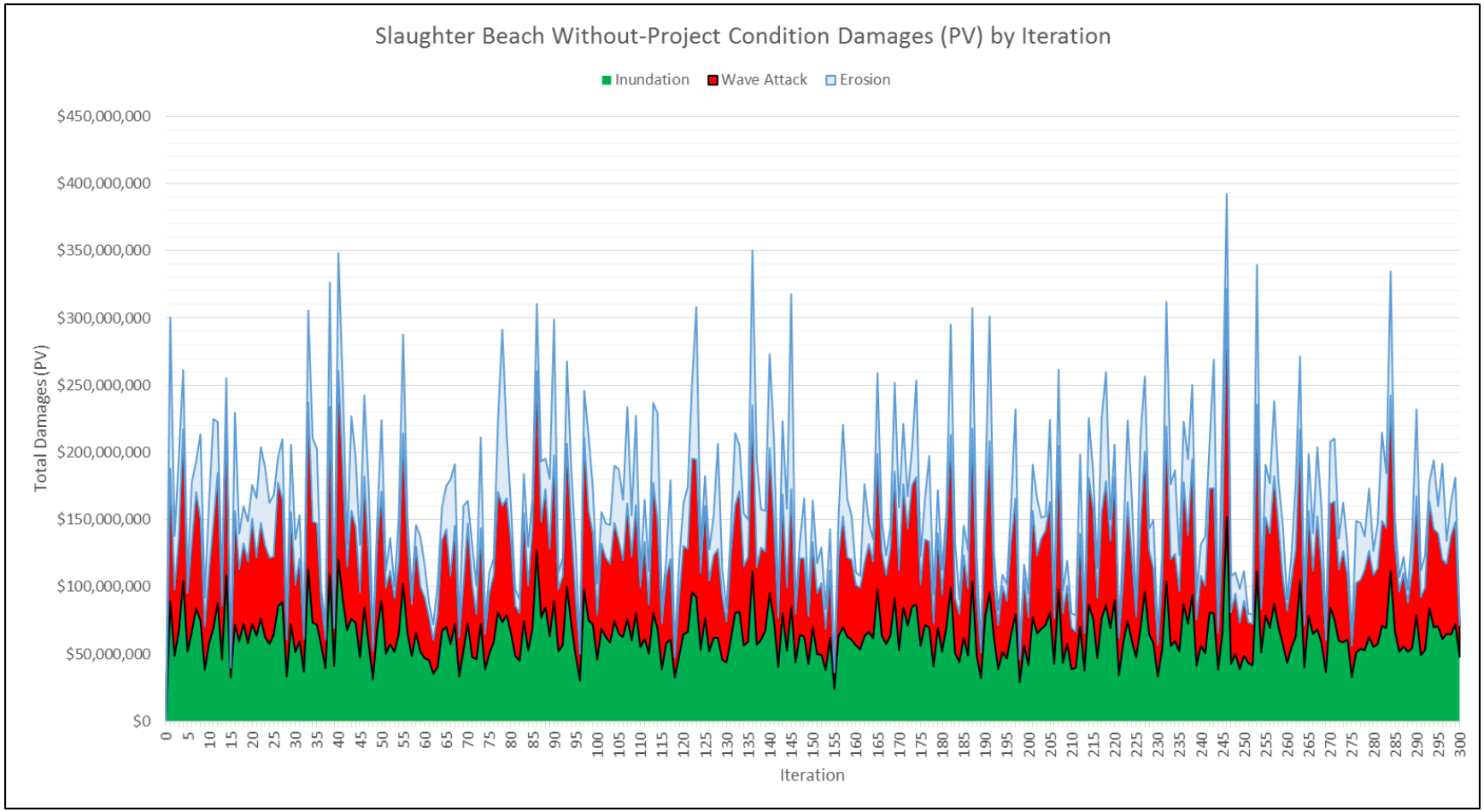
Figure 16: Without-Project Condition Damages by Site by Damage Driver per Iteration

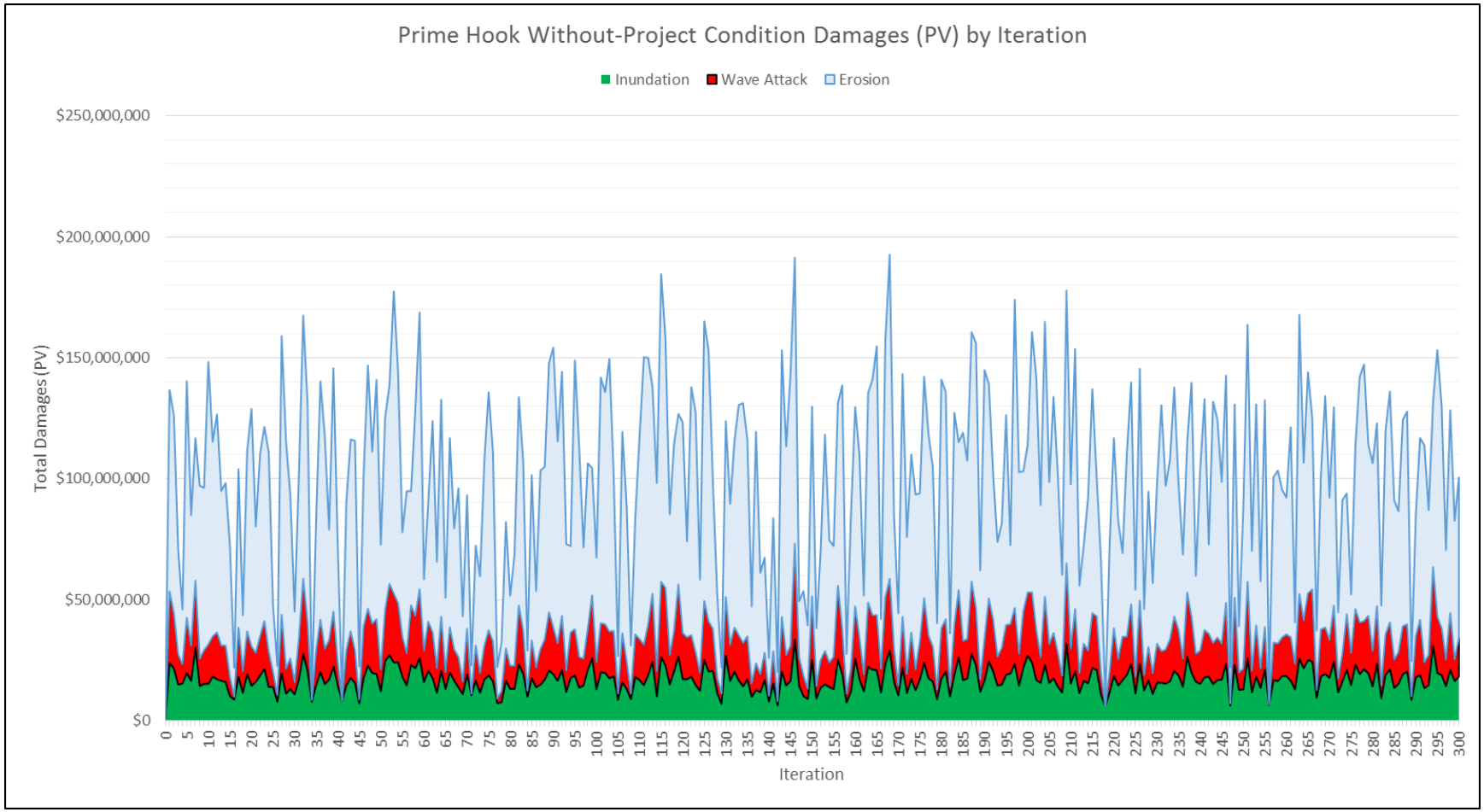


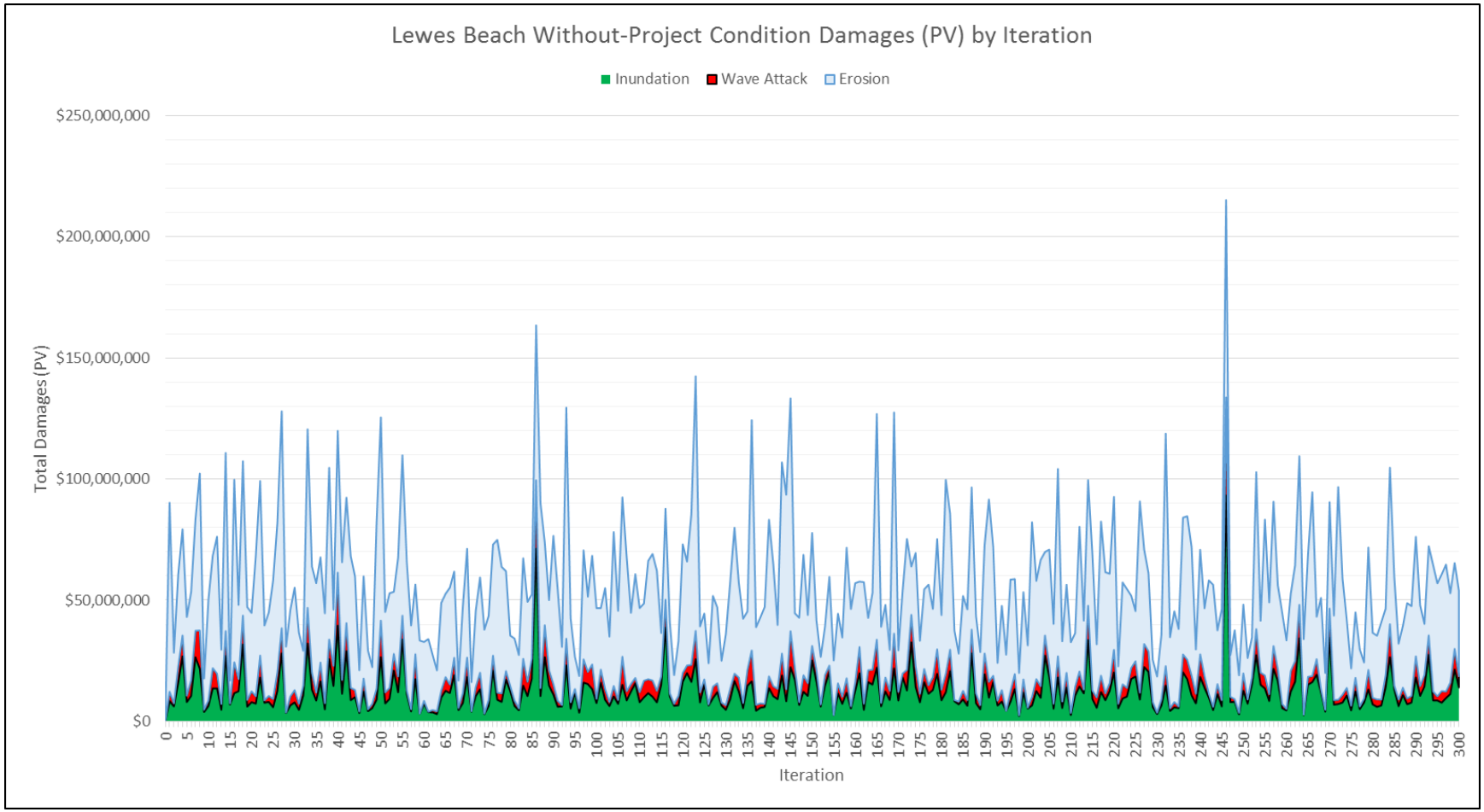

Kitts Hummock Without-Project Condition Damages (PV) by Iteration
Inundation
Wave Attack
Erosion
$90,000,000
$80,000,000
$70,000,000
$60,000,000
$50,000,000
$40,000,000
$30,000,000
$20,000,000
$10,000,000
$0
Total Damages (PV)
0 5 10 15 20 25 30 35 40 45 50 55 60 65 70 75 80 85 90 95 100 105 110 115 120 125 130 135 140 145 150 155 160 165 170 175 180 185 190 195 200 205 210 215 220 225 230 235 240 245 250 255 260 265 270 275 280 285 290 295 300
Iteration


Bowers Beach Without-Project Condition Damages (PV) by Iteration
Inundation
Wave Attack
Erosion
$70,000,000
$60,000,000
$50,000,000
$40,000,000
$30,000,000
$20,000,000
$10,000,000
$0
Total Damages (PV)
0 5 10 15 20 25 30 35 40 45 50 55 60 65 70 75 80 85 90 95 100 105 110 115 120 125 130 135 140 145 150 155 160 165 170 175 180 185 190 195 200 205 210 215 220 225 230 235 240 245 250 255 260 265 270 275 280 285 290 295 300
Iteration


South Bowers Beach Without-Project Condition Damages (PV) by Iteration
Inundation
Wave Attack
Erosion
Total Damages (PV)
$45,000,000
$40,000,000
$35,000,000
$30,000,000
$25,000,000
$20,000,000
$15,000,000
$10,000,000
$5,000,000
$0
0 5 10 15 20 25 30 35 40 45 50 55 60 65 70 75 80 85 90 95 100 105 110 115 120 125 130 135 140 145 150 155 160 165 170 175 180 185 190 195 200 205 210 215 220 225 230 235 240 245 250 255 260 265 270 275 280 285 290 295 300
Iteration


Slaughter Beach Without-Project Condition Damages (PV) by Iteration
Inundation
Wave Attack
Erosion
Total Damages (PV)
$450,000,000
$400,000,000
$350,000,000
$300,000,000
$250,000,000
$200,000,000
$150,000,000
$100,000,000
$50,000,000
$0
0 5 10 15 20 25 30 35 40 45 50 55 60 65 70 75 80 85 90 95 100 105 110 115 120 125 130 135 140 145 150 155 160 165 170 175 180 185 190 195 200 205 210 215 220 225 230 235 240 245 250 255 260 265 270 275 280 285 290 295 300
Iteration


Prime Hook Without-Project Condition Damages (PV) by Iteration
Inundation
Wave Attack
Erosion
$250,000,000
$200,000,000
$150,000,000
$100,000,000
$50,000,000
$0
Total Damages (PV)
0 5 10 15 20 25 30 35 40 45 50 55 60 65 70 75 80 85 90 95 100 105 110 115 120 125 130 135 140 145 150 155 160 165 170 175 180 185 190 195 200 205 210 215 220 225 230 235 240 245 250 255 260 265 270 275 280 285 290 295 300
Iteration



As shown in Figure 16, erosion constitutes a plurality, and sometimes a majority, of damages in many of the potential project sites, including Pickering Beach, Bowers Beach, South Bowers Beach, Prime Hook, and Lewes Beach. For Kitts Hummock and Slaughter Beach, wave attack and inundation also contribute heavily to overall structure and content damages.

FUTURE WITH-PROJECT CONDITION (FWP)

This section of the Appendix describes the evaluation of the selected CSRM alternative for seven Delaware sites. A description of the alternative, the methodology for developing cost estimates, and the alternative's performance in terms of damages reduced (benefits) is included in this section.

Initial Construction and Periodic Nourishment

The NED plan consists of the construction of the optimized dune and berm template (listed in Table 9) with periodic nourishments at regular six year intervals. This measure includes placement of beach compatible material dredged from the Delaware River channel for both the initial construction and nourishments. Periodic nourishments are timed with maintenance dredging from the Delaware River Main Channel Deepening Project. Nourishment of the beach is undertaken periodically to maintain the erosion control features within design dimensions. In addition to assumptions stated for the FWOP scenario, the FWP scenario requires further Beach-fx inputs for the modeled alternatives. Assumptions stated in the FWOP section are included and identical to the assumptions stated for the FWP scenario.

Initial Construction Start Date

- FY2020 – Slaughter Beach / Prime Hook Beach / Lewes Beach
- FY2026 – Pickering / Kitts Hummock / Bowers / South Bowers

Due to anticipated dredge material availability limitations, construction for four sites was necessarily pushed out to FY2026. The first Periodic Nourishment interval for the three sites previously constructed in FY2020 also occurs in FY2026. The Base Year and overall 50 year period of analysis remains constant for all seven sites and thus Pickering, Kitts Hummock, Bowers, and South Bowers will have the same With- and Without-Project Condition Damages until construction of the NED template in FY2026.

Time Increment – 6 years – Periodic Nourishment cycle
Production Rate – 5,500 cubic yards per day
Borrow to Placement Ratio – 100% – All lost beach material is replaced by an equal volume of material during beach nourishment
Reach Planform Rate – dependent on Dune/Berm configuration. Added to historic (background) erosion rate to account for increased beach material losses with a wider berm
Mobilization Threshold – 0 cubic yards
Nourishment Trigger – 95% – fractional amount of template (dune height, dune width, berm width) that denotes requirement for renourishment.

Beach-fx uses a Periodic-Tested nourishment implementation. This type of nourishment implementation assumes testing volumetric nourishment needs on a regular cycle; in this study a six year cycle. If at the time of testing, the volumetric nourishment needs for all of the Reaches at a given site are less than the mobilization threshold, the nourishment mobilization is not implemented during that cycle and not reattempted until the next cycle. If a given site does have a nourishment need greater than the mobilization threshold, but none of the nourishment triggers have been reached for either Dune Height, Dune Width, or Berm Width for any of the Reaches at a given site, then nourishment implementation is again skipped for that cycle.

If any Reach, however, has crossed the nourishment trigger threshold for any portion of the design template, then all Reaches within the site are nourished back to full design template specifications. Essentially, this means that there is a maximum of eight periodic nourishment implementations for each

site, but sites will not necessarily receive all eight nourishments if their beach profiles do not cross selected mobilization and nourishment triggers at the start of a periodic nourishment cycle.

During screening and template optimization, Beach-fx calculated approximate initial construction and periodic nourishment costs based on Cost Engineering inputs generated by Micro-computer Aided Cost Estimating System (MCACES) Second Generation (MII).

After optimization and selection of the NED template for each study location, costs were generated outside of Beach-fx using certified Corps procedures to increase accuracy, reduce uncertainty, and fulfill Corps guidance. These final cost estimates and relevant assumptions are detailed in the following section. Additional details can be found in the Cost Engineering Appendix.

Table 9: NED Plan Dune and Berm Template Summary

Site	Dune Height (ft, NAVD88)	Dune Width (ft, NAVD88)	Berm Width (ft, NAD83)	Erosion (ft/yr)	Planform Rate (ft/yr)	Construct Year
Pickering	BERM ONLY	BERM ONLY	100	-4.9	-2.0	2026
Kitts Hummock	BERM ONLY	BERM ONLY	100	-4.3	-3.2	2026
Bowers	12	25	75	-2.5	-5.0	2026
South Bowers	12	25	100	-3.0	-9.0	2026
Slaughter Beach	8.5	25	50	-1.9	-1.2	2020
Prime Hook	12	25	50	-0.7	-1.9	2020
Lewes Beach	12	25	50	-3.0*	-0.7	2020

*Reaches R6-R9 have Erosion Rate of +0.0ft/yr

Project Cost Methodology

A key assumption in this study is the application of Federal Standard dredging and disposal costs in the Without Project condition. As explained in greater detail in the Main Report, the Federal Standard is the practice of dredged material disposal at the least cost, environmentally acceptable disposal location.

For this study area, the current least cost, environmentally acceptable disposal location is an overboard disposal site designated as Buoy 10. This site is a deep trench in the lower portion of the Delaware Bay located approximately six miles northwest of Cape May Point. Buoy 10 is currently used as a disposal location for maintenance dredging material as part of the Delaware River Main Channel Deepening Project. Maintenance efforts utilize a two-year dredging cycle.

The proposed NED Plan is to divert this dredged material from disposal at the fixed capacity Buoy 10 site and instead use that dredged material as beachfill at the project locations. For this reason, the Federal Standard cost of disposal at Buoy 10 is accepted as a Without-Project Cost. Therefore, the cost of the NED Plan is only the incremental cost above the Federal Standard.

Another important assumption used during the cost estimation process is the expectation that the Buoy 10 disposal site, using current capacity constraints and current disposal volume rates, will exceed its limits in FY2030 (or 10 years into the 50 year period of analysis). Starting in FY2030, disposal material from maintenance dredging would need to be shipped to an alternate disposal site, the next closest being Artificial Island.

Figure 17 shows the approximate locations of disposal sites Buoy 10 and Artificial Island. The latter disposal site has a capacity of 15.8 million cubic yards to a dike height of 50 feet and is located approximately 40 miles further up the channel. This change in disposal location is important as the Federal Standard Without-Project Cost changes significantly between the two sites. Transportation and disposal of dredge material at Artificial Island is considerably more expensive than similar work completed at Buoy 10.

In effect, the Federal Standard Without-Project Cost for Initial Construction and Periodic Nourishment in FY2020 and FY2026 will be different than the Federal Standard Without-Project Cost in the remaining periodic nourishment cycles (FY2032 to FY2070).

It is also important to note that due to material being diverted from Buoy 10 to the Delaware Bay coastline in both FY2020 and FY2026, the lifetime capacity of the Buoy 10 disposal site in the With-Project Condition is extended for two additional maintenance cycles. Maintenance can offload dredge material at the less expensive Buoy 10 in FY2030 and FY2034 instead of shipping that material all the way to Artificial Island. This delta is another cost saving and is counted as a Federal Disposal Extension benefit.

Cost estimates (Table 10 - Table 12) were computed by the PDT using Micro-computer Aided Cost Estimating System (MCACES) Second Generation (MII) with cost risk analysis evaluated using Oracle Crystal Ball. Cost Engineering products were certified via Agency Technical Review (ATR) from the USACE Cost Engineering Directory of Expertise (Cost DX) at Walla Walla District.

Interest During Construction was calculated based on a 7.4 month construction period in FY2020 for Slaughter Beach, Prime Hook, and Lewes Beach and then also an 8.0 month construction period in FY2026 for Pickering, Kitts Hummock, Bowers Beach, and South Bowers Beach.

Figure 17: Buoy 10 and Artificial Island Disposal Site Locations

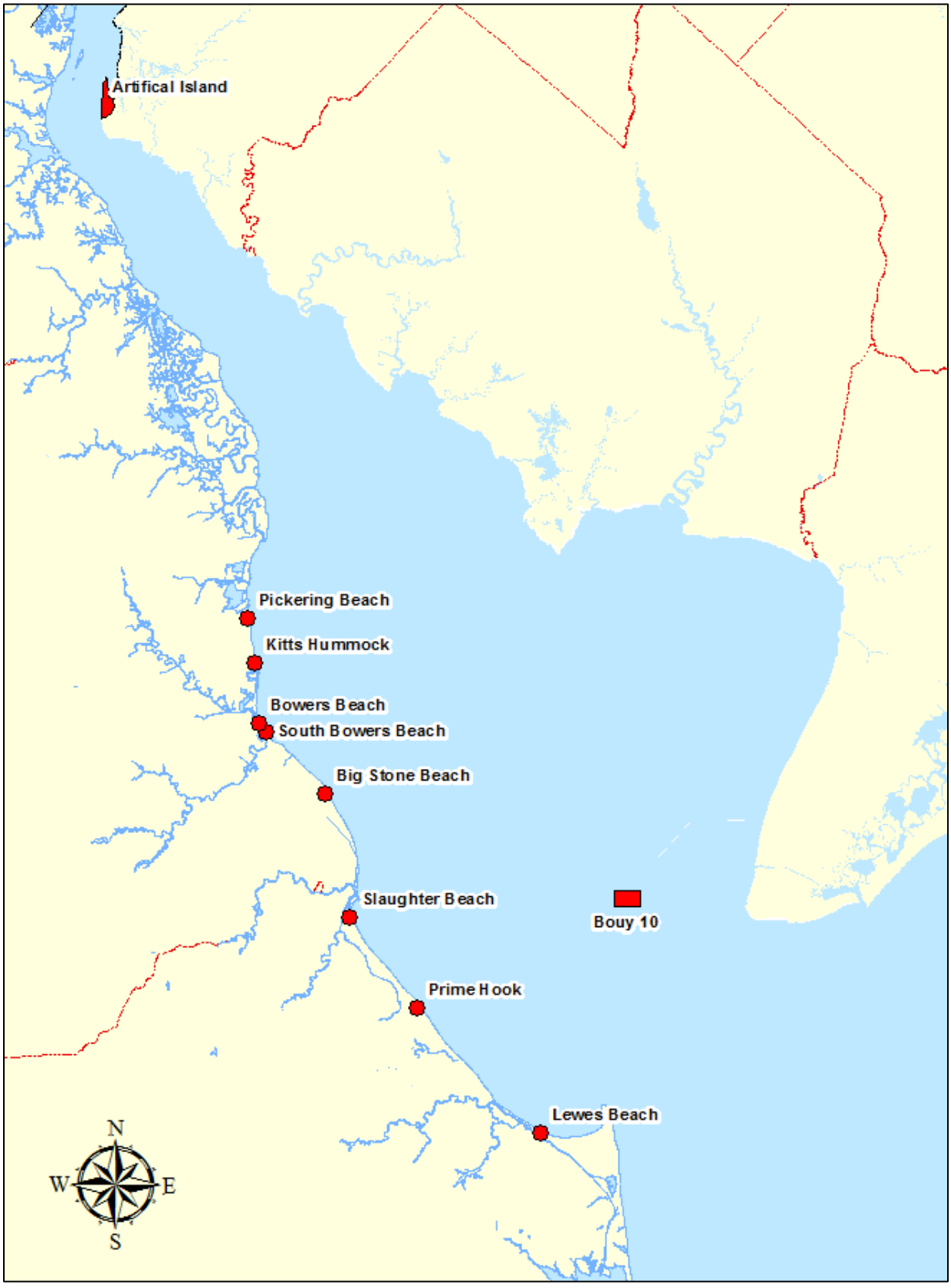


Table 10: Initial Construction Costs (FY2020)

Number	Product Description	Quantity	UOM	Unit Price	Estimated	Contingency	TOTAL
01	**LANDS AND DAMAGES**	**1**	**JOB**	**LS**	**$ 11,654,400**	**$ 5,619,930**	**$ 17,274,330**
02	**RELOCATION**	**1**	**JOB**	**LS**	**$ -**	**$ -**	**$ -**
17	**BEACH REPLENISHMENT**				**$ 41,114,182**	**$ 10,278,546**	**$ 51,392,728**
17 00 17 01	Mobilization, Demobilization, and Preparatory Work				$ 7,893,335	$ 1,973,334	$ 9,866,669
17 01 01	Pickering Beach	1	JOB	LS	$ -	$ -	$ -
17 01 02	Between Pickering Beach & Kitts Hummock Beach	1	JOB	LS	$ -	$ -	$ -
17 01 03	Between Kitts Hummock & Bowers Beach	1	JOB	LS	$ -	$ -	$ -
17 01 04	Between Bowers Beach & South Bowers Beach	1	JOB	LS	$ -	$ -	$ -
17 01 05	Big Stone Beach	1	JOB	LS	$ -	$ -	$ -
17 01 06	Slaughter Beach	1	JOB	LS	$ 5,318,291	$ 1,329,573	$ 6,647,864
17 01 07	Between Slaughter Beach & Prime Hook Beach	1	JOB	LS	$ 1,376,176	$ 344,044	$ 1,720,220
17 01 08	Between Prime Hook Beach & Lewes Beach	1	JOB	LS	$ 1,198,868	$ 299,717	$ 1,498,585
17 01 09	Outfall, Kitts Hummock	1	JOB	LS	$ -	$ -	$ -
17 01 10	Terminal Groin/Jetty, South Bowers Beach	1	JOB	LS	$ -	$ -	$ -
17 00 17 02	Site Work				$ 32,184,705	$ 8,046,176	$ 40,230,881
17 02 01	Dredging and Beachfill - Pickering Beach	1	JOB	LS	$ -	$ -	$ -
17 02 02	Dredging and Beachfill - Kitts Hummock Beach	1	JOB	LS	$ -	$ -	$ -
17 02 03	Dredging and Beachfill - Bowers Beach	1	JOB	LS	$ -	$ -	$ -
17 02 04	Dredging and Beachfill - South Bowers Beach	1	JOB	LS	$ -	$ -	$ -
17 02 05	Dredging and Beachfill - Big Stone Beach	1	JOB	LS	$ -	$ -	$ -
17 02 06	Dredging and Beachfill - Slaughter Beach	1	JOB	LS	$ 12,794,848	$ 3,198,712	$ 15,993,560
17 02 07	Dredging and Beachfill - Prime Hook Beach	1	JOB	LS	$ 11,111,769	$ 2,777,942	$ 13,889,711
17 02 08	Dredging and Beachfill - Lewes Beach	1	JOB	LS	$ 8,278,088	$ 2,069,522	$ 10,347,610
17 00 99 02	Associated General Items				$ 1,036,142	$ 259,036	$ 1,295,178
99 02 01	Outfall, Kitts Hummock Beach	1	JOB	LS	$ -	$ -	$ -
99 02 02	Jetty, South Bowers Beach	1	JOB	LS	$ -	$ -	$ -
99 02 03	Dune Grass Plantings	1	JOB	LS	$ 423,312	$ 105,828	$ 529,140
99 02 04	Pedestrian Dune Crossovers	1	JOB	LS	$ 99,458	$ 24,865	$ 124,323
99 02 05	Vehicle Dune Crossovers	1	JOB	LS	$ 54,935	$ 13,734	$ 68,669
99 02 06	ADA Dune Crossover	1	JOB	LS	$ 93,859	$ 23,465	$ 117,324
99 02 07	Sand Fence	1	JOB	LS	$ 364,578	$ 91,145	$ 455,723
30	**PLANNING, ENGINEERING, AND DESIGN**	**1**	**JOB**	**LS**	**$ 2,744,372**	**$ 686,093**	**$ 3,430,465**
31	**CONSTRUCTION MANAGEMENT (S&I)**	**1**	**JOB**	**LS**	**$ 1,748,997**	**$ 437,249**	**$ 2,186,246**
	TOTAL ESTIMATED AMOUNT						**$ 74,283,769**
	ROUNDED						**$ 74,284,000**

Table 11: Initial Construction + Nourishment (FY2026)

Number	Product Description	Quantity	UOM	Unit Price	Estimated	Contingency	TOTAL
01	**LANDS AND DAMAGES**	**1**	**JOB**	**LS**	**$ -**	**$ -**	**$ -**
02	**RELOCATION**	**1**	**JOB**	**LS**	**$ -**	**$ -**	**$ -**
17	**BEACH REPLENISHMENT**				**$ 58,083,176**	**$ 15,101,626**	**$ 73,184,802**
17 00 17 01	Mobilization, Demobilization, and Preparatory Work				$ 15,373,570	$ 3,997,128	$ 19,370,698
17 01 01	Pickering Beach	1	JOB	LS	$ 5,548,734	$ 1,442,671	$ 6,991,405
17 01 02	Between Pickering Beach & Kitts Hummock Beach	1	JOB	LS	$ 1,858,394	$ 483,182	$ 2,341,576
17 01 03	Between Kitts Hummock & Bowers Beach	1	JOB	LS	$ 1,773,659	$ 461,151	$ 2,234,810
17 01 04	Between Bowers Beach & South Bowers Beach	1	JOB	LS	$ 1,765,921	$ 459,139	$ 2,225,060
17 01 05	Big Stone Beach	1	JOB	LS	$ -	$ -	$ -
17 01 06	Slaughter Beach	1	JOB	LS	$ 1,726,938	$ 449,004	$ 2,175,942
17 01 07	Between Slaughter Beach & Prime Hook Beach	1	JOB	LS	$ 1,405,451	$ 365,417	$ 1,770,868
17 01 08	Between Prime Hook Beach & Lewes Beach	1	JOB	LS	$ 1,217,956	$ 316,669	$ 1,534,625
17 01 09	Outfall, Kitts Hummock	1	JOB	LS	$ 76,517	$ 19,894	$ 96,411
17 01 10	Terminal Groin/Jetty, South Bowers Beach	1	JOB	LS	$ -	$ -	$ -
17 00 17 02	Site Work				$ 41,905,495	$ 10,895,429	$ 52,800,924
17 02 01	Dredging and Beachfill - Pickering Beach	1	JOB	LS	$ 8,680,480	$ 2,256,925	$ 10,937,405
17 02 02	Dredging and Beachfill - Kitts Hummock Beach	1	JOB	LS	$ 9,410,885	$ 2,446,830	$ 11,857,715
17 02 03	Dredging and Beachfill - Bowers Beach	1	JOB	LS	$ 8,478,142	$ 2,204,317	$ 10,682,459
17 02 04	Dredging and Beachfill - South Bowers Beach	1	JOB	LS	$ 5,267,184	$ 1,369,468	$ 6,636,652
17 02 05	Dredging and Beachfill - Big Stone Beach	1	JOB	LS	$ -	$ -	$ -
17 02 06	Dredging and Beachfill - Slaughter Beach	1	JOB	LS	$ 4,064,700	$ 1,056,822	$ 5,121,522
17 02 07	Dredging and Beachfill - Prime Hook Beach	1	JOB	LS	$ 2,300,961	$ 598,250	$ 2,899,211
17 02 08	Dredging and Beachfill - Lewes Beach	1	JOB	LS	$ 3,703,143	$ 962,817	$ 4,665,960
17 00 99 02	Associated General Items				$ 804,111	$ 209,069	$ 1,013,180
99 02 01	Outfall, Kitts Hummock Beach	1	JOB	LS	$ 174,787	$ 45,445	$ 220,232
99 02 02	Jetty, South Bowers Beach	1	JOB	LS	$ -	$ -	$ -
99 02 03	Dune Grass Plantings	1	JOB	LS	$ 212,060	$ 55,136	$ 267,196
99 02 04	Pedestrian Dune Crossovers	1	JOB	LS	$ 38,836	$ 10,097	$ 48,933
99 02 05	Vehicle Dune Crossovers	1	JOB	LS	$ 110,192	$ 28,650	$ 138,842
99 02 06	ADA Dune Crossover	1	JOB	LS	$ 124,817	$ 32,452	$ 157,269
99 02 07	Sand Fence	1	JOB	LS	$ 143,419	$ 37,289	$ 180,708
30	**PLANNING, ENGINEERING, AND DESIGN**	**1**	**JOB**	**LS**	**$ 3,877,052**	**$ 1,008,034**	**$ 4,885,086**
31	**CONSTRUCTION MANAGEMENT (S&I)**	**1**	**JOB**	**LS**	**$ 2,470,858**	**$ 642,423**	**$ 3,113,281**
	TOTAL ESTIMATED AMOUNT						**$ 81,183,168**
	ROUNDED						**$ 81,183,000**

Table 12: Periodic Nourishment (FY2032 – FY2070)

Number	Product Description	Quantity	UOM	Unit Price	Estimated	Contingency	TOTAL
01	**LANDS AND DAMAGES**	**1**	**JOB**	**LS**	**$ -**	**$ -**	**$ -**
02	**RELOCATION**	**1**	**JOB**	**LS**	**$ -**	**$ -**	**$ -**
09	**CHANNELS & CANALS**	**1**	**JOB**	**LS**	**$13,119,609**	**$ 3,411,098**	**$16,530,707**
01 17 01	Mobilization, Demobilization, and Preparatory Work	1	JOB	LS	$ 1,212,819	$ 315,333	$ 1,528,152
02 17 01	Dredging (Artificial Island CDF)	1	JOB	lS	$11,906,790	$ 3,095,765	$15,002,555
17	**BEACH REPLENISHMENT**				**$35,265,853**	**$ 9,169,122**	**$44,434,975**
17 00 17 01	Mobilization, Demobilization, and Preparatory Work				$15,297,053	$ 3,977,234	$19,274,287
17 01 01	Pickering Beach	1	JOB	LS	$ 5,548,734	$ 1,442,671	$ 6,991,405
17 01 02	Between Pickering Beach & Kitts Hummock Beach	1	JOB	LS	$ 1,858,394	$ 483,182	$ 2,341,576
17 01 03	Between Kitts Hummock & Bowers Beach	1	JOB	LS	$ 1,773,659	$ 461,151	$ 2,234,810
17 01 04	Between Bowers Beach & South Bowers Beach	1	JOB	LS	$ 1,765,921	$ 459,139	$ 2,225,060
17 01 05	Big Stone Beach	1	JOB	LS	$ -	$ -	$ -
17 01 06	Slaughter Beach	1	JOB	LS	$ 1,726,938	$ 449,004	$ 2,175,942
17 01 07	Between Slaughter Beach & Prime Hook Beach	1	JOB	LS	$ 1,405,451	$ 365,417	$ 1,770,868
17 01 08	Between Prime Hook Beach & Lewes Beach	1	JOB	LS	$ 1,217,956	$ 316,669	$ 1,534,625
17 00 17 02	Site Work				$19,968,800	$ 5,191,888	$25,160,688
17 02 01	Dredging and Beachfill - Pickering Beach	1	JOB	LS	$ 1,934,824	$ 503,054	$ 2,437,878
17 02 02	Dredging and Beachfill - Kitts Hummock Beach	1	JOB	LS	$ 3,988,578	$ 1,037,030	$ 5,025,608
17 02 03	Dredging and Beachfill - Bowers Beach	1	JOB	LS	$ 2,142,230	$ 556,980	$ 2,699,210
17 02 04	Dredging and Beachfill - South Bowers Beach	1	JOB	LS	$ 1,834,364	$ 476,935	$ 2,311,299
17 02 05	Dredging and Beachfill - Big Stone Beach	1	JOB	LS	$ -	$ -	$ -
17 02 06	Dredging and Beachfill - Slaughter Beach	1	JOB	LS	$ 4,064,700	$ 1,056,822	$ 5,121,522
17 02 07	Dredging and Beachfill - Prime Hook Beach	1	JOB	LS	$ 2,300,961	$ 598,250	$ 2,899,211
17 02 08	Dredging and Beachfill - Lewes Beach	1	JOB	LS	$ 3,703,143	$ 962,817	$ 4,665,960
99	**OMRR&R**	**1**	**JOB**	**LS**	**$ 175,000**	**$ 45,500**	**$ 220,500**
30	**PLANNING, ENGINEERING, AND DESIGN**	**1**	**JOB**	**LS**	**$ 3,229,730**	**$ 839,730**	**$ 4,069,460**
31	**CONSTRUCTION MANAGEMENT (S&I)**	**1**	**JOB**	**LS**	**$ 2,480,336**	**$ 644,887**	**$ 3,125,223**
	TOTAL ESTIMATED AMOUNT						**$68,380,865**
	ROUNDED						**$68,381,000**

During the Periodic Nourishment cycles from FY2032 to FY2070, the With-Project Condition volume requirements do not utilize all of the anticipated 930,000CY of dredge material excavated during maintenance of the Delaware River main channel. Only about 517,000CY of beachfill are expected to be necessary to maintain the NED Plan Dune and Berm template, therefore 413,000CY of material will still need to be shipped to Artificial Island and cannot be counted as a Federal Standard cost deduction. Table 12 above shows the additional $16,530,707 cost to transport this material to Artificial Island.

Table 13 shows the Present Value Total Project Cost accounting for a 50 year period of analysis with the FY2018 Project Evaluation and Formulation Rate of 2.75% (EGM 18-01, *Federal Interest Rate for Corps of Engineers Projects for Fiscal Year 2018*).

Table 14 and Table 15 show the Federal Standard cost estimates.

Table 13: Total Project Cost (Present Value) with No Federal Standard Deduction

PY	PV Factor	Year Date	Type	COST	PV COST
0	1.00000	2020	Initial Construction	$ 74,283,769	$ 74,283,769
0	1.00000	2020	IDC	$ 1,259,729	$ 1,259,729
1	0.97324	2021			
2	0.94719	2022			
3	0.92184	2023			
4	0.89717	2024			
5	0.87315	2025			
6	0.84978	2026	Initial + Periodic	$ 81,183,168	$ 68,988,232
6	0.84978	2026	IDC	$ 735,428	$ 624,955
7	0.82704	2027			
8	0.80491	2028			
9	0.78336	2029			
10	0.76240	2030			
11	0.74199	2031			
12	0.72213	2032	Periodic Nourishment	$ 68,380,865	$ 49,380,175
13	0.70281	2033			
14	0.68400	2034			
15	0.66569	2035			
16	0.64787	2036			
17	0.63053	2037			
18	0.61366	2038	Periodic Nourishment	$ 68,380,865	$ 41,962,528
19	0.59723	2039			
20	0.58125	2040			
21	0.56569	2041			
22	0.55055	2042			
23	0.53582	2043			
24	0.52148	2044	Periodic Nourishment	$ 68,380,865	$ 35,659,123
25	0.50752	2045			
26	0.49394	2046			
27	0.48072	2047			
28	0.46785	2048			
29	0.45533	2049			
30	0.44314	2050	Periodic Nourishment	$ 68,380,865	$ 30,302,585
31	0.43128	2051			
32	0.41974	2052			
33	0.40851	2053			
34	0.39757	2054			
35	0.38693	2055			
36	0.37658	2056	Periodic Nourishment	$ 68,380,865	$ 25,750,679
37	0.36650	2057			
38	0.35669	2058			
39	0.34714	2059			
40	0.33785	2060			
41	0.32881	2061			
42	0.32001	2062	Periodic Nourishment	$ 68,380,865	$ 21,882,539
43	0.31144	2063			
44	0.30311	2064			
45	0.29500	2065			
46	0.28710	2066			
47	0.27942	2067			
48	0.27194	2068	Periodic Nourishment	$ 68,380,865	$ 18,595,451
49	0.26466	2069			
50	0.25758	2070			
TOTAL ESTIMATED AMOUNT					**$ 368,689,765**
ROUNDED					**$ 368,690,000**

Table 14: Buoy 10 Federal Standard

Number	Product Description	Quantity	UOM	Unit Price	Estimated	Contingency	TOTAL
01	**LANDS AND DAMAGES**	**1**	**JOB**	**LS**	**$ -**	**$ -**	**$ -**
02	**RELOCATION**	**1**	**JOB**	**LS**	**$ -**	**$ -**	**$ -**
09	**CHANNELS AND CANALS**				**$ 15,993,642**	**$ 3,038,792**	**$ 19,032,434**
09 01	Mobilization, Demobilization, and Preparatory Work	1	JOB	LS	$ 1,680,942	$ 319,379	$ 2,000,321
09 02	Site Work	930,000	JOB	$ 15.39	$ 14,312,700	$ 2,719,413	$ 17,032,113
30	**PLANNING, ENGINEERING, AND DESIGN**	**1**	**JOB**	**LS**	**$ 778,772**	**$ 147,967**	**$ 926,739**
31	**CONSTRUCTION MANAGEMENT (S&I)**	**1**	**JOB**	**LS**	**$ 834,802**	**$ 158,612**	**$ 993,414**
	TOTAL ESTIMATED AMOUNT						**$ 20,952,587**
	ROUNDED						**$ 20,953,000**

Table 15: Artificial Island Federal Standard (Total)

Number	Product Description	Quantity	UOM	Unit Price	Estimated	Contingency	TOTAL
01	**LANDS AND DAMAGES**	**1**	**JOB**	**LS**	**$ -**	**$ -**	**$ -**
02	**RELOCATION**	**1**	**JOB**	**LS**	**$ -**	**$ -**	**$ -**
09	**CHANNELS AND CANALS**				**$ 29,260,675**	**$ 5,559,528**	**$ 34,820,203**
09 01	Mobilization, Demobilization, and Preparatory Work	1	JOB	LS	$ 2,467,375	$ 468,801	$ 2,936,176
09 02	Site Work	930,000	JOB	$ 28.81	$ 26,793,300	$ 5,090,727	$ 31,884,027
30	**PLANNING, ENGINEERING, AND DESIGN**	**1**	**JOB**	**LS**	**$ 1,133,665**	**$ 215,396**	**$ 1,349,061**
31	**CONSTRUCTION MANAGEMENT (S&I)**	**1**	**JOB**	**LS**	**$ 1,075,129**	**$ 204,275**	**$ 1,279,404**
	TOTAL ESTIMATED AMOUNT						**$ 37,448,668**
	ROUNDED						**$ 37,449,000**

Table 16: Total Project Cost (Present Value) with Applied Federal Standard Deduction

PY	PV Factor	Year Date	Type	Federal Standard	COST	Fed. Std. Cost	ADJ. COST	PV COST
0	1.00000	2020	Initial Construction	Buoy 10	$ 74,283,769	$ 20,952,587	$ 53,331,182	$ 53,331,182
0	1.00000	2020	IDC		$ 1,259,729	$ -	$ 1,259,729	$ 1,259,729
1	0.97324	2021						
2	0.94719	2022						
3	0.92184	2023						
4	0.89717	2024						
5	0.87315	2025						
6	0.84978	2026	Initial + Periodic	Buoy 10	$ 81,183,168	$ 20,952,587	$ 60,230,581	$ 51,183,039
6	0.84978	2026	IDC		$ 735,428	$ -	$ 735,428	$ 624,955
7	0.82704	2027						
8	0.80491	2028						
9	0.78336	2029						
10	0.76240	2030						
11	0.74199	2031						
12	0.72213	2032	Periodic Nourishment	Artificial Island	$ 68,380,865	$ 37,448,668	$ 30,932,197	$ 22,337,204
13	0.70281	2033						
14	0.68400	2034						
15	0.66569	2035						
16	0.64787	2036						
17	0.63053	2037						
18	0.61366	2038	Periodic Nourishment	Artificial Island	$ 68,380,865	$ 37,448,668	$ 30,932,197	$ 18,981,819
19	0.59723	2039						
20	0.58125	2040						
21	0.56569	2041						
22	0.55055	2042						
23	0.53582	2043						
24	0.52148	2044	Periodic Nourishment	Artificial Island	$ 68,380,865	$ 37,448,668	$ 30,932,197	$ 16,130,463
25	0.50752	2045						
26	0.49394	2046						
27	0.48072	2047						
28	0.46785	2048						
29	0.45533	2049						
30	0.44314	2050	Periodic Nourishment	Artificial Island	$ 68,380,865	$ 37,448,668	$ 30,932,197	$ 13,707,424
31	0.43128	2051						
32	0.41974	2052						
33	0.40851	2053						
34	0.39757	2054						
35	0.38693	2055						
36	0.37658	2056	Periodic Nourishment	Artificial Island	$ 68,380,865	$ 37,448,668	$ 30,932,197	$ 11,648,362
37	0.36650	2057						
38	0.35669	2058						
39	0.34714	2059						
40	0.33785	2060						
41	0.32881	2061						
42	0.32001	2062	Periodic Nourishment	Artificial Island	$ 68,380,865	$ 37,448,668	$ 30,932,197	$ 9,898,603
43	0.31144	2063						
44	0.30311	2064						
45	0.29500	2065						
46	0.28710	2066						
47	0.27942	2067						
48	0.27194	2068	Periodic Nourishment	Artificial Island	$ 68,380,865	$ 37,448,668	$ 30,932,197	$ 8,411,683
49	0.26466	2069						
50	0.25758	2070						
TOTAL ESTIMATED AMOUNT								**$ 207,514,463**
ROUNDED								**$ 207,514,000**

Table 17: Individual Site Cost (Present Value) with No Federal Standard

Site	IC (2020)	IC (2026)	IDC	PN	TOTAL	AAC
Pickering Beach	$0	$12,773,742	$170,398	$28,152,747	$41,096,887	$1,522,266
Kitts Hummock	$0	$13,824,886	$184,736	$36,611,886	$50,621,508	$1,875,067
Bowers Beach	$0	$12,557,093	$166,426	$29,007,025	$41,730,544	$1,545,738
South Bowers	$0	$9,119,027	$103,395	$27,738,966	$36,961,387	$1,369,084
Slaughter Beach	$27,344,523	$0	$463,718	$44,588,456	$72,396,696	$2,681,640
Prime Hook	$25,240,674	$0	$428,040	$35,435,364	$61,104,077	$2,263,351
Lewes Beach	$21,698,573	$0	$367,972	$42,712,121	$64,778,666	$2,399,461
TOTAL ESTIMATE	**$74,283,769**	**$48,274,747**	**$1,884,684**	**$244,246,565**	**$368,689,765**	**$13,656,608**

*IC = Initial Construction
*PN = Periodic Nourishment

Table 18: Individual Site Cost (Present Value) with Applied Federal Standard

Site	IC (2020)	IC (2026)	IDC	PN	TOTAL	AAC
Pickering Beach	$0	$9,157,747	$170,398	$17,290,264	$26,618,408	$985,970
Kitts Hummock	$0	$9,872,380	$184,736	$12,548,674	$22,605,790	$837,339
Bowers Beach	$0	$9,000,833	$166,426	$16,723,835	$25,891,094	$959,030
South Bowers	$0	$6,737,567	$103,395	$16,432,512	$23,273,474	$862,071
Slaughter Beach	$19,872,302	$0	$463,718	$19,411,837	$39,747,856	$1,472,297
Prime Hook	$17,255,598	$0	$428,040	$18,598,302	$36,281,939	$1,343,916
Lewes Beach	$16,203,282	$0	$367,972	$16,524,647	$33,095,900	$1,225,903
TOTAL ESTIMATE	**$53,331,182**	**$34,768,527**	**$1,884,684**	**$117,530,070**	**$207,514,463**	**$7,686,527**

Table 16 through Table 18 show the application of the Federal Standard as well as the difference in net present value cost between withholding the Federal Standard deduction and its application. In present value terms, the Federal Standard deduction removes $161,175,302 from the Total Cost, or $5,970,081 in Average Annual Cost.

COASTAL STORM RISK MANAGEMENT (CSRM) BENEFITS

Coastal Storm Risk Management Benefits for this study include Structure Damages avoided, Content Damages avoided, Disposal site extension cost reductions, and land loss prevention benefits. Benefits are computed using the formula (*Without Project Damages – With Project Damages) + Disposal Savings + Land Loss Prevention = CSRM Benefits.* No other benefit categories (e.g. Recreation) were found to be significant contributors to overall CSRM benefits.

Residual risk refers to the storm damages a study area can be anticipated to experience post project implementation. This is computed using *Without Project Damages – CSRM Benefits = Residual Risk*.

Maintenance Material Disposal Cost Savings and Land Loss Prevention Benefits are presented later in the Appendix.

Structure and Content Damages Avoided

The Damages Reduced by the optimized NED Dune and Berm template are shown in Table 19:

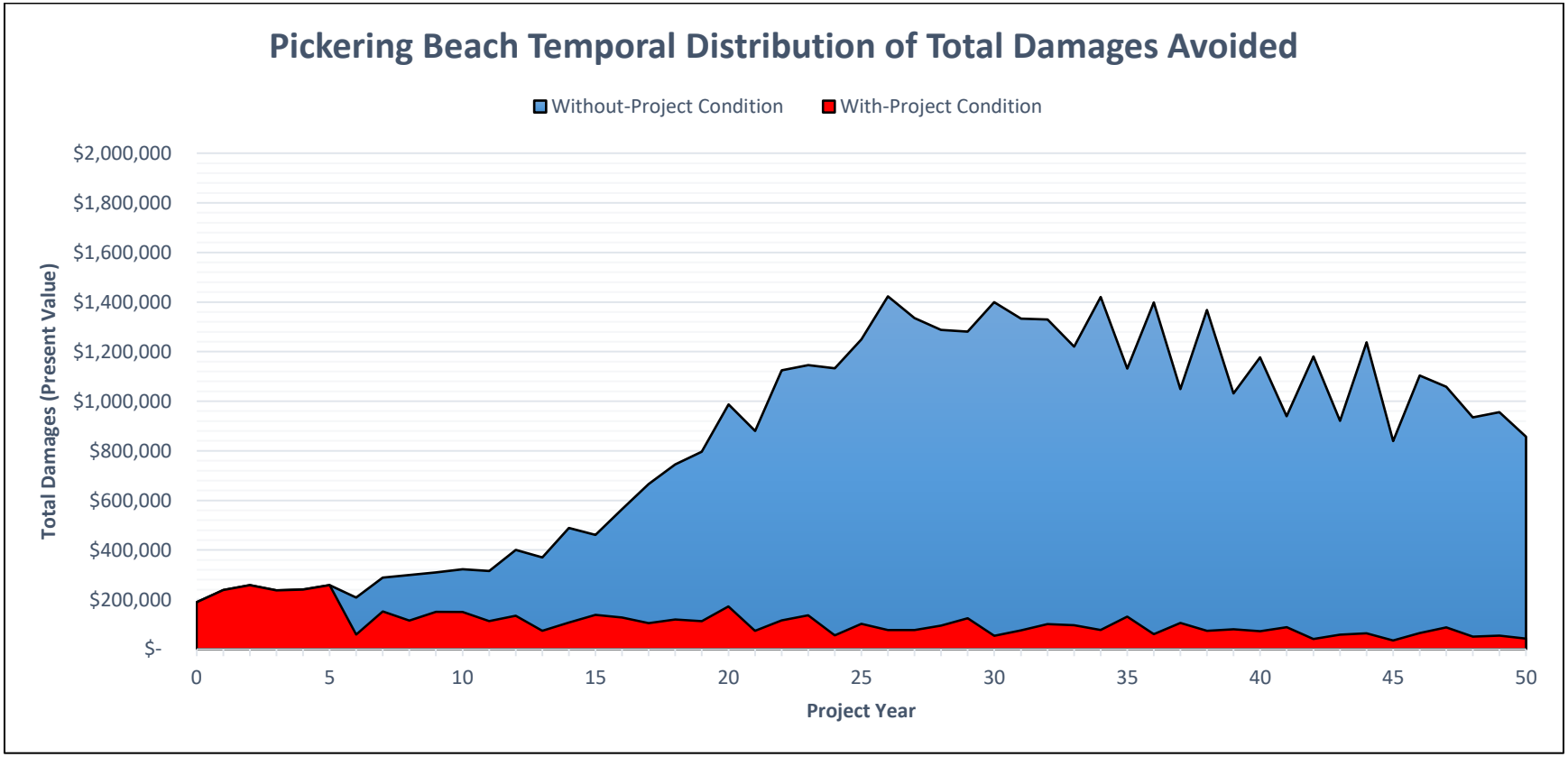
Table 19: Damage Reduction Benefits by Site

Site	WoP	WP	Avoided	AAB	Residual
Pickering	$42,711,258	$4,392,400	$38,318,858	$1,419,366	10.3%
Kitts Hummock	$41,839,836	$13,490,213	$28,349,623	$1,050,096	32.2%
Bowers	$33,128,526	$7,774,641	$25,353,885	$939,131	23.5%
South Bowers	$22,073,876	$5,659,488	$16,414,388	$608,004	25.6%
Slaughter Beach	$117,199,509	$52,836,194	$64,363,316	$2,384,076	45.1%
Prime Hook	$85,513,901	$29,503,690	$56,010,211	$2,074,670	34.5%
Lewes Beach	$54,759,098	$20,511,505	$34,247,593	$1,268,562	37.5%
Total Project	**$397,226,004**	**$134,168,130**	**$263,057,874**	**$9,743,906**	**33.8%**

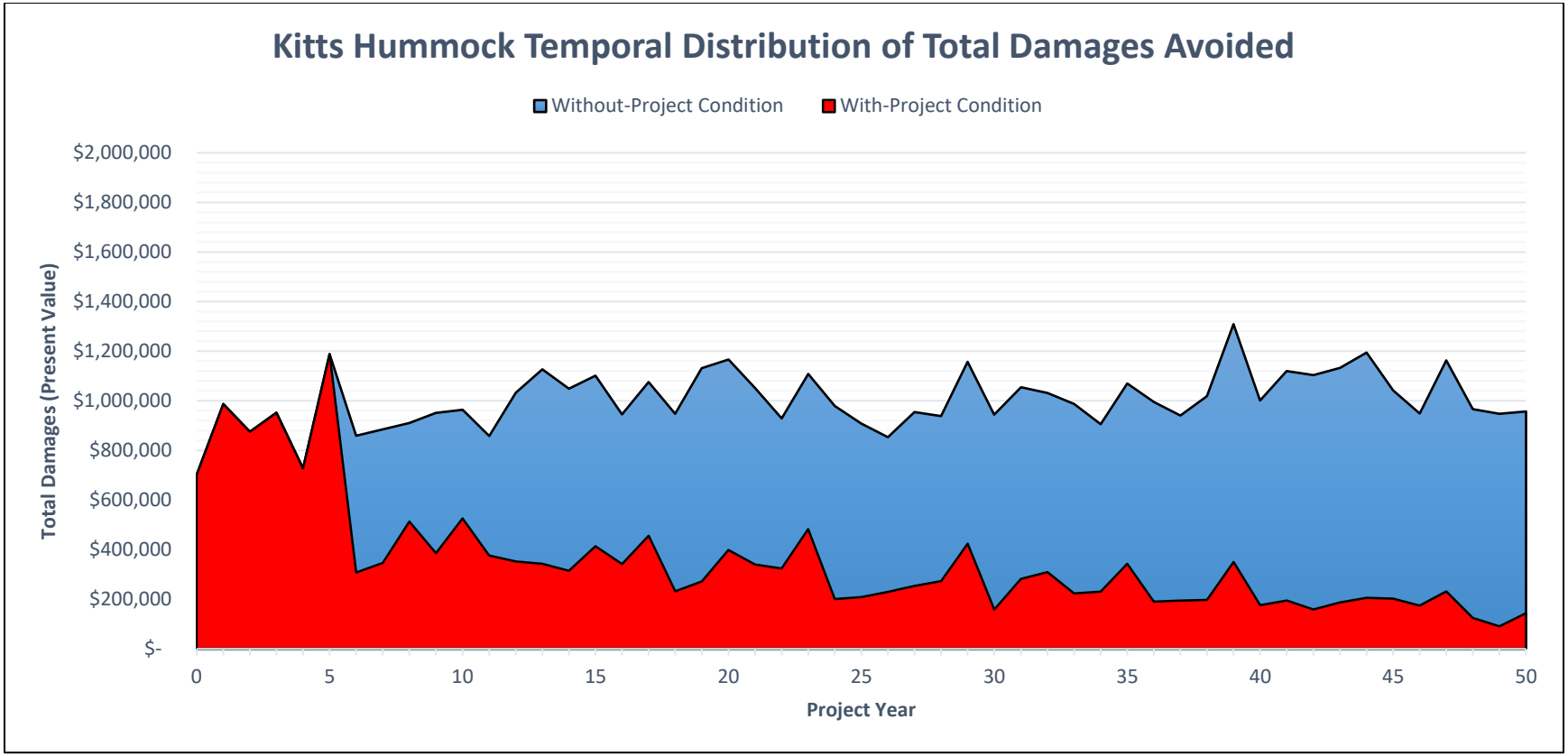
The selected NED Plan reduces 66.2% of damages in the study area. For this particular study area, the proposed dune and berm templates are expected to significantly reduce erosion and wave attack damages with only minimal reductions to inundation damage due to the presence of back bay flooding. Slaughter Beach, as shown in Table 8 and Figure 16, experiences greater inundation-related impacts than the other study locations. Unsurprisingly, Slaughter Beach also experiences the highest Residual Risk post construction.

Figure 18 illustrates the temporal distribution of damages for each study location. This analysis provides insight into the change in inventory conditions and damages over the 50 year period of analysis with Intermediate Relative Sea Level Change.

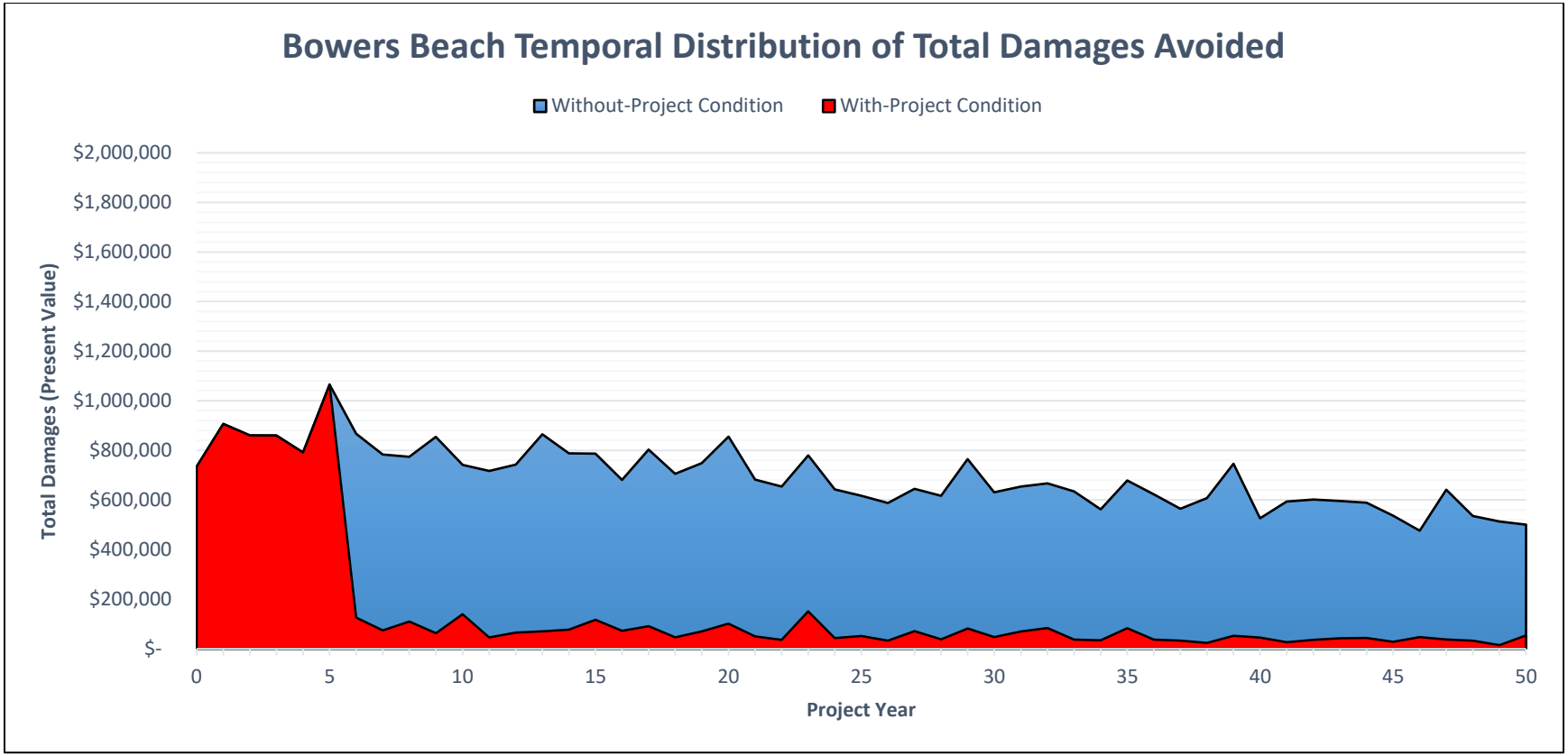
Figure 18: Temporal Distribution of Total Damages Reduced



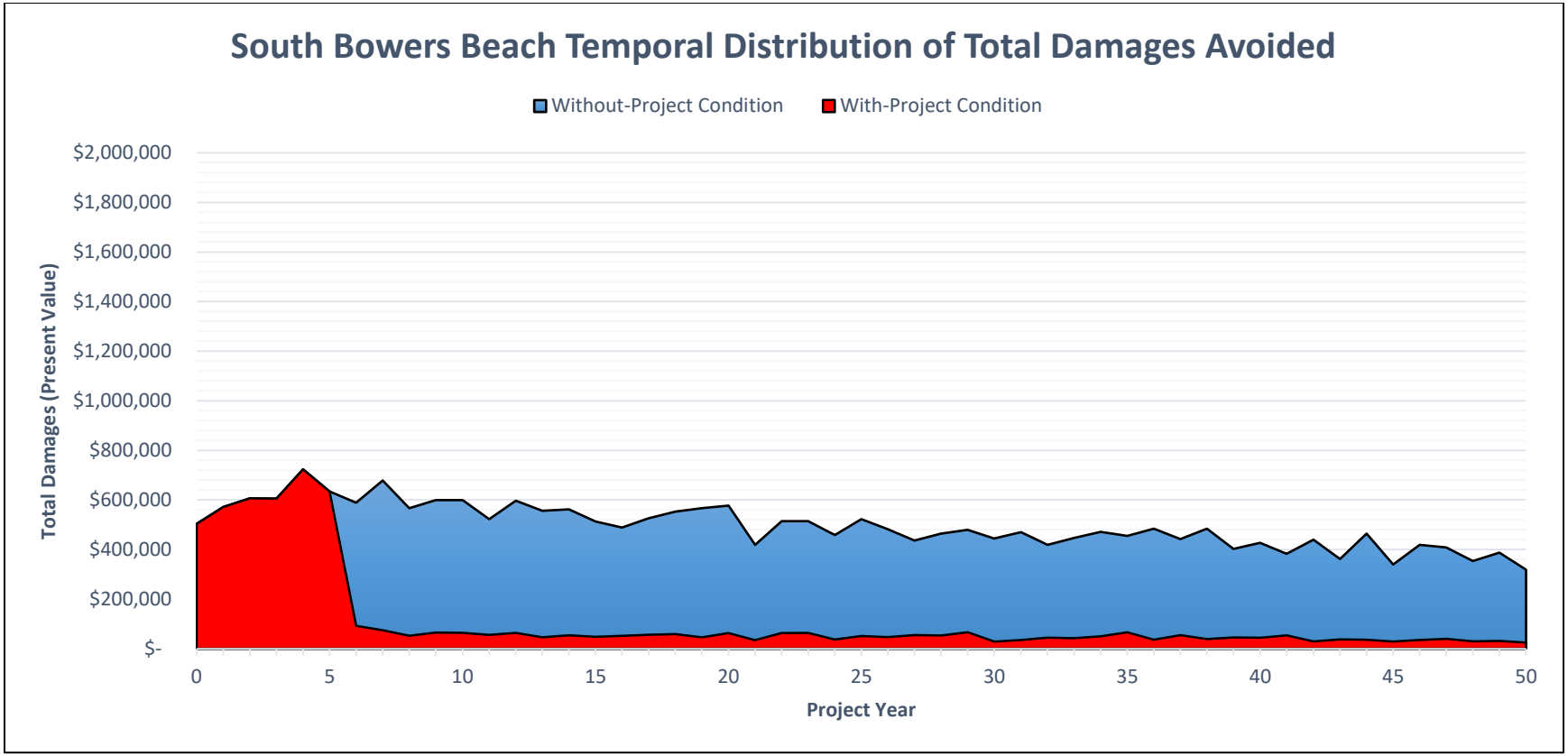
Pickering Beach is one of the four study sites slated for a deferred initial construction in Project Year 06. As the temporal distribution illustrates, the Without-Project Condition Total Damages and With-Project Condition Total Damages are identical up to PY06. The construction of a wider berm in FY2026 then severely reduces erosion and wave attack damages. The graph also shows that Total Damages begin to decline starting in PY26 as repetitively damaged structures are condemned more frequently and thus removed from the inventory for up to 1.5 years at a time.



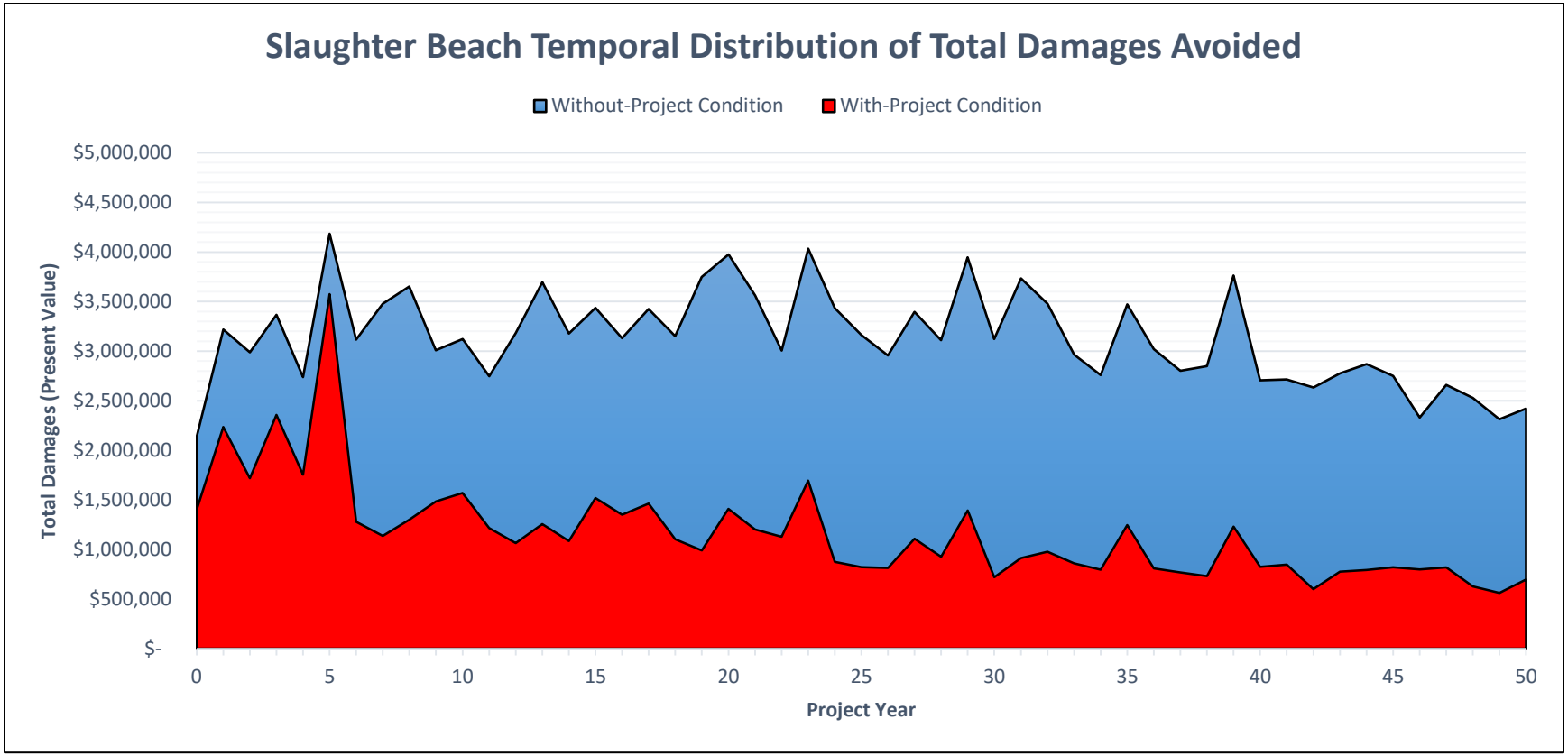
Kitts Hummock is another study location with a deferred initial construction period. Total Damage over time also remains fairly constant, suggesting that structures in Kitts Hummock are not being condemned at a high rate or that Total Damage per structure is increasing at the same rate that structures are being removed from the inventory.



Bowers Beach also has a deferred initial construction period as evidenced by the lack of With-Project Condition damage reductions until Project Year 06. Bowers Beach shows a steady reduction in Without-Project Condition Total Damages over time, suggesting that structure condemnations took place at a stable rate throughout the period of analysis.

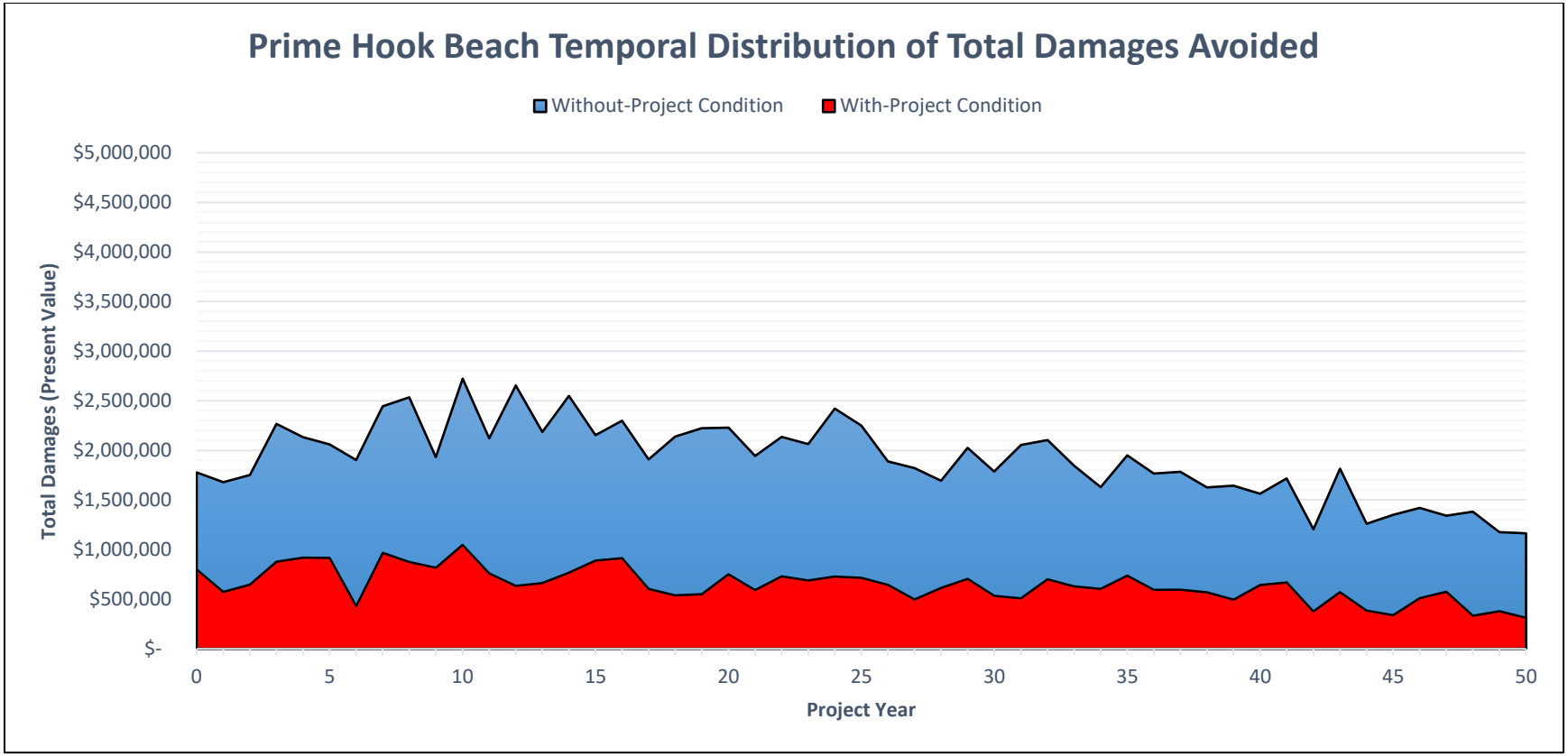


South Bowers is the final deferred initial construction location and follows a similar damage timeline as Bowers Beach though South Bowers only experiences about 66% as many Total Damages in the Without-Project Condition.

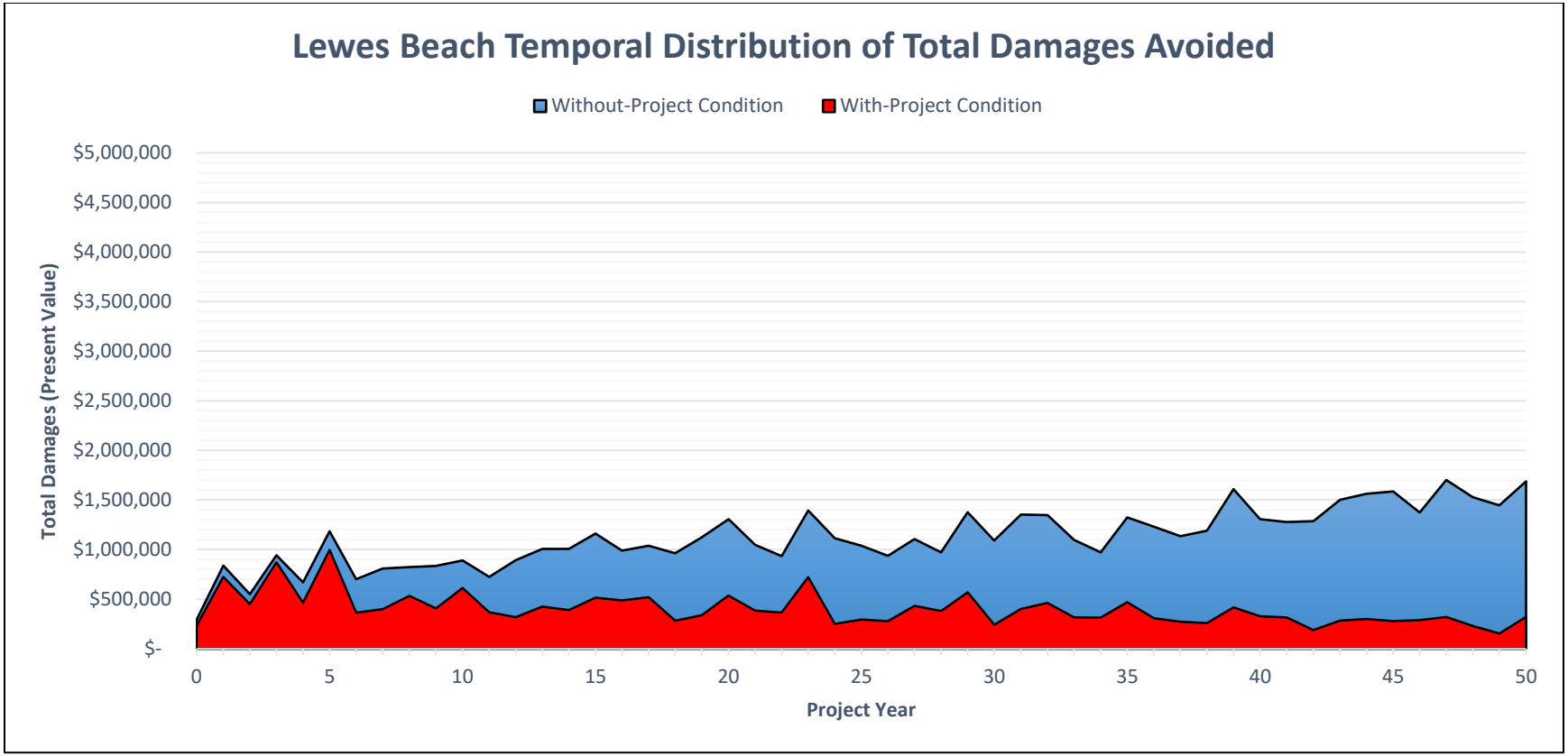


Slaughter Beach is the first study location to be constructed in Project Year 00, granting Total Damage reductions throughout all 50 years of the period of analysis. High residual damages, especially in Project Year 05, are the result of inundation damage impacts. Total Damages remain fairly steady over time though there is a slight downward trend starting in Project Year 40.

(Note: the Y-axis maximum has changed from $2,000,000 in previous charts to $5,000,000 for Slaughter Beach / Prime Hook / Lewes Beach)



Prime Hook Beach also receives initial construction in Project Year 00 and shows significantly lower Residual Risk than Slaughter Beach. Total Damages trend upward until approximately Project Year 10 and then an increase in the inventory condemnation rate drops Total Damages steadily until the end of the period of analysis.



Lewes Beach is the only study site that actually increases Total Damage over time in the Without-Project Condition. Unlike the inventories at the other six study locations, where structures are typically no further than one hundred feet from the shoreline, Lewes Beach has several rows of homes with many structures several hundred feet from the coastline. In the Without-Project Condition, as the line of erosion, inundation, and wave attack damages moves further inland over time, the potential damage pool increases in size at a faster rate than structures are condemned. This causes overall Total Damages to increase.

In the With-Project Condition, with a steady dune and berm template, the trend disappears and Residual damages remain fairly level over the period of analysis.

Disposal Site Lifetime Extension Benefits

As mentioned earlier, the With-Project Condition involves maintenance dredged material to be diverted from Buoy 10 to the Delaware Bay coastline in both FY2020 and FY2026 thus extending the lifetime capacity of the Buoy 10 disposal site for the Delaware River Main Channel Deepening Project in the With-Project Condition for two additional maintenance cycles.

Maintenance occurs on a two-year cycle and can offload dredge material at the less expensive Buoy 10 in FY2030 and FY2034 (Periodic Nourishment in FY2032) instead of shipping that material all the way to Artificial Island. This reduction is a Cost Foregone for the Delaware River Main Channel Maintenance Operation

As disposal of dredge material at Artificial Island costs the U.S. Army Corps of Engineers $37,448,668, but disposal at Buoy 10 only costs $20,952,587 for the same quantity of sand, any instances where Maintenance Dredging can offload at Buoy 10 instead of Artificial Island will save USACE $16,496,081 per trip.

Table 20 on the following page shows the summary Navigation benefits with $23,859,852 Present Value savings over the 50 year period of analysis. This equates to $883,791 in total additional Average Annual Benefits.

Table 20: Buoy 10 Lifetime Extension Benefits

			Without-Project Condition		With-Project Condition			
PY	PV Factor	Year	DISPOSAL	COST	DISPOSAL	COST	SAVING	PV SAVING
0	1.00000	2020	BUOY 10		BUOY 10			
1	0.97324	2021						
2	0.94719	2022	BUOY 10		BUOY 10			
3	0.92184	2023						
4	0.89717	2024	BUOY 10		BUOY 10			
5	0.87315	2025						
6	0.84978	2026	BUOY 10		BUOY 10			
7	0.82704	2027						
8	0.80491	2028	BUOY 10		BUOY 10			
9	0.78336	2029						
10	**0.76240**	**2030**	**ARTIFICIAL ISLAND**	**$ 37,448,668**	**BUOY 10**	**$ 20,952,587**	**$ 16,496,081**	**$ 12,576,578**
11	0.74199	2031						
12	0.72213	2032	ARTIFICIAL ISLAND		BUOY 10			
13	0.70281	2033						
14	**0.68400**	**2034**	**ARTIFICIAL ISLAND**	**$ 37,448,668**	**BUOY 10**	**$ 20,952,587**	**$ 16,496,081**	**$ 11,283,275**
15	0.66569	2035						
16	0.64787	2036	ARTIFICIAL ISLAND		ARTIFICIAL ISLAND			
17	0.63053	2037						
18	0.61366	2038	ARTIFICIAL ISLAND		ARTIFICIAL ISLAND			
19	0.59723	2039						
20	0.58125	2040	ARTIFICIAL ISLAND		ARTIFICIAL ISLAND			
21	0.56569	2041						
22	0.55055	2042	ARTIFICIAL ISLAND		ARTIFICIAL ISLAND			
23	0.53582	2043						
24	0.52148	2044	ARTIFICIAL ISLAND		ARTIFICIAL ISLAND			
25	0.50752	2045						
26	0.49394	2046	ARTIFICIAL ISLAND		ARTIFICIAL ISLAND			
27	0.48072	2047						
28	0.46785	2048	ARTIFICIAL ISLAND		ARTIFICIAL ISLAND			
29	0.45533	2049						
30	0.44314	2050	ARTIFICIAL ISLAND		ARTIFICIAL ISLAND			
31	0.43128	2051						
32	0.41974	2052	ARTIFICIAL ISLAND		ARTIFICIAL ISLAND			
33	0.40851	2053						
34	0.39757	2054	ARTIFICIAL ISLAND		ARTIFICIAL ISLAND			
35	0.38693	2055						
36	0.37658	2056	ARTIFICAL ISLAND		ARTIFICAL ISLAND			
37	0.36650	2057						
38	0.35669	2058	ARTIFICIAL ISLAND		ARTIFICIAL ISLAND			
39	0.34714	2059						
40	0.33785	2060	ARTIFICIAL ISLAND		ARTIFICIAL ISLAND			
41	0.32881	2061						
42	0.32001	2062	ARTIFICIAL ISLAND		ARTIFICIAL ISLAND			
43	0.31144	2063						
44	0.30311	2064	ARTIFICIAL ISLAND		ARTIFICIAL ISLAND			
45	0.29500	2065						
46	0.28710	2066	ARTIFICIAL ISLAND		ARTIFICIAL ISLAND			
47	0.27942	2067						
48	0.27194	2068	ARTIFICIAL ISLAND		ARTIFICIAL ISLAND			
49	0.26466	2069						
50	0.25758	2070	ARTIFICIAL ISLAND		ARTIFICIAL ISLAND			

TOTAL ESTIMATED AMOUNT **$ 23,859,852**
ROUNDED **$ 23,860,000**

Land Loss Prevention Benefits

The methodology for the evaluation of land loss is based on guidance from IWR Report 91-R-6 *National Economic Development Procedures Manual: Coastal Storm Damage and Erosion* and ER 1165-2-130 *Water Resources Policies and Authorities: Federal Participation in Shore Protection*.

As per ER 1165-2-130, Land Loss prevention benefits are "benefits from prevention of public and/or private land loss due to shore erosion. Prevention of losses of developed private land should be categorized as storm damage reduction benefits. Prevention of losses of undeveloped private land (including privately-owned marshes or wetlands) is a benefit category in which there is no Federal interest (i.e., non-Federal interests are assigned all costs of preventing losses of undeveloped private land), even though the shore may be public. Prevention of loss of Federal and/or non-Federal public land will reflect the special use to which the land is dedicated and the value of the output produced by that use (e.g., lands dedicated to non-Federal park and conservation areas will normally be valued on the basis of loss of recreation output)."

IWR Report 91-R-6 further clarifies that "anticipated damages from land loss due to erosion may be computed for the private lands as the market value of the average annual area expected to be lost. This should be determined from an analysis of adjacent nearshore lands of similar character for the land use conditions expected in the absence of the project."

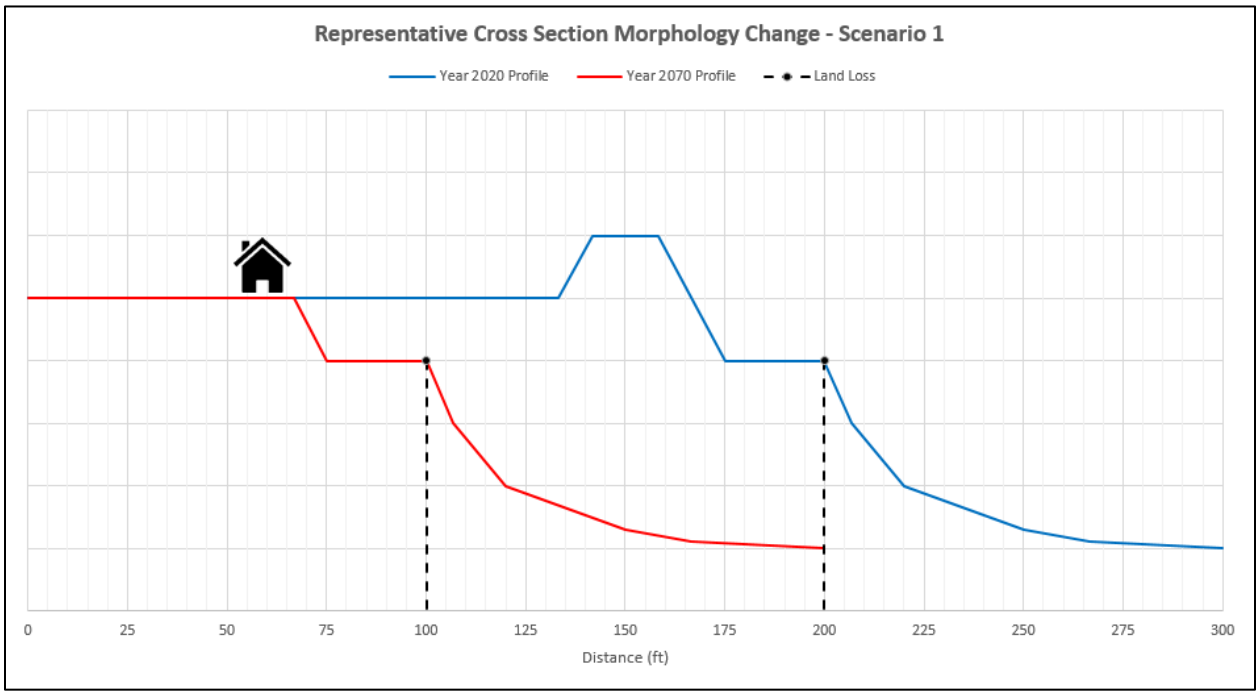
In addition, due to parameters within the Beach-fx model used to calculate Average Annual Damages from coastal storm impacts (inundation, wave attack, erosion), land loss is limited to the shoreward extent of the most seaward row of structures. As Damage Elements (structures) can only be temporarily condemned in the Beach-fx model (except through maximizing the number of rebuilds), land loss cannot be assumed to extend beyond the point where erosion would reduce the structural integrity of the damage element. To avoid any analysis contradiction where land loss extends beyond the structure, but the Damage Element is not removed from the active Beach-fx inventory, quantified land loss is halted at the seaward extent of the structure.

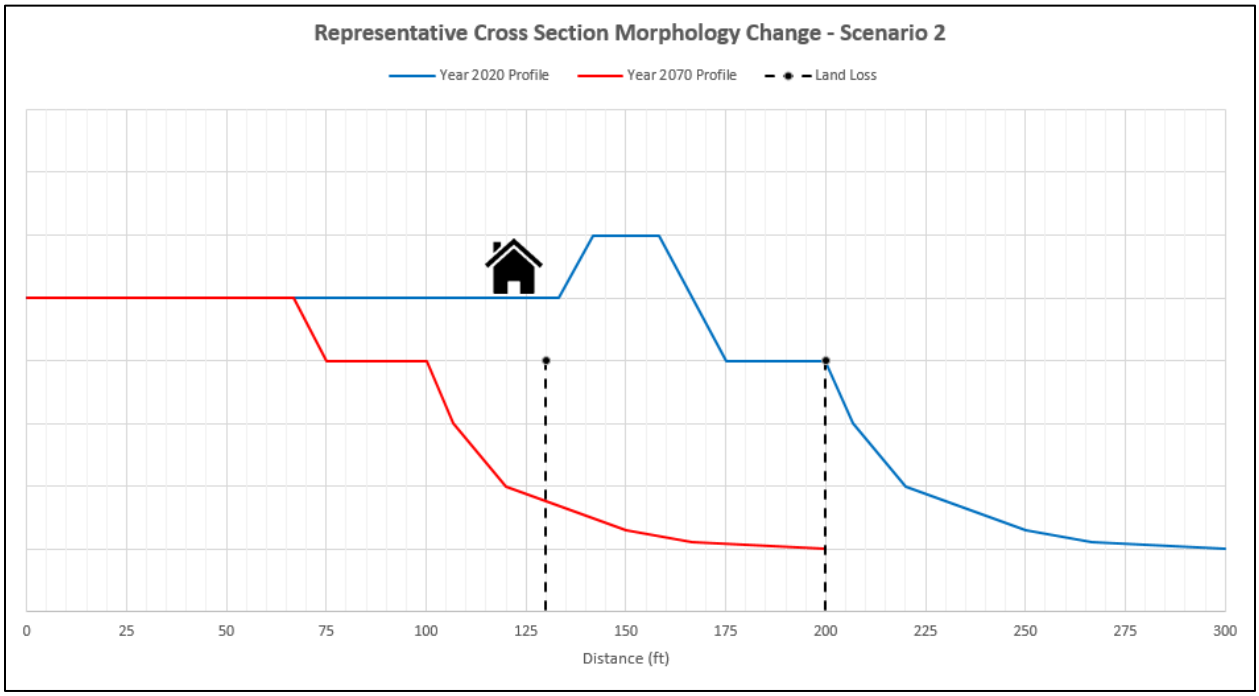
The area of land loss is calculated by determining the square footage difference in land from Year 2020 to Year 2070 with Intermediate Relative Sea Level Change (RSLC). Precisely, the difference in area from the seaward berm edge in Year 2020 to the seaward berm edge in Year 2070. Only the portion of land that intersects a developed, private lot (up until the seaward extent of the structure) is counted towards land loss prevention benefits. Additionally, if an existing developed, private lot extends seaward the Year 2020 berm edge, that loss in value is not counted. The average location of the seaward berm edge was calculated using Beach-fx profile morphology changes over 300 iterations for each site.

Figure 19 shows a representative Beach-fx profile cross section change over a 50 year period of analysis. In the first scenario, the Damage Element at that cross section of the beach is located landward of the Year 2070 erosion line. Therefore, any private land located between the Year 2020 and Year 2070 boundaries would count towards land loss. In the second scenario, the structure is located seaward of the Year 2070 erosion line. As such, land loss quantification ends at the most seaward edge of the structure.

Land loss prevention results will be counted as a storm damage reduction benefits.

Figure 19: Beach-fx Profile Morphology Cross Section Change Scenarios

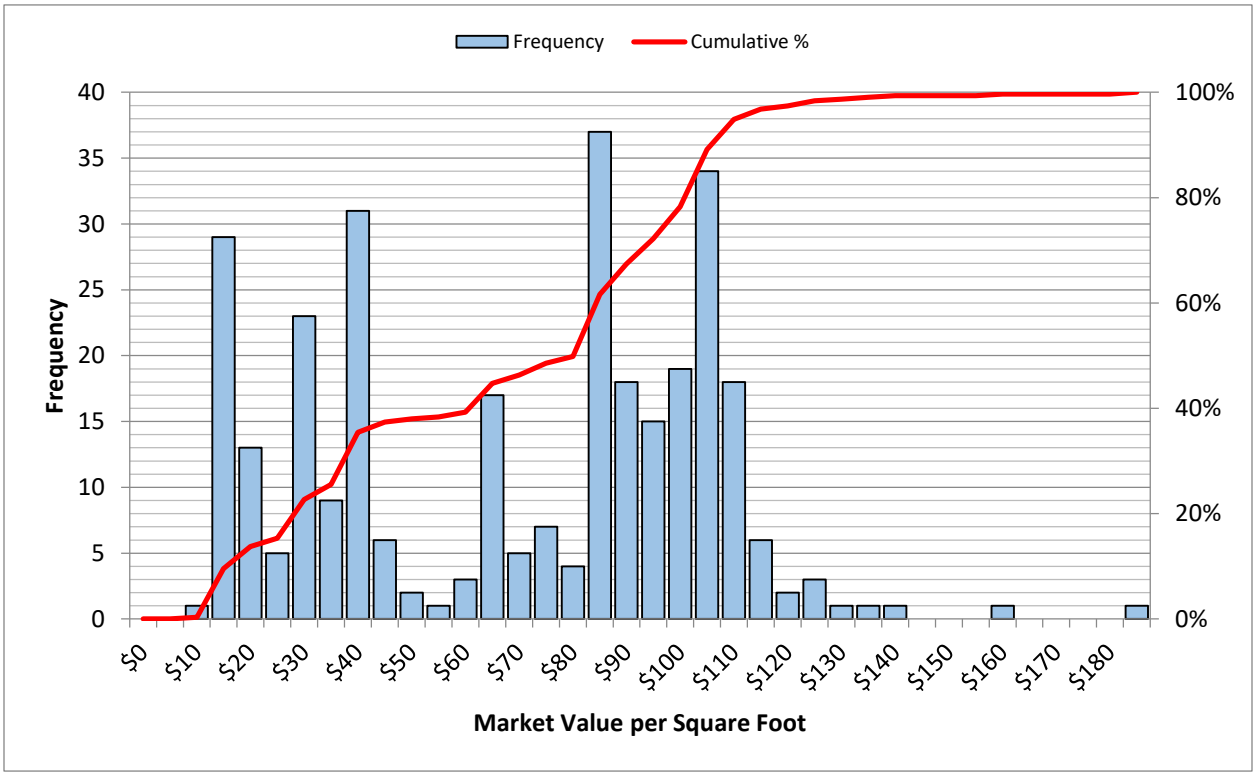




The market value of the land parcels is calculated by aggregating a large sample of developed, nearshore parcels throughout the study area. For this effort, 313 tax parcels were selected for the nearshore sample. Land appraisal values from Kent County and Sussex County tax records were used as the base for Market Value and then weighted using available recent lot sales in the study area (data from Zillow.com).

Figure 20 shows the distribution of market value per square foot for the 313 sample parcels.

Figure 20: Sample Distribution of Market Value per Square Foot



The histogram shows a slight bimodal distribution with an average of $66.79 market value per sqft with a median of $80.61 and a total range of $9.84 to $180.55.

Across the entire study area, there are 583 privately-owned, developed, ocean front parcels. This constitutes the population of potential land loss market value. Total land loss area is measured using the area of the parcels between the Year 2020 and Year 2070 berm edges, excluding area landward of the structure on the parcel, if applicable. As an example, Figure 21 shows the aerial view of Prime Hook Beach R-1 with the Year 2020 and Year 2070 average berm edges as well as the ocean front private lots.

Total land loss area was calculated from all 583 parcels and multiplied by the average market value per square foot. This total land loss value was then spread equally over the entire period of analysis and discounted back to Net Present Value. Land loss was spread evenly as knowledge uncertainty and natural variability in the study area make assigning specific damages in specific years at specific locations difficult, even with the aid of an event-based Monte Carlo life cycle simulation model such as Beach-fx.

Figure 21: Prime Hook Beach – Reach 1 – Example Land Loss Parcels

Table 21 shows the Net Present Value calculation. Total land loss prevention benefits (NPV) is $43,299,834 across the study area with $1,603,866 in Average Annual dollars.

Table 21: Land Loss Prevention Benefits (Net Present Value)

FY	PY	PV Factor	Year	LandLoss	Present Value
2020	00	1.00000	2020	$0	$0
2021	01	0.97324	2021	$1,603,866	$1,560,940
2022	02	0.94719	2022	$1,603,866	$1,519,163
2023	03	0.92184	2023	$1,603,866	$1,478,504
2024	04	0.89717	2024	$1,603,866	$1,438,933
2025	05	0.87315	2025	$1,603,866	$1,400,422
2026	06	0.84978	2026	$1,603,866	$1,362,941
2027	07	0.82704	2027	$1,603,866	$1,326,463
2028	08	0.80491	2028	$1,603,866	$1,290,962
2029	09	0.78336	2029	$1,603,866	$1,256,410
2030	10	0.76240	2030	$1,603,866	$1,222,784
2031	11	0.74199	2031	$1,603,866	$1,190,057
2032	12	0.72213	2032	$1,603,866	$1,158,207
2033	13	0.70281	2033	$1,603,866	$1,127,208
2034	14	0.68400	2034	$1,603,866	$1,097,040
2035	15	0.66569	2035	$1,603,866	$1,067,679
2036	16	0.64787	2036	$1,603,866	$1,039,103
2037	17	0.63053	2037	$1,603,866	$1,011,293
2038	18	0.61366	2038	$1,603,866	$984,226
2039	19	0.59723	2039	$1,603,866	$957,885
2040	20	0.58125	2040	$1,603,866	$932,248
2041	21	0.56569	2041	$1,603,866	$907,297
2042	22	0.55055	2042	$1,603,866	$883,014
2043	23	0.53582	2043	$1,603,866	$859,381
2044	24	0.52148	2044	$1,603,866	$836,381
2045	25	0.50752	2045	$1,603,866	$813,996
2046	26	0.49394	2046	$1,603,866	$792,210
2047	27	0.48072	2047	$1,603,866	$771,007
2048	28	0.46785	2048	$1,603,866	$750,372
2049	29	0.45533	2049	$1,603,866	$730,289
2050	30	0.44314	2050	$1,603,866	$710,744
2051	31	0.43128	2051	$1,603,866	$691,721
2052	32	0.41974	2052	$1,603,866	$673,208
2053	33	0.40851	2053	$1,603,866	$655,190
2054	34	0.39757	2054	$1,603,866	$637,655
2055	35	0.38693	2055	$1,603,866	$620,589
2056	36	0.37658	2056	$1,603,866	$603,979
2057	37	0.36650	2057	$1,603,866	$587,814
2058	38	0.35669	2058	$1,603,866	$572,082
2059	39	0.34714	2059	$1,603,866	$556,771
2060	40	0.33785	2060	$1,603,866	$541,870
2061	41	0.32881	2061	$1,603,866	$527,367
2062	42	0.32001	2062	$1,603,866	$513,253
2063	43	0.31144	2063	$1,603,866	$499,516
2064	44	0.30311	2064	$1,603,866	$486,147
2065	45	0.29500	2065	$1,603,866	$473,136
2066	46	0.28710	2066	$1,603,866	$460,473
2067	47	0.27942	2067	$1,603,866	$448,149
2068	48	0.27194	2068	$1,603,866	$436,154
2069	49	0.26466	2069	$1,603,866	$424,481
2070	50	0.25758	2070	$1,603,866	$413,120
TOTAL ESTIMATED AMOUNT					**$43,299,834**
ROUNDED					**$43,300,000**

Average Annual Net Benefits and Benefit-Cost Ratio

Tables 22 and 23 below show the Average Annual Net Benefits (AANB) and Benefit-Cost Ratio (BCR) for each individual study location.

Table 22: Average Annual Net Benefits with No Federal Standard

Site	Total NPV Cost	AAC	AAB	AANB	BCR
Pickering	$41,096,887	$1,522,266	$1,774,745	$252,479	1.17
Kitts Hummock	$50,621,508	$1,875,067	$1,405,476	-$469,592	0.75
Bowers	$41,730,544	$1,545,738	$1,294,511	-$251,227	0.84
South Bowers	$36,961,387	$1,369,084	$963,384	-$405,700	0.70
Slaughter Beach	$72,396,696	$2,681,640	$2,739,456	$57,816	1.02
Prime Hook	$61,104,077	$2,263,351	$2,430,049	$166,698	1.07
Lewes Beach	$64,778,666	$2,399,461	$1,623,942	-$775,519	0.68
Total Project	**$368,689,765**	**$13,656,608**	**$12,231,562**	**-$1,425,046**	**0.90**

Table 23: Average Annual Net Benefits with Applied Federal Standard

Site	Total NPV Cost	AAC	AAB	AANB	BCR
Pickering	$26,618,408	$985,970	$1,774,745	$788,775	1.80
Kitts Hummock	$22,605,790	$837,339	$1,405,476	$568,136	1.68
Bowers	$25,891,094	$959,030	$1,294,511	$335,481	1.35
South Bowers	$23,273,474	$862,071	$963,384	$101,313	1.12
Slaughter Beach	$39,747,856	$1,472,297	$2,739,456	$1,267,159	1.86
Prime Hook	$36,281,939	$1,343,916	$2,430,049	$1,086,133	1.81
Lewes Beach	$33,095,900	$1,225,903	$1,623,942	$398,039	1.32
Total Project	**$207,514,463**	**$7,686,527**	**$12,231,562**	**$4,545,036**	**1.59**

The application of the Federal Standard is necessary for justification of Kitts Hummock, Bowers Beach, South Bowers Beach, and Lewes Beach. Pickering Beach, Slaughter Beach, and Prime Hook achieve positive Average Annual Net Benefits in either scenario.

Figure 22 graphically represents the Average Annual Net Benefits with Applied Federal Standard and Table 24 shows the same information with a 7% Federal Discount Rate.

Figure 22: Average Annual Net Benefits with Applied Federal Standard

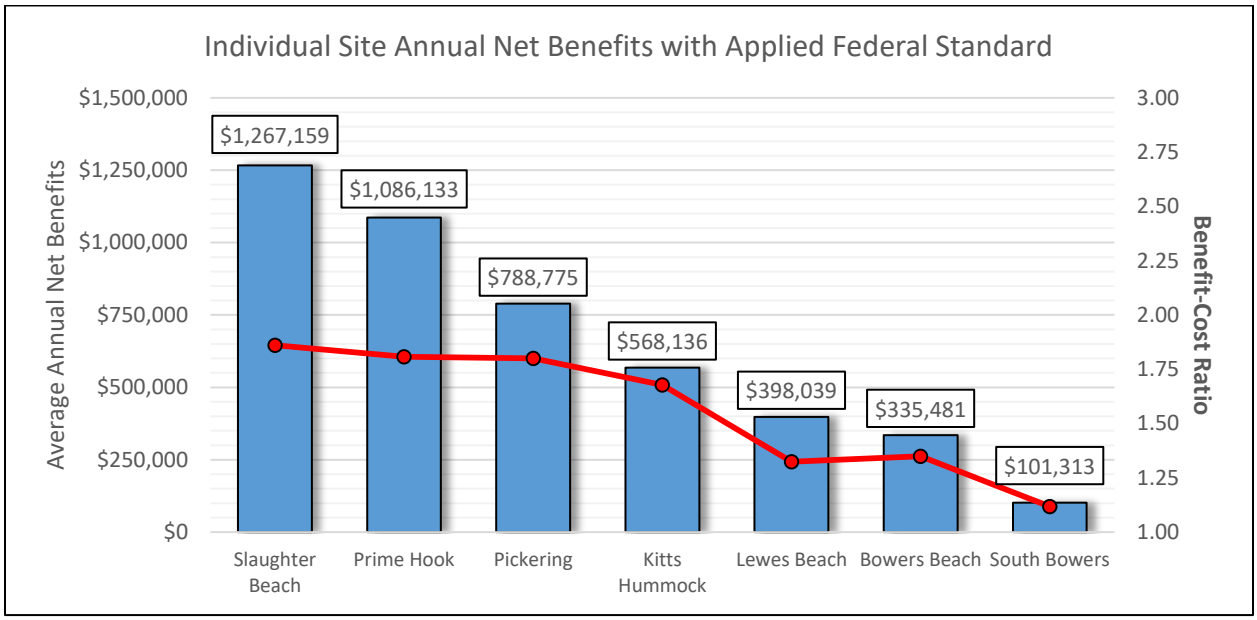


Table 24: Average Annual Net Benefits with Applied Federal Standard (7% Federal Discount Rate)

Site	Total NPV Cost	AAC	AAB	AANB	BCR
Pickering	$14,149,049	$1,025,238	$1,212,506	$187,268	1.18
Kitts Hummock	$12,920,386	$936,209	$1,045,643	$109,433	1.12
Bowers	$13,800,945	$1,000,014	$1,079,994	$79,980	1.08
South Bowers	$11,788,765	$854,212	$838,577	-$15,635	0.98
Slaughter Beach	$30,929,251	$2,241,129	$2,188,758	-$52,371	0.98
Prime Hook	$27,363,668	$1,982,767	$2,069,984	$87,217	1.04
Lewes Beach	$25,729,039	$1,864,322	$1,590,479	-$273,843	0.85
Total Project	**$136,681,103**	**$9,903,892**	**$10,025,942**	**$122,049**	**1.01**

The Average Annual Net Benefits for this study are also represented as a distribution of results to illustrate the relative risk of a negative future outcome (Figure 23 and Figure 24).

Average Annual Net Benefits are calculated using 300 iterations to provide a wide range of future storm damage condition scenarios; allowing for analysis into the relative frequency in which the model calculates the NED proposed alternative is not a justified Federal investment.

Table 24 shows the project Average Annual Net Benefits with a 7% Federal Discount Rate. The overall project remains justified with $122,049 in AANB with a 1.01 BCR though several individual sites (South Bowers, Bowers, Lewes Beach) have negative AANB.

Figure 23: Distribution of Average Annual Net Benefits Results (No Federal Standard)

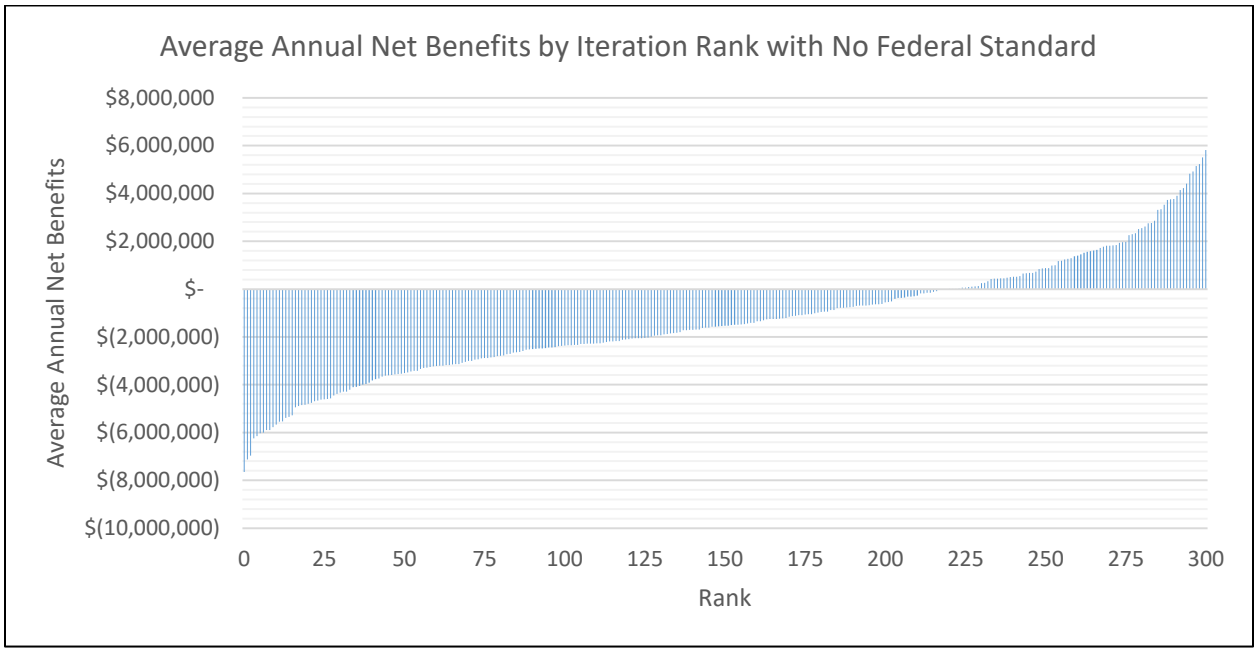
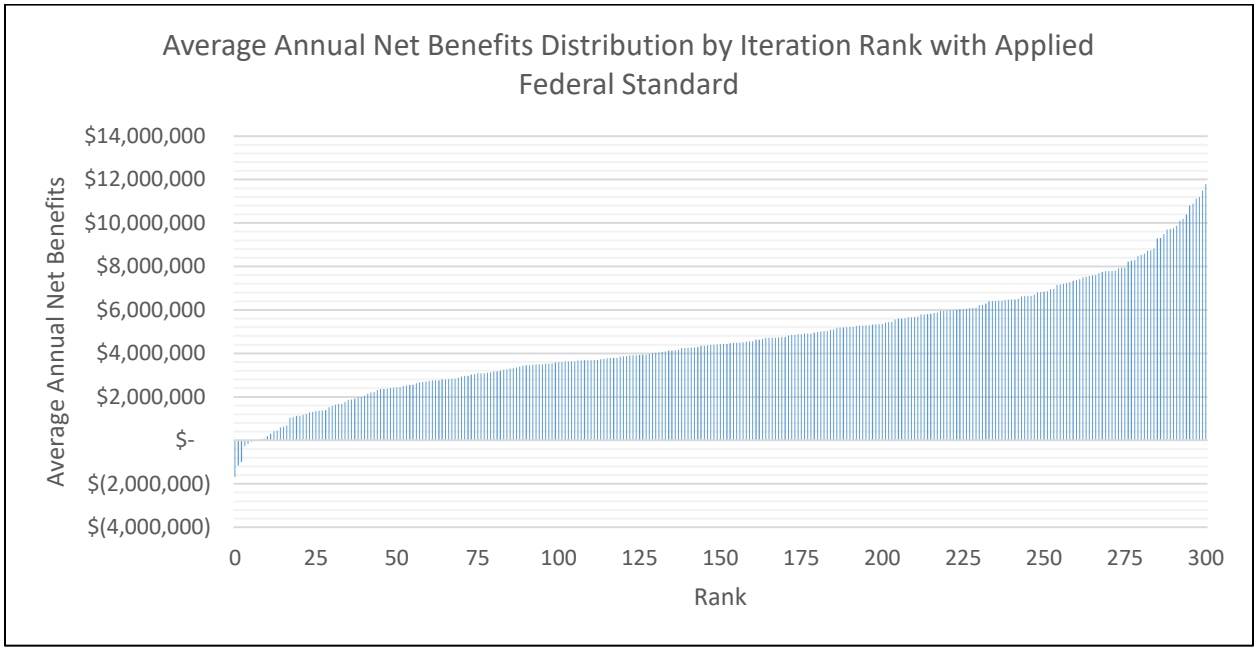


Figure 24: Distribution of Average Annual Net Benefits Results (Applied Federal Standard)



With no project cost adjustments, 219 of 300 results (73.00%) show negative Average Annual Net Benefits over the 50 year period of analysis (project mean Average Annual Net Benefits of -$1,425,046).

With the application of the Federal Standard deduction, only 7 of 300 results (2.33%) display negative Average Annual Net Benefits (mean Average Annual Net Benefits of $4,545,036).

SENSITIVITY AND RISK ANALYSIS

This section of the Appendix measures the sensitivity of the final Average Annual Net Benefits and Benefit-Cost Ratio results to several uncertain variables in order to understand the risk surrounding the NED Plan. While every input variable or assumption has some degree of uncertainty, model outputs suggest that results may be highly sensitive to Federal Standard application assumptions and Relative Sea Level Change (RSLC) scenarios.

As mentioned in the Project Cost Methodology section, the Federal Standard deduction is partly based on the assumption that the Buoy 10 disposal site will reach capacity in Project Year 10 of the Future Without-Project Condition. To evaluate the relative risk of this assumption, the total project Average Annual Net Benefits are calculated with a range of scenarios regarding the lifetime capacity of Buoy 10. Ranging from 0 Years capacity (all maintenance dredged material is shipped to Artificial Island in the Without-Project Condition) to 50 Years capacity (dredged material is only shipped to Buoy 10).

For this sensitivity analysis, it was necessary to develop an additional cost estimate based on the Periodic Nourishment (2032-2070) estimates presented in Table 12. As detailed in the Project Cost Methodology section, the Delaware Main River Channel Deeping Project in the Without-Project Condition will incur a $20,952,587 cost to ship all 930,000CY of expected dredge material to Buoy 10 (Table 14) or $37,448,668 to ship all 930,000CY to Artificial Island (Table 15). In FY2020 and FY2026, when all 930,000CY of material is diverted to the Delaware coastline, application of the Federal Standard is simple with all $20,952,587 (or $37,448,668 in the 0 Years Capacity at Buoy 10 scenario) counted as a cost reduction as Maintenance Dredging does not send any material to a disposal site.

Periodic Nourishment of the NED Plan, however, only requires 517,000CY of material and the remaining 413,000CY of material is still disposed at Buoy 10 or Artificial Island. The cost to transport the remaining material to Artificial Island is $16,530,707 (shown in the Channels and Canals business line in Table 12). Effectively, the net Federal Standard reduction during nourishments drops from $37,448,668 to $20,917,961. This results in a total nourishment cost with the Artificial Island Federal Standard deduction of $30,932,197. This is the cost applied for all nourishment cycles (2032-2070) in the NED Plan and shown in the 10 Years Buoy 10 Capacity column in Table 27.

For this sensitivity analysis, however, it is necessary to estimate the net Federal Standard deduction for periodic nourishments in the scenario that Buoy 10 has a larger than anticipated lifetime capacity. If Buoy 10 has remaining capacity during a periodic nourishment, then the cost to ship the remaining 413,000CY of material to Buoy 10 is only $8,896,282 (shown in Table 25 on the following page). However, the Federal Standard for Buoy 10 (the Without-Project cost to dispose all 930,000CY at Buoy 10) is only $20,952,587. This results in a net Federal Standard deduction of $12,056,305 with an overall total nourishment cost of $39,113,192.

When analyzing the timeseries breakdown of the Buoy 10 Capacity Sensitivity Test, this explains why nourishments with an Artificial Island Federal Standard deduction cost $30,932,197 per cycle (same as the NED Plan) and why nourishments with a Buoy 10 Federal Standard deduction cost $39,113,192 per cycle.

Table 25: Periodic Nourishment (FY2032 – FY2070) Buoy 10 Federal Standard

nber	Product Description	Quantity	UOM	Unit Price	Estimated	Contingency	TOTAL
	LANDS AND DAMAGES	**1**	**JOB**	**LS**	**$ -**	**$ -**	**$ -**
	RELOCATION	**1**	**JOB**	**LS**	**$ -**	**$ -**	**$ -**
	CHANNELS & CANALS	**1**	**JOB**	**LS**	**$ 7,060,541**	**$ 1,835,741**	**$ 8,896,282**
01 17 01	Mobilization, Demobilization, and Preparatory Work	1	JOB	LS	$ 704,471	$ 183,162	$ 887,633
02 17 01	Dredging (Buoy 10 CDF)	1	JOB	lS	$ 6,356,070	$ 1,652,578	$ 8,008,648
	BEACH REPLENISHMENT				**$ 35,265,853**	**$ 9,169,122**	**$ 44,434,975**
00 17 01	Mobilization, Demobilization, and Preparatory Work				$ 15,297,053	$ 3,977,234	$ 19,274,287
17 01 01	Pickering Beach	1	JOB	LS	$ 5,548,734	$ 1,442,671	$ 6,991,405
17 01 02	Between Pickering Beach & Kitts Hummock Beach	1	JOB	LS	$ 1,858,394	$ 483,182	$ 2,341,576
17 01 03	Between Kitts Hummock & Bowers Beach	1	JOB	LS	$ 1,773,659	$ 461,151	$ 2,234,810
17 01 04	Between Bowers Beach & South Bowers Beach	1	JOB	LS	$ 1,765,921	$ 459,139	$ 2,225,060
17 01 05	Big Stone Beach	1	JOB	LS	$ -	$ -	$ -
17 01 06	Slaughter Beach	1	JOB	LS	$ 1,726,938	$ 449,004	$ 2,175,942
17 01 07	Between Slaughter Beach & Prime Hook Beach	1	JOB	LS	$ 1,405,451	$ 365,417	$ 1,770,868
17 01 08	Between Prime Hook Beach & Lewes Beach	1	JOB	LS	$ 1,217,956	$ 316,669	$ 1,534,625
00 17 02	Site Work				$ 19,968,800	$ 5,191,888	$ 25,160,688
17 02 01	Dredging and Beachfill - Pickering Beach	1	JOB	LS	$ 1,934,824	$ 503,054	$ 2,437,878
17 02 02	Dredging and Beachfill - Kitts Hummock Beach	1	JOB	LS	$ 3,988,578	$ 1,037,030	$ 5,025,608
17 02 03	Dredging and Beachfill - Bowers Beach	1	JOB	LS	$ 2,142,230	$ 556,980	$ 2,699,210
17 02 04	Dredging and Beachfill - South Bowers Beach	1	JOB	LS	$ 1,834,364	$ 476,935	$ 2,311,299
17 02 05	Dredging and Beachfill - Big Stone Beach	1	JOB	LS	$ -	$ -	$ -
17 02 06	Dredging and Beachfill - Slaughter Beach	1	JOB	LS	$ 4,064,700	$ 1,056,822	$ 5,121,522
17 02 07	Dredging and Beachfill - Prime Hook Beach	1	JOB	LS	$ 2,300,961	$ 598,250	$ 2,899,211
17 02 08	Dredging and Beachfill - Lewes Beach	1	JOB	LS	$ 3,703,143	$ 962,817	$ 4,665,960
	OMRR&R	**1**	**JOB**	**LS**	**$ 175,000**	**$ 45,500**	**$ 220,500**
	PLANNING, ENGINEERING, AND DESIGN	**1**	**JOB**	**LS**	**$ 2,825,287**	**$ 734,575**	**$ 3,559,862**
	CONSTRUCTION MANAGEMENT (S&I)	**1**	**JOB**	**LS**	**$ 2,344,572**	**$ 609,589**	**$ 2,954,161**
	TOTAL ESTIMATED AMOUNT						**$ 60,065,779**
	ROUNDED						**$60,066,000**

Results in Table 26 and Figure 25 illustrate that while overall project Average Annual Net Benefits rely on the Federal Standard to remain positive, the assumptions governing Buoy 10 vs Artificial Island placement are much less impactful. Even with Buoy 10 capacity extended to the end of the period of analysis, Average Annual Net Benefits remain positive and the BCR remains above 1.0.

Table 26: Average Annual Net Benefits Sensitivity to Buoy 10 Capacity

Scenario	TOTAL	AAC	AAB	AANB	BCR
0 Years	$177,000,261	$6,556,252	$12,231,562	$5,675,310	1.87
10 Years	$207,514,463	$7,686,527	$12,231,562	$4,545,036	1.59
20 Years	$218,442,581	$8,091,314	$12,231,562	$4,140,248	1.51
30 Years	$222,708,790	$8,249,338	$12,231,562	$3,982,224	1.48
40 Years	$229,414,927	$8,497,740	$12,231,562	$3,733,822	1.44
50 Years	$234,257,659	$8,677,119	$12,231,562	$3,554,443	1.41

Figure 25: Average Annual Net Benefits Sensitivity to Buoy 10 Capacity

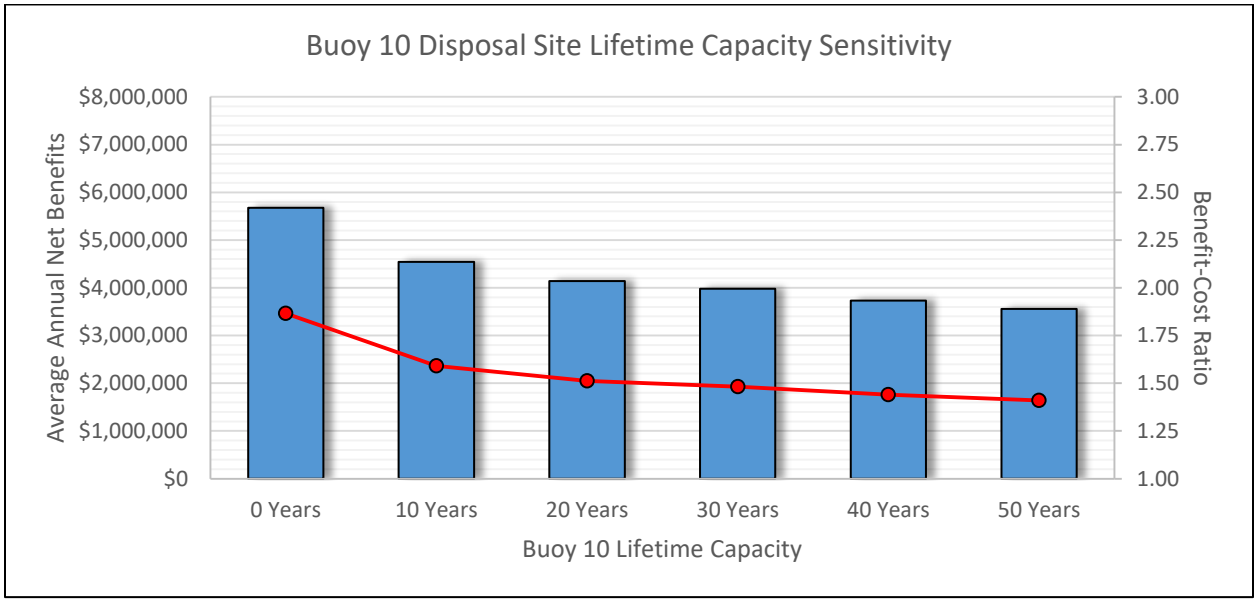


Table 27: Average Annual Net Benefits Sensitivity to Buoy 10 Capacity Timeseries

PY	PV Factor	Year	Type	No Federal Standard		50 YEARS BUOY 10		40 YEARS BUOY 10		30 YEARS BUOY 10		20 YEARS BUOY 10		10 YEARS BUOY 10		0 YEARS BUOY 10	
				COST	PV COST	COST	PV COST	COST	PV COST	COST	PV COST	COST	PV COST	COST	PV COST	COST	PV COST
0	1.00000	2020	Initial Construction	$74,283,769	$74,283,769	$53,331,182	$53,331,182	$53,331,182	$53,331,182	$53,331,182	$53,331,182	$53,331,182	$53,331,182	$53,331,182	$53,331,182	$36,835,101	$36,835,101
0	1.00000	2020	IDC	$1,259,729	$1,259,729	$1,259,729	$1,259,729	$1,259,729	$1,259,729	$1,259,729	$1,259,729	$1,259,729	$1,259,729	$1,259,729	$1,259,729	$1,259,729	$1,259,729
1	0.97324	2021															
2	0.94719	2022															
3	0.92184	2023															
4	0.89717	2024															
5	0.87315	2025															
6	0.84978	2026	Initial + Periodic	$81,183,168	$68,988,232	$60,230,581	$51,183,039	$60,230,581	$51,183,039	$60,230,581	$51,183,039	$60,230,581	$51,183,039	$60,230,581	$51,183,039	$43,734,500	$37,164,919
6	0.84978	2026	IDC	$735,428	$624,955	$735,428	$624,955	$735,428	$624,955	$735,428	$624,955	$735,428	$624,955	$735,428	$624,955	$735,428	$624,955
7	0.82704	2027															
8	0.80491	2028															
9	0.78336	2029															
10	0.76240	2030															
11	0.74199	2031															
12	0.72213	2032	Periodic Nourishment	$68,380,865	$49,380,175	$39,113,192	$28,244,981	$39,113,192	$28,244,981	$39,113,192	$28,244,981	$39,113,192	$28,244,981	$30,932,197	$22,337,204	$30,932,197	$22,337,204
13	0.70281	2033															
14	0.68400	2034															
15	0.66569	2035															
16	0.64787	2036															
17	0.63053	2037															
18	0.61366	2038	Periodic Nourishment	$68,380,865	$41,962,528	$39,113,192	$24,002,159	$39,113,192	$24,002,159	$39,113,192	$24,002,159	$39,113,192	$24,002,159	$30,932,197	$18,981,819	$30,932,197	$18,981,819
19	0.59723	2039															
20	0.58125	2040															
21	0.56569	2041															
22	0.55055	2042															
23	0.53582	2043															
24	0.52148	2044	Periodic Nourishment	$68,380,865	$35,659,123	$39,113,192	$20,396,673	$39,113,192	$20,396,673	$39,113,192	$20,396,673	$30,932,197	$16,130,463	$30,932,197	$16,130,463	$30,932,197	$16,130,463
25	0.50752	2045															
26	0.49394	2046															
27	0.48072	2047															
28	0.46785	2048															
29	0.45533	2049															
30	0.44314	2050	Periodic Nourishment	$68,380,865	$30,302,585	$39,113,192	$17,332,785	$39,113,192	$17,332,785	$30,932,197	$13,707,424	$30,932,197	$13,707,424	$30,932,197	$13,707,424	$30,932,197	$13,707,424
31	0.43128	2051															
32	0.41974	2052															
33	0.40851	2053															
34	0.39757	2054															
35	0.38693	2055															
36	0.37658	2056	Periodic Nourishment	$68,380,865	$25,750,679	$39,113,192	$14,729,139	$39,113,192	$14,729,139	$30,932,197	$11,648,362	$30,932,197	$11,648,362	$30,932,197	$11,648,362	$30,932,197	$11,648,362
37	0.36650	2057															
38	0.35669	2058															
39	0.34714	2059															
40	0.33785	2060															
41	0.32881	2061															
42	0.32001	2062	Periodic Nourishment	$68,380,865	$21,882,539	$39,113,192	$12,516,600	$30,932,197	$9,898,603	$30,932,197	$9,898,603	$30,932,197	$9,898,603	$30,932,197	$9,898,603	$30,932,197	$9,898,603
43	0.31144	2063															
44	0.30311	2064															
45	0.29500	2065															
46	0.28710	2066															
47	0.27942	2067															
48	0.27194	2068	Periodic Nourishment	$68,380,865	$18,595,451	$39,113,192	$10,636,418	$30,932,197	$8,411,683	$30,932,197	$8,411,683	$30,932,197	$8,411,683	$30,932,197	$8,411,683	$30,932,197	$8,411,683
49	0.26466	2069															
50	0.25758	2070															
TOTAL ESTIMATED AMOUNT				**$368,689,765**		**$234,257,659**		**$229,414,927**		**$222,708,790**		**$218,442,581**		**$207,514,463**		**$177,000,261**	

= Buoy 10 Federal Standard Applicxation

NED Plan formulation is based on the Intermediate Relative Sea Level Change (RSLC) curve as calculated by the USACE Sea Level Change Curve Calculator. The Intermediate curve was selected for formulation to limit the risk of overstating Future Without-Project Damages in the High RSLC scenario and mitigate the risk of understating NED benefits in the Low RSLC scenario. Future Sea Level Change scenarios are not provided a probability of occurrence, but a sensitivity analysis provides data on project performance at each RSLC scenario.

Table 28: Relative Sea Level Change Sensitivity Analysis

Low RSLC	WoP	WP	Residual	Avoided	AANB	BCR
Pickering	$40,680,938	$4,153,016	10.21%	$36,527,923	$754,283	1.80
Kitts Hummock	$39,329,488	$13,022,580	33.11%	$26,306,908	$518,065	1.65
Bowers	$31,711,281	$7,608,974	23.99%	$24,102,307	$319,834	1.35
South Bowers	$21,222,624	$5,419,354	25.54%	$15,803,269	$105,309	1.13
Slaughter Beach	$109,718,887	$48,657,339	44.35%	$61,061,548	$1,197,168	1.85
Prime Hook	$82,840,735	$28,121,967	33.95%	$54,718,768	$1,085,205	1.84
Lewes Beach	$48,129,567	$18,805,843	39.07%	$29,323,724	$257,597	1.22
Total Project	**$373,633,519**	**$125,789,073**	**33.67%**	**$247,844,446**	**$4,237,461**	**1.58**

Int RSLC	WoP	WP	Residual	Avoided	AANB	BCR
Pickering	$42,711,258	$4,392,400	10.28%	$38,318,858	$788,775	1.80
Kitts Hummock	$41,839,836	$13,490,213	32.24%	$28,349,623	$568,136	1.68
Bowers	$33,128,526	$7,774,641	23.47%	$25,353,885	$335,481	1.35
South Bowers	$22,073,876	$5,659,488	25.64%	$16,414,388	$101,313	1.12
Slaughter Beach	$117,199,509	$52,836,194	45.08%	$64,363,316	$1,267,159	1.86
Prime Hook	$85,513,901	$29,503,690	34.50%	$56,010,211	$1,086,133	1.81
Lewes Beach	$54,759,098	$20,511,505	37.46%	$34,247,593	$398,039	1.32
Total Project	**$397,226,004**	**$134,168,130**	**33.78%**	**$263,057,874**	**$4,545,036**	**1.59**

High RSLC	WoP	WP	Residual	Avoided	AANB	BCR
Pickering	$48,413,183	$5,388,784	11.13%	$43,024,399	$810,404	1.68
Kitts Hummock	$48,655,890	$15,417,877	31.69%	$33,238,013	$626,520	1.62
Bowers	$38,098,064	$8,579,270	22.52%	$29,518,794	$342,519	1.30
South Bowers	$24,906,000	$6,697,098	26.89%	$18,208,902	$40,107	1.04
Slaughter Beach	$142,549,972	$68,973,894	48.39%	$73,576,078	$1,357,639	1.77
Prime Hook	$94,715,184	$35,132,303	37.09%	$59,582,881	$993,595	1.62
Lewes Beach	$79,827,978	$28,654,012	35.89%	$51,173,966	$823,941	1.56
Total Project	**$477,166,271**	**$168,843,238**	**35.38%**	**$308,323,033**	**$4,994,724**	**1.54**

Figure 26: Relative Sea Level Change Sensitivity Analysis

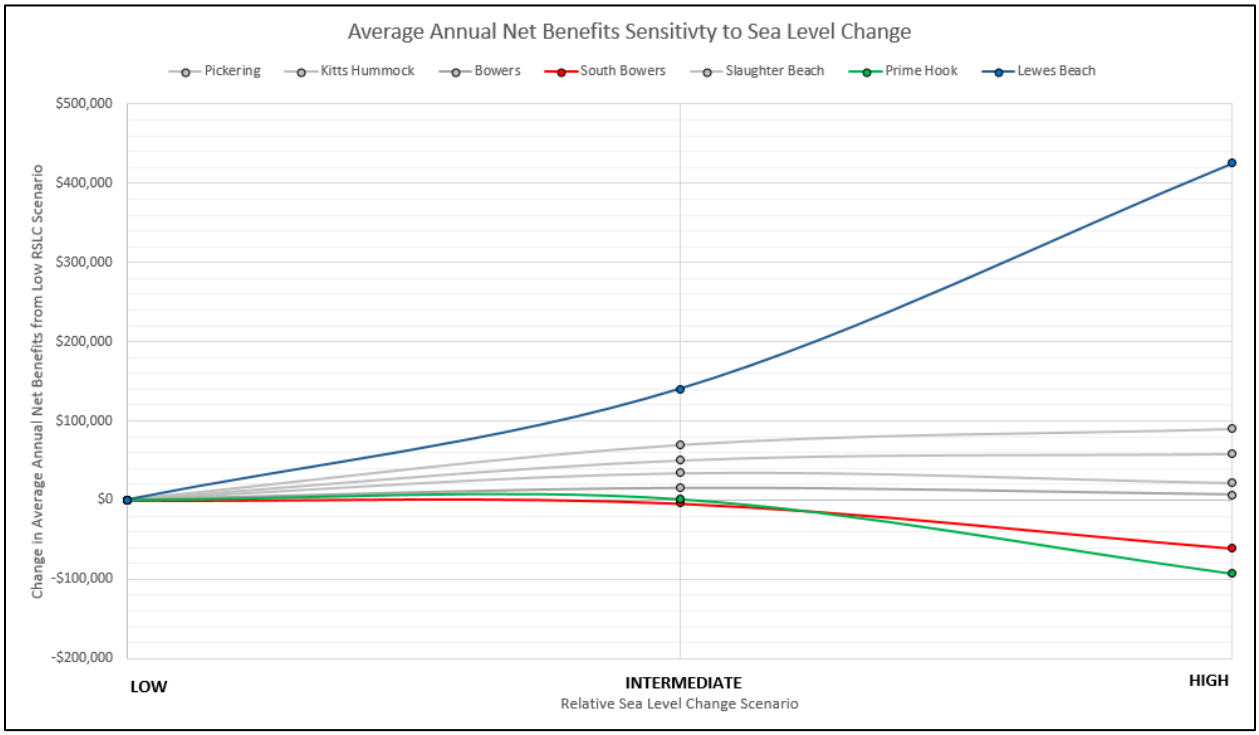


Figure 26 shows that the majority of sites in the NED Plan are not very sensitive to changes in Relative Sea Level Change. The overall project Average Annual Net Benefits increase 7.26% from Low RSLC to Intermediate RSLC and then a further 9.89% from Intermediate RSLC to High RSLC. Potential damages avoided are accrued at a slightly faster rate than increases in project cost.

The only outlier site is Lewes Beach, which increases 54.52% (+$140,442) and then a further 107.00% (+$425,901) in Average Annual Net Benefits as a greater portion of the inventory enters the potential damage pool in the Intermediate and High RSLC scenarios. This increase in Average Annual Net Benefits is partially offset by South Bowers Beach and Prime Hook Beach, which drop -$61,206 and -$92,537 from the Intermediate RSLC to High RSLC curves, respectively.

Overall NED Plan sensitivity to Relative Sea Level Change is fairly low with the project experiencing a net increase in Average Annual Net Benefits from the Intermediate RSLC to High RSLC while maintaining positive Average Annual Net Benefits in the Low RSLC curve scenario.

CONCLUSION

The Delaware Bay shoreline is highly susceptible to hurricane and storm damage from erosion, inundation, and wave attack damage drivers. Residential homes are the most strongly affected damageable asset category in this region, with some commercial properties also experiencing significant impact. The Beach-fx economic analysis results have demonstrated that, in the absence of a federal project, significant economic damage from coastal forces can be expected over the next 50 years.

The National Economic Development Plan has been determined using technical expertise, professional judgment, and rigorous certified modeling to maximize net benefits in the reduction of coastal storm damage. With prevented erosion, inundation, and wave damages to coastal infrastructure, the Average Annual Net Benefits for the NED Plan in present value dollars is $4,545,036, with a Benefit-Cost Ratio of 1.6. Additionally, each individual site recommended as part of the NED Plan has positive Average Annual Net Benefits and a BCR above 1.0.

Appendix B – Real Estate Plan

REAL ESTATE PLAN
FOR THE
Delaware River Dredged Material Beneficial Utilization Study (DMU)
State of Delaware Study Area
Sussex and Kent Counties, Delaware

1. GENERAL

2. REAL ESTATE REQUIREMENTS

    a. Description of Land, Easements, Rights of Way and Access Road Requirements for Project
    b. Standard Estates
    c. Non-Standard Estates
    d. Current Ownership
    e. Real Estate Mapping

3. EXISTING FEDERAL PROJECTS

4. EXISTING FEDERALLY OWNED LANDS

5. LANDS OWNED BY THE NON-FEDERAL SPONSOR

6. NAVIGATIONAL SERVITUDE

7. INDUCED FLOODING

8. BASELINE COST ESTIMATE FOR REAL ESTATE

9. PUBLIC LAW 91-646 RELOCATIONS

10. MINERAL ACTIVITY

11. TIMBER RIGHTS

12. ASSESSMENT OF NON-FEDERAL SPONSOR ACQUISITION CAPABILITY

13. ZONING

14. ACQUISITION SCHEDULE

15. UTILITY AND FACILITY RELOCATIONS

16. ENVIRONMENTAL CONCERNS

17. ATTITUDES OF THE LANDOWNERS

18. NOTIFICATION TO NON-FEDERAL SPONSOR

19. RISK ANALYSIS

1. GENERAL:

This Real Estate Plan is in support of the Delaware River Dredged Material Beneficial Utilization Study (DMU), State of Delaware Area Feasibility Study, 30% Design/TSP. The plan is tentative in nature for planning purposes only and is intended to match the level of detail available in the main feasibility investigation report. Therefore, the final real property lines, estimates of value and rights required for project construction and operation and maintenance are subject to change even after approval of this report. Due to the nature of shore protection projects, it is difficult to assert complete certainty regarding future project real estate requirements based solely on 30% designs for a particular snapshot in time. For the project areas included in this feasibility report, changes in project designs from the 10% to the 30% design stage have resulted in marked changes in the real estate requirements due to changes in project work limits. Since the entire real estate process will be repeated once the project reaches the pre-construction, 100% design phase, projected real estate requirements under this report will match the 30% design detail level only. Areas for which further investigation are required during and after design completion will be noted. A Risk Analysis is included in this report under Item Number 19. Risk Analysis, in order to comply with a risk-based assessment model for current project planning guidelines.

The initial study authority for the Delaware DMU is the October 26, 2005 resolution of the Committee on Environment and Public Works of the United States Senate. The resolution reads as follows:

> Resolved by the Committee on Environmental and Public Works of the United States Senate, that the Secretary of the Army is requested to review the report of the Chief of Engineers on the Delaware River between Philadelphia, Pennsylvania and Trenton, New Jersey, and Philadelphia to the Sea, published as House Document 358, Eighty Third Congress, Second Session (1954), and other pertinent reports, with a view to determining whether any modifications of the recommendations contained therein are advisable in the interest of beneficial use of dredged material resulting from the aforementioned project, including transfer and transport facilities for the drying, rehandling, and transferring of dredged material, as it relates to comprehensive watershed and regional sediment management (RSM), ecosystem restoration, navigation, stream restoration, water quality, restoration of coal and other mined area, cover material for sanitary landfills and other allied purposes.

In response to Hurricane Sandy in October 2012, Congress passed the Disaster Relief Appropriations Act (PL 113-2, 2013) which authorized supplemental appropriations to Federal agencies for expenses related to the consequences of Hurricane Sandy. Chapter 4 of PL 113-2 identified USACE-specific actions which included two interim reports to Congress, a project performance evaluation report and a comprehensive study to address the flood risks of vulnerable coastal populations in areas affected by Hurricane Sandy within the boundaries of the North Atlantic Division of USACE. The aforementioned Delaware DMU study was identified in the Second Interim Report, placing additional emphasis on Coastal Storm Damage Reduction (CSDR). The Feasibility Cost-Sharing Agreement was signed between the USACE, Philadelphia District and the Delaware Non-Federal Sponsor (NFS), Delaware Department of Natural Resources and Environmental Control (DNREC) on February 27, 2014.

The study area includes the State of Delaware portion of the Delaware River Watershed, the Delaware River itself, multiple tributaries of the Delaware which contribute to localized flooding and inland bay communities along the Atlantic Ocean coastline of Delaware. The north/south boundaries

of the study area extend from the Delaware-Pennsylvania state line to the Delaware-Maryland state line. All of the selected plan Delaware locations included in the feasibility report are located in the Southern Reach and are listed on the chart included in Figure 1.

The primary problem identified in the study are damages along the Delaware Estuary shoreline (as well as along Delaware's Inland Bays) caused by erosion, wave attack, and inundation due to coastal storms, along with rising water levels due to sea level change.

The primary purpose of this study is to investigate the beneficial use of dredged material to improve coastal storm risk management (CSRM) to locations in the study area. The recommended plan consists of beach restoration at 7 dredged material placement locations in the southern reach of the study area. The 7 dredged material placement locations span approximately 29 miles along the Delaware Bay and include (from north to south): Pickering Beach, Kitts Hummock, Bowers Beach, South Bowers Beach, Slaughter Beach, Prime Hook Beach and Lewes Beach.

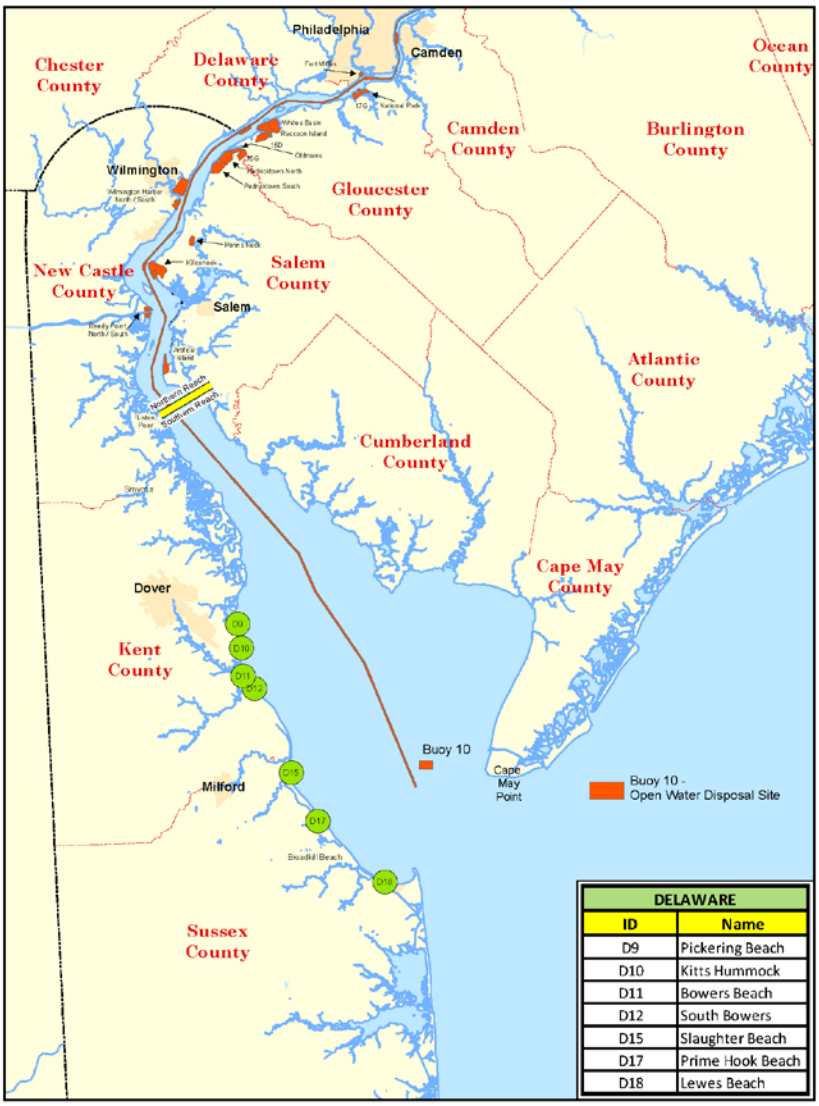


Figure 1 – Study Locations and Selected Plan Sites (Delaware)

The recommended plan for each of the project areas is as follows:

a. Pickering Beach: The recommended plan calls for a berm-only beachfill at Pickering Beach with the parameters shown below. The fill width of the design extends in front of all currently developed property in Pickering Beach except one home at the southern end of the project.

Length of Design Dune/Berm (feet)	Length of Initial Construction Dune (feet)	Southern Taper (feet)	Northern Taper (feet)	Length of Shoreline (feet)	Dune Height (feet NAVD88)	Dune Width (feet)	Berm Height (feet NAVD88)	Design Berm Width (feet)	Advance Berm Width (feet)
2,295	N/A	1,010	1,016	4,321	N/A	N/A	7	55	45

b. Kitts-Hummock: The recommended plan calls for a berm-only beachfill at Kitts-Hummock with the parameters shown below. The full width of the design berm extends in front of all currently developed property with the exception of one lot at the northern end of the project area where a recently-demolished home is slated to be replaced. The existing outfall will be extended if necessary.

Length of Design Dune/Berm (feet)	Length of Initial Construction Dune (feet)	Southern Taper (feet)	Northern Taper (feet)	Length of Shoreline (feet)	Dune Height (feet NAVD88)	Dune Width (feet)	Berm Height (feet NAVD88)	Design Berm Width (feet)	Advance Berm Width (feet)
4,685	N/A	965	1,000	6,650	N/A	N/A	7	55	45

c. Bowers Beach (North Bowers): The recommended plan calls for a dune and berm beachfill at Bowers Beach with the parameters shown in the table above. The design will tie into the existing jetty at the southern end, with a tapered beachfill at the north end wrapping around the beachfront at the mouth of the St. Jones River.

Length of Design Dune/Berm (feet)	Length of Initial Construction Dune (feet)	Southern Taper (feet)	Northern Taper (feet)	Length of Shoreline (feet)	Dune Height (feet NAVD88)	Dune Width (feet)	Berm Height (feet NAVD88)	Design Berm Width (feet)	Advance Berm Width (feet)
2,326	2,326	34	846	3,206	12	25	7	25	50

d. South Bowers Beach: The recommended plan calls for a dune and berm beachfill at South Bowers Beach with the parameters shown in the table above. The design will tie into the jetty alignment upon reconstruction by the local sponsor at the northern end with a tapered beachfill at the south end.

Length of Design Dune/Berm (feet)	Length of Initial Construction Dune (feet)	Southern Taper (feet)	Northern Taper (feet)	Length of Shoreline (feet)	Dune Height (feet NAVD88)	Dune Width (feet)	Berm Height (feet NAVD88)	Design Berm Width (feet)	Advance Berm Width (feet)
1,367	1,367	1,005	129	2,501	12	25	7	25	75

e. Slaughter Beach: The recommended plan calls for a dune and berm beachfill at Slaughter Beach with the parameters shown in the table above. The design will utilize tapers at each end to tie the beachfill into existing conditions.

Length of Design Dune/Berm (feet)	Length of Initial Construction Dune (feet)	Southern Taper (feet)	Northern Taper (feet)	Length of Shoreline (feet)	Dune Height (feet NAVD88)	Dune Width (feet)	Berm Height (feet NAVD88)	Design Berm Width (feet)	Advance Berm Width (feet)
14,468	9,482	1,000	942	16,410	8.5	25	7	25	25

f. Prime Hook Beach: The recommended plan calls for a dune and berm beachfill at Prime Hook Beach with the parameters shown in the table above. The design will utilize tapers at each end to tie the beachfill into existing conditions.

Length of Design Dune/Berm (feet)	Length of Initial Construction Dune (feet)	Southern Taper (feet)	Northern Taper (feet)	Length of Shoreline (feet)	Dune Height (feet NAVD88)	Dune Width (feet)	Berm Height (feet NAVD88)	Design Berm Width (feet)	Advance Berm Width (feet)
6,408	4,252	941	258	7,607	12	25	7	25	25

g. Lewes Beach: The recommended plan calls for a dune and berm beachfill at Lewes Beach with the parameters shown in the table above. The design will tie into the Roosevelt Inlet Federal Shore Protection Project at the western end with the beachfill tapering to existing conditions at the eastern end.

Length of Design Dune/Berm (feet)	Length of Initial Construction Dune (feet)	Southern Taper (feet)	Northern Taper (feet)	Length of Shoreline (feet)	Dune Height (feet NAVD88)	Dune Width (feet)	Berm Height (feet NAVD88)	Design Berm Width (feet)	Advance Berm Width (feet)
7,223	2,515	30	0	9,768	12	25	7	25	25

Varying volumes of dredged material are required at each of the 7 placement locations, depending on the length of shoreline to be nourished and the existing beach profile. In order to maintain the integrity of design beachfill alternatives, beachfill renourishment must be included in the project design. If periodic renourishment was not performed throughout the life of the project, the longshore and cross shore sediment transport mechanisms, separate from storm induced erosion, would act to erode the design beach. A 6-year periodic nourishment cycle is anticipated to maintain optimal CSRM. This nourishment cycle is in line with the proposed O&M dredging to be performed in Lower Reach E (the proposed project dredged material source area).

2. REAL ESTATE REQUIREMENTS

a. Description of Land, Easements, Rights-of-Way and Access Road Requirements for Project

Based on the information available, the current TSP requires three (3) types of easements/instruments for the combined projects. Currently, all mobilization and construction activities, including lay down and storage of contractor materials and equipment, are assumed to be located within the project area Limit of Construction for the entire project. At this time, four (4) total road easements are needed in four (4) of the project areas, requiring the use of Standard Estate

No. 11, Road/Access Road Easement. One project area includes land owned by the United States, under the purview of the United States Fish and Wildlife Service (USFWS). Use of this property requires a non-standard estate in the form of a Memorandum of Agreement and/or a Special Use Permit.

The standard Perpetual Beach Storm Damage Reduction Easement (Standard Estate No. 26) is required for the construction of the beach berm and/or dune system on the beachfront properties that are above the mean high water line or that include riparian grants, including any owned by the local municipalities. Easements must be acquired over the areas below the mean high water line covered by riparian grants for construction, operation and maintenance work required by the Non-Federal Sponsor. See Section 6 entitled "Navigational Servitude" for further explanation of this possible easement acquisition requirement. The third estate/instrument required is for lands in the project area currently owned by the United States Fish and Wildlife Service. See Section 2.c. Non-Standard Estates below for a description of the estate/instruments required. A summary chart is provided below:

	Easements Required		**Easements In-Hand**		**Outstanding Easements**	
Project Area	**HSDR**	**Road**	**HSDR**	**Road**	**HSDR**	**Road**
Pickering	32	1	18	1	14	0
Kitts-Hummock	77	0	77	0	0	0
Bowers	50	0	40	0	10	0
South Bowers	10	1	1	1	9	0
Slaughter Beach	106	1	0	0	106	1
Prime Hook	67	1	0	0	67	1
Lewes	1	0	0	0	1	0
TOTALS:	**343**	**4**	**136**	**2**	**207**	**2**

No borrow area easements are required, since the material required for construction is to be obtained through required maintenance dredging of Federal navigation project areas.

A note on the "Voluntary Easements" listed below: Per the DNREC, beach easements were obtained in the mid-1970's for various projects that were subsequently constructed in several localities. However, in the mid-2000's when Delaware checked on the easements to confirm the real estate rights held in order to conduct dredge-management activities, they found that several were never recorded. In order to be absolutely certain regarding real estate rights for subsequent beach work and dredge management, the State of Delaware obtained voluntary easements in case funding for the 10-year dredge management plan were awarded. Funding was never received, so the outstanding easements from the voluntary request period are still outstanding. The project area localities containing parcels with Voluntary Easements as defined here are Pickering Beach, Kitts Hummock Beach, Bowers Beach, South Bowers Beach, and Slaughter Beach.

D9 - PICKERING BEACH

Pickering Beach is the northernmost project area under the current TSP. A review of the project drawing provided resulted in the following real estate required for the current 30% design template. The Voluntary Easement sample submitted for review was determined to be adequate for project purposes by NAB Office of Counsel as it contains USACE Standard Estate No. 26. Since this is a 30% design report, we are assuming that the list of properties provided by the NFS showing the properties in the Pickering Beach Project Area covered by the sample easement is accurate and all of the properties are covered by the same easement.

Total Perpetual HSDR Easements Required:	32
Total Perpetual Road Easements Required:	1
Less Total NFS-Owned Parcels (Incl Road Easement):	4
Less Total Voluntary Easements Obtained by NFS:	15
Total Outstanding Potential HSDR Easements Required:	14

A perpetual road easement is required for construction and O&M access to the northern portion of the project area due to the lack of a public road. It has currently been placed on lands owned by the NFS, adjacent to a trail currently worn through several private properties.

The remainder of the beach section of the project area outside of the adjacent private parcels does not have a tax ID and is shown to be under the control of the State of Delaware according to available servitude definitions. See REP Item 6 below.

D10 – KITTS HUMMOCK

A review of the Kitts-Hummock project drawing provided resulted in the following real estate required for the current 30% design template. The Voluntary Easement sample submitted for review was determined to be adequate for project purposes by NAB Office of Counsel as it contains USACE Standard Estate No. 26. Since this is a 30% design report, we are assuming that the list of properties provided by the NFS showing the properties in the Pickering Beach Project Area covered by the sample easement is accurate and all of the properties are covered by the same easement.

Total Potential Perpetual HSDR Easements Required:	77
Less Total NFS-Owned Parcels:	2
Less Total Voluntary Easements Obtained by NFS:	75
Total Outstanding Potential HSDR Easements Required:	0

No Perpetual Road Easements are currently required, since local roads are shown to be public.

Both of the parcels listed as being owned by the State of Delaware are a part of the southern beach area and have their own tax ID numbers. The remainder of the beach section of the project area outside of the adjacent private parcels does not have a tax ID and is shown to be under the control of the State of Delaware according to available servitude definitions. See REP Item 6 below.

D11 – BOWERS BEACH (NORTH BOWERS)

A review of the Bowers Beach project drawing provided resulted in the following real estate required for the current 30% design template. The Voluntary Easement sample submitted for review

was determined to be adequate for project purposes by NAB Office of Counsel as it contains USACE Standard Estate No. 26. Since this is a 30% design report, we are assuming that the list of properties provided by the NFS showing the properties in the Pickering Beach Project Area covered by the sample easement is accurate and all of the properties are covered by the same easement.

Total Potential Perpetual HSDR Easements Required:	50
Less Total NFS-Owned Parcels:	0
Less Total Voluntary Easements Obtained by NFS:	40
Total Outstanding Potential HSDR Easements Required:	10

No Perpetual Road Easements are required, since local roads are shown to be public. Once the final design is complete, confirmation is required that the dedicated public right-of-way continues past the currently paved roadway through to its current end on lands controlled by the State of Delaware.

The remainder of the beach section of the project area outside of the adjacent private parcels does not have a tax ID and is shown to be under the control of the State of Delaware according to available servitude definitions. See REP Item 6 below.

D12 – SOUTH BOWERS

A review of the South Bowers Beach project drawing provided resulted in the following real estate required for the current 30% design template. The Voluntary Easement sample submitted for review was determined to be inadequate for project purposes by NAB Office of Counsel since it does not contain adequate estate language for the construction and O&M of this project. A new easement is required for all privately-owned properties included in the project area.

Total Potential Perpetual HSDR Easements Required:	10
Total Perpetual Road Easements Required:	1
Less Total NFS-Owned Parcels (Incl Road Easement):	2
Less Total Voluntary Easements Obtained by NFS:	0
Total Outstanding Potential HSDR Easements Required:	9

A perpetual road easement is required for construction, and O&M access to the northern portion of the project area due to the lack of a public road. It is located at the end of the northern terminus of the public road and extends to the beginning of the project area. The road area required is located entirely on lands owned by the NFS.

The remainder of the beach section of the project area outside of the adjacent private parcels does not have a tax ID and is shown to be under the control of the State of Delaware according to available servitude definitions. See REP Item 6 below.

D14 – SLAUGHTER BEACH

A review of the Slaughter Beach project drawing provided resulted in the following real estate required for the current 30% design template. The Voluntary Easement sample submitted for review was determined to be inadequate for project purposes by NAB Office of Counsel since it does not contain adequate estate language for the construction, operation and maintenance of this project, based on available plan information. For this reports, a new easement is required for all privately-owned properties included in the project area.

Total Potential Perpetual HSDR Easements Required:	106
Total Perpetual Road Easements Required:	1
Less Total NFS-Owned Parcels:	0
Less Total Voluntary Easements Obtained by NFS:	0
Total Outstanding Potential HSDR Easements Required:	107

A perpetual road easement is required for construction, and O&M access to the northern portion of the project.

The remainder of the beach section of the project area outside of the adjacent private parcels does not have a tax ID and is shown to be under the control of the State of Delaware according to available servitude definitions. See REP Item 6 below.

D17 – PRIME HOOK BEACH

A review of the Prime Hook Beach project drawing provided resulted in the following possible real estate required.

Total Potential Perpetual HSDR Easements Required:	67
Total Perpetual Road Easements Required:	1
Less Total NFS-Owned Parcels:	0
Less Total Voluntary Easements Obtained by NFS:	0
Total Outstanding Potential HSDR Easements Required:	68

One outstanding parcel belongs to the United States of America and is maintained by the USFWS as a part of the Prime Hook National Wildlife Refuge. Although owned by the United States, it is managed by an Agency other than the US Army Corps of Engineers. Therefore, its use is required to be obtained by the acquisition of a Memorandum of Record and/or Special Use Permit, depending on the requirements of FWS at the time of acquisition. See Item 2.c. Non-Standard Estates, below for further explanation,

The remainder of the beach section of the project area outside of the adjacent private parcels does not have a tax ID and is shown to be under the control of the State of Delaware according to available servitude definitions. See REP Item 6 below.

D18 – LEWES BEACH

A review of the Lewes Beach project drawing provided resulted in the following real estate required for the current 30 % design template. The first 1,400 feet of the project area is already included in the Delaware Coast Roosevelt Inlet to Lewes Beach Shore Protection Project. Therefore, all real estate for that portion has already been acquired and certified for construction, operation and maintenance for the Roosevelt Inlet – Lewes Beach Shore Protection Project. Since this is a different project, the NFS is required to re-certify its use for this project. The remainder of the project area is owned by the City of Lewes as part of the same large parcel containing the existing Federal project.

Total Potential Perpetual HSDR Easements Required:	1
Less Total NFS-Owned Parcels:	0
Less Total Voluntary Easements Obtained by NFS:	0
Total Outstanding Potential HSDR Easements Required:	1

No anticipated Perpetual Road Easement required, since local roads are shown to be public.

b. Standard Estates

A standard Perpetual Beach Storm Damage Reduction Easement (Standard Estate No. 26, EC 405-1-11, Exhibit 5-29) is required for the construction of the beach berm and dune for upland beachfront properties above the MHWL and those covered by riparian grants. A standard Perpetual Road Easement (Standard Estate No. 11, EC 405-1-11, Exhibit 5-29) is required for construction and operations and maintenance access for project areas containing private roadways.

PERPETUAL BEACH STORM DAMAGE REDUCTION EASEMENT
(Standard Estate No. 26)

A perpetual and assignable easement and right-of-way in, on, over and across (the land described in Schedule A) (Tract No. __) for use by the (Project Sponsor), its representatives, agents, contractors, and assigns, to construct; preserve; patrol; operate; maintain; repair; rehabilitate; and replace; a public beach [a dune system] and other erosion control and storm damage reduction measures together with appurtenances thereto, including the right to deposit sand; to accomplish any alterations of contours on said land; to construct berms [and dunes]; to nourish and renourish periodically; to move, store and remove equipment and supplies; to erect and remove temporary structures; and to perform any other work necessary and incident to the construction, periodic renourishment and maintenance of the (Project Name), together with the right of public use and access; [to plant vegetation on said dunes and berms; to erect, maintain and remove silt screens and sand fences; to facilitate preservation of dunes and vegetation through the limitation of access to dune areas;] to trim, cut, fell, and remove from said land all trees, underbrush, debris, obstructions, and any other vegetation, structures and obstacles within the limits of the easement (except_____); [reserving, however, to the grantor(s), (his) (her) (its) (their) (heirs), successors and assigns, the right to construct dune overwalk structures in accordance with any applicable Federal, State or local laws or regulations, provided that such structures shall not violate the integrity of the dune in shape, dimension or function, and that prior approval of the plans and specifications for such structures is obtained from the (designated representative of the Project Sponsor) and provided further that such structures are subordinate to the construction, operation, maintenance, repair, rehabilitation and replacement of the project; and further] reserving to the grantor(s), (his) (her) (its) (their) (heirs), successors and assigns all such rights and privileges as may be used and enjoyed without interfering

with or abridging the rights and easements hereby acquired; subject however to existing easements for public roads and highways, public utilities, railroads and pipelines.

PERPETUAL ROAD EASEMENT
(Standard Estate No. 11)

A (perpetual [exclusive] [non-exclusive] and assignable) (temporary) easement and right-of-way in, on, over and across (the land described in Schedule A) (Tracts Nos. _____, _____ and _____) for the location, construction, operation, maintenance, alteration replacement of (a) road(s) and appurtenances thereto; together with the right to trim, cut, fell and remove therefrom all trees, underbrush, obstructions and other vegetation, structures, or obstacles within the limits of the right-of-way; (reserving, however, to the owners, their heirs and assigns, the right to cross over or under the right-of-way as access to their adjoining land at the locations indicated in Schedule B); subject, however, to existing easements for public roads and highways, public utilities, railroads and pipelines.

c. Non-Standard Estates

One parcel located in the Prime Hook project area is owned by the United States of America and managed by the US Fish and Wildlife Service (FWS) as part of the Prime Hook National Wildlife Refuge. Although the parcel is owned by the United States, it is managed by an Agency other than the US Army Corps of Engineers. Therefore, one or more of the following documents will be required: a permit or cooperative agreement, a special use permit or an easement (if permissible at the time of request). The particular documentation required will be determined once more detailed plans are completed for those particular project areas. Coordination of project activities with US FWS is on-going and has resulted in additional land requirements for the project and taper area currently located upon FWS-managed property.

d. Current Ownership

A tax data list of all parcels required for the construction and operation and maintenance for each of the proposed projects is attached to the report as Exhibit A.

e. Real Estate Mapping

Project mapping for each project area is attached as Exhibit B. The project mapping as attached includes project limit lines, tax parcel lines, and a line showing the surveyed line used by the NFS to acquire parcels in areas for which the voluntary easements were approved for project use by NAB (Pickering Beach, Kitts-Hummock, and Bowers).

Note regarding the Pickering Beach, Kitts-Hummock, and Bowers real estate mapping: The red line superimposed on the project drawing is the surveyed line the State of Delaware used when obtaining easements for that area. There are small areas for which the surveyed line is within the proposed project work limit, showing that additional easement areas may be required. These areas have been left off the project acquisition list at this time. The decision to leave them off the acquisition list at this time considered the 30% nature of the design, the multiple changes to the designs made between the 10% and 30% design stages, and the unstable and shifting conditions of shore areas requiring CSRM. The areas are also currently small enough to consider an adjustment of the project limit line as the designs approach 100% (as has been done for other shore protection

projects that have now been constructed). An additional cost contingency has been added to the baseline real estate cost to account for these areas instead.

3. EXISTING FEDERAL PROJECTS

There are two (2) existing Federal projects located near one of the project areas. Proximate to the Lewes portion are the Lewes and Rehobeth Canal and the Roosevelt Inlet, both Federal navigation projects. The proposed projects will not impact the existing Federal navigation projects. Included in a proposed project area is the Delaware Coast Roosevelt Inlet to Lewes Shore Erosion Project. The proposed Lewes portion of this project will impact the existing cost-shared project by providing additional sand to the existing template and adding an additional 9,768 linear feet to the current designed beach template.

4. EXISTING FEDERALLY OWNED LANDS

The study area contains lands owned and operated by the US FWS, located on the northern end of the Prime Hook project area. Current project drawings show that the area required will be used primarily for a project taper area with minor dune and berm placement. The DE DMU Project Team has been actively coordinating the placement and size of the project dune/berm and taper requirements for the Prime Hook Project area with the US FWS, resulting in the current project design on US FWS lands in the Prime Hook Project Area.

5. LANDS OWNED BY THE NON-FEDERAL SPONSOR

There are currently 8 parcels owned by the State of Delaware in the collective upland project areas: four in Pickering Beach, two in Kitts-Hummock, and two in South Bowers. Submerged lands below the MHWL of the Delaware River not specifically subject to riparian grants are owned/controlled by the State of Delaware and managed by DNREC, Division of Soil and Water Conservation, Shoreline and Waterway Management Section.

6. NAVIGATIONAL SERVITUDE

Per the March 19, 2014 CECC-R Memo entitled “Availability of Navigation Servitude for Coastal Storm Damage Reduction Projects,” the determination of the applicability of Federal Navigation Servitude for the construction of coastal storm damage reduction measures by the United States under a Federal cost-shared project is done on a case-by-case basis and requires a two-step review process: a legal opinion of applicability completed by the District and a review for concurrence through the Real Estate Law Section of the Office of the Chief Counsel, staffed through Division Counsel.

In order to align real estate timelines with current project-planning best practices, the request for concurrence through Division Counsel will occur concurrently with this REP. Attached as Exhibit C is a memorandum provided by NAB Office of Counsel, dated 2 February 2018 entitled “Legal Opinion on the Use of Federal Navigation Servitude for Coastal Storm Damage Reduction Projects at Seven Locations Along the Delaware Bay Pursuant to the Delaware Beneficial Use of Dredged Material for the Delaware Feasibility Study.” Per the attached:

“It is the District opinion that navigation servitude may be invoked for construction of the proposed coastal storm damage reduction project, in utilization of the federal channel to be dredged, and in the CSRM footprint below MHW.”

Therefore, although the State of Delaware owns/controls all lands below the MLLW and has navigational servitude and jurisdiction over lands between the MWHL and MLLW, no authorization for entry will be required from the NFS and no credit or reimbursement will be afforded the NFS for these areas.

It should be noted that there may be riparian grants issued by the State of Delaware to some private owners which extend beyond the MHWL and MLLW. If lands covered by riparian grants are found to be included in the project area, the State of Delaware must either demonstrate that they still retain the rights required to operate and maintain the project areas or acquire the rights required to conduct ongoing operations and maintenance activities required under a future Project Partnership Agreement.

7. INDUCED FLOODING

No induced flooding is anticipated due to the proposed project features.

8. BASELINE COST ESTIMATE FOR REAL ESTATE

The detailed Real Estate Cost Estimate in MCACES format is included in Exhibit D. The 209 outstanding easements listed below include 207 Perpetual Beach Storm Damage Reduction Easements and 2 outstanding Perpetual Road Easements. The Valuation Estimate included both privately-owned parcels and locality owned parcels not owned by the NFS and includes the application of offsetting project benefits, also known as special benefits. The appraisal approach assumes that the proposed project will create a special benefit to the properties that otherwise would not exist due to erosion. The appraisal estimate provided for this report is based on a 30% design template and reflects the same 30% level of detail of the Real Estate Plan. In order to account for the additional risk present when determining real estate requirements for a 30% design, a higher-than-normal contingency of 50% has been included in the Baseline Cost Estimate summarized below.

ID	Location	Total Easements	$ RE Interest Acquired	$ Potential Damages	Total RE Estimate
D9	Pickering Beach	14	$ 167,506	$ 33,501	$ 201,007
D10	Kitts Hummock	0	$ -	$ -	$ -
D11	Bowers	10	$ 316,295	$ 63,259	$ 379,554
D12	South Bowers	9	$ 303,337	$ 60,667	$ 364,004
107	Slaughter Beach	107	$ 3,853,166	$ 770,633	$ 4,623,799
D17	Prime Hook Beach	68	$ 3,601,890	$ 720,378	$ 4,322,268
D18	Lewes	1	$ -	$ -	$ -
	Totals:	209	$ 8,242,194	$ 1,648,438	$ 9,890,632
				Say:	**$ 9,890,000**

Based on all of the factors discussed in this section, the total estimated Baseline Cost for Real Estate for the project is **$17,274,330**, summarized as follows:

Acquisition/Administrative Costs:		
Privately-Owned	194 Properties	$1,268,400
Commercial	0 Properties	$ -----
Publically-Owned	15 Properties	$ 154,000
Condemnation Costs:		
Privately-Owned	25 Properties	$ 237,500
Commercial	0 Properties	$ -----
P.L. 91-646 Assistance:		$ 0.00
Real Estate Payments:		
Land Payments	Total	$8,346,694
Potential Damages	Total	$1,647,806
Contingency (50%)		$5,619,930
		TOTAL: $17,274,330

9. PUBLIC LAW 91-646 RELOCATIONS

No P.L. 91-646 relocations are anticipated for this project at this time.

10. MINERAL ACTIVITY

There is no present or anticipated mining and drilling activity in the vicinity of the project that may affect the operation thereof.

11. TIMBER RIGHTS

There is no present or anticipated timber harvesting activity in the vicinity of the project that may affect the operation thereof.

12. ASSESSMENT OF NON-FEDERAL SPONSOR ACQUISITION CAPABILITY

The Non-Federal Sponsor, DNREC, has indicated that the required real estate acquisition would be accomplished by their office. The Assessment of the Non-Federal Sponsor's Real Estate Acquisition Capability is attached at the end of this report as Exhibit E.

13. ZONING

The enactment of zoning ordinances is not proposed to facilitate acquisition.

14. ACQUISITION SCHEDULE

The Non-Federal Sponsor will officially initiate real estate acquisition activities after final execution of the Project Partnership Agreement (PPA). Due to there not yet being a date specific schedule for this project, the following estimated LERRD acquisition schedule indicates the length of time required for each step in the standard acquisition process. As there is currently no estimated PPA signing date, the following is a generic, worst-case scenario real estate timeline. Once an anticipated signing date for the PPA is identified, a more specific schedule will be prepared.

a.	PPA Execution	Start Date
b.	Forward Maps to Sponsor	Within 1 week of Start Date
c.	Survey and Title Work	Within 14 weeks of sponsor map receipt
d.	Appraisals receipt	Within 10 weeks of survey and title
e.	Review Appraisals	Within 4 weeks of appraisal receipt
f.	Negotiations	Within 9 weeks after appraisal review
g.	Closings	Within 6 weeks of completion of negotiations
h.	Possession	Within 1 day of closings
i.	Certification of Real Estate	Within 1 week of possession; requires the transmittal of the Non-Federal Sponsor's Authorization for Entry for Construction and Certificate of Authority
	Approximate Total	1 year (Without Condemnations)

Condemnations are anticipated for at least 25 properties required for this project. Condemnations may take up to six total months from initiation of negotiation to possession, adding approximately three months to the entire acquisition process. Depending upon the number of condemnation actions required and negotiation timelines used by the State of Delaware, a conservative acquisition schedule for this project is estimated to be 2 years from PPA Execution.

15. UTILITY AND FACILITY RELOCATIONS

There are no relocations of utilities or facilities identified for this project at this time. There is one outfall located in the southern project taper area of the Kitts-Hummock Project Area. If it is later determined that project plans require the relocation of the outfall, an Attorney's Opinion of Compensability will be completed.

16. ENVIRONMENTAL CONCERNS

There is no known or suspected on-site contamination and the real estate cost estimates contained in this Real Estate Plan do not reflect the presence of contamination.

17. ATTITUDES OF THE LANDOWNERS

Discussion with landowners and other stakeholders to date have produced the typical mix of support and non-support of the project. Common areas of concern are opening the area beach to the public, having the public on the beaches behind their houses, and loss of control over the beach area. However, many have expressed support for the projects in general.

18. NOTIFICATION TO NON-FEDERAL SPONSOR

The Non-Federal Sponsor, the Delaware Department of Natural Resourced and Environmental Control (DNREC), will be notified in writing regarding the risks associated with the acquisition of land prior to execution of the PPA once a Feasibility Study is approved and the project is authorized and funded.

19. RISK ANALYSIS

The real estate plan was formulated to reflect the current 30% design. The following should be kept in mind when considering the real estate requirements covered under this REP:

a. More than 25 condemnations required. There is always a risk that current landowners, particularly those located in areas with completely private beaches, will be opposed to this project. Common objections to coastal storm damage reduction projects generally involve the loss of a private beach, loss of view and/or sea breeze, loss of immediate access from the property to the beach and the admittance of the public onto the beach.

Outcome: Additional cost to project for real estate and additional time required for acquisition.

b. The beach areas below the MHWL currently shown as being under the control of the State of Delaware may be covered by riparian grants that do not permit the NFS to enter onto the property for Project O&M purposes. In other CSRM projects, some riparian grants unknown to the NFS were located during shoreline title searches.

Outcome: Additional real estate acquisition required and additional real estate costs.

c. The gap between the acquired areas and required project limit lines for Pickering, Kitts-Hummock, and North Bowers cannot be removed by altering the project limit line once the project design reaches 100% design phase.

Outcome: Additional real estate acquisition required and additional real estate costs.

In order to account for the risks outlined above, a 50% contingency has been added to the total real estate costs for this project.

PICKERING BEACH

County Name	Situs Address Full	Owner 1	Owner 2	APN
Kent, De	Pickering Beach Road, Dover, De 19901	Delaware Wildlands, Inc.	c/o Kate Hackett	2-00-08802-02-1300-00001
Kent, De	Pickering Beach Road, Dover, De 19901	Delaware State Of (DNREC)	Fish and Game	2-00-08802-02-1700-00001
Kent, De	Pickering Beach Road, Dover, De 19901	Simpson, William D.		2-00-08802-02-1100-00001
Kent, De	Pickering Beach Road, Dover, De 19901	Delaware State Of (DNREC)	Fish and Game	2-00-08802-02-1200-00001
Kent, De	Portion of Pickering Beach Road	Adjacent to 2-00-08802-02-1300-00001		
Kent, De	Pickering Beach Rd, Dover, De 19901	Delaware State Of		2-00-08800-01-1200-00001
Kent, De	181 Sandpiper Dr, Dover, De 19901	Panayotti Anabel	North Gwendolyn	2-00-08802-03-1400-00001
Kent, De	173 Sandpiper Dr, Dover, De 19901	Malinoski Arthur J		2-00-08802-03-1401-00001
Kent, De	191 Sandpiper Dr, Dover, De 19901	Ennis Bruce C & Diane W		2-00-08802-03-1500-00001
Kent, De	201 Sandpiper Dr, Dover, De 19901-7103	Chen Haiwen	Yan Yanning	2-00-08802-03-1600-00001
Kent, De	209 Sandpiper Dr, Dover, De 19901-7103	Panayotti Anabel	North Gwendolyn	2-00-08802-03-1700-00001
Kent, De	219 Sandpiper Dr, Dover, De 19901	Herbst Rene L Jr & Carolyn G		2-00-08802-03-1800-00001
Kent, De	229 Sandpiper Dr, Dover, De 19901	Lister Patricia L		2-00-08802-03-1900-00001
Kent, De	239 Sandpiper Dr, Dover, De 19901-7103	Parker Michael		2-00-08802-03-2000-00001
Kent, De	251 Sandpiper Dr, Dover, De 19901-7103	Smith Nancy L		2-00-08802-03-2100-00001
Kent, De	251 Sandpiper Dr, Dover, De 19901-7103	Cornelison Ruth W		2-00-08802-03-2200-00001
Kent, De	327 Sandpiper Dr, Dover, De 19901-7196	Antoniou Vicky L		2-00-08802-03-2300-00001
Kent, De	143 Sandpiper Dr, Dover, De 19901	Ennis Heather D		2-00-08802-03-1302-00001
Kent, De	153 Sandpiper Dr, Dover, De 19901-7102	Miller Patricia G		2-00-08802-03-1303-00001
Kent, De	163 Sandpiper Dr, Dover, De 19901	Eckenroad Gladys I		2-00-08802-03-1402-00001
Kent, De	42 N Sandpiper Dr, Dover, De 19901	Smith Gerald B & Janet M		2-00-08802-03-2800-00001
Kent, De	50 N Sandpiper Dr, Dover, De 19901-7106	Valiquette Edith M	Burns Darlene D	2-00-08802-03-2900-00001
Kent, De	58 N Sandpiper Dr, Dover, De 19901	Schofield Evan H	Schwartz Donna L	2-00-08802-03-3000-00001
Kent, De	68 N Sandpiper Dr, Dover, De 19901-7106	Welliver Dorothy E		2-00-08802-03-3100-00001
Kent, De	76 N Sandpiper Dr, Dover, De 19901-7106	Smith Robert C & Monica L		2-00-08802-03-3200-00001
Kent, De	88 N Sandpiper Dr, Dover, De 19901	Eisenbrey Mary F	Dempsey William R Jr	2-00-08802-03-3300-00001
Kent, De	96 N Sandpiper Dr, Dover, De 19901	Wright Catharine	Woodson James A	2-00-08802-03-3400-00001
Kent, De	106 N Sandpiper Dr, Dover, De 19901	Lisanti Svetlana		2-00-08802-03-3500-00001
Kent, De	Sandpiper Dr, Dover, De 19901	Satterfield Ralph G & Edith S		2-00-08802-03-3600-00001
Kent, De	126 N Sandpiper Dr, Dover, De 19901-7105	Satterfield Ralph G & Edith S		2-00-08802-03-3700-00001
Kent, De	132 N Sandpiper Dr, Dover, De 19901	Lorenzoni Cindy A		2-00-08802-03-3800-00001
Kent, De	142 N Sandpiper Dr, Dover, De 19901	Messina Christopher P	Brown Valerie J	2-00-08802-03-3900-00001

PERPETUAL ROAD EASEMENT REQUIRED FOR O&M ACCESS

Kent, De	Lands Owned by NFS, Adjacent to Private Trail Road

Total Parcels Required: **35**

Perpetual HSDR: 34

Perpetual Road: 1

Owned by State of Delaware

Parcel Already Covered by Easement

EXHIBIT A

KITTS HUMMOCK BEACH

County Name	Situs Address Full	Owner 1	Owner 2	APN
Kent, De	Bay Dr, Dover, De 19901	Shevock David A & Suzanne		2-00-09700-01-0600-00001
Kent, De	484 N Bay Dr, Dover, De 19901-7009	Tobias Nigel	Accime-tobias Cynthia	2-00-09716-01-2400-00001
Kent, De	472 N Bay Dr, Dover, De 19901-7009	Francis Jean E		2-00-09716-01-2500-00001
Kent, De	Bay Dr, Dover, De 19901	Mccloskey Macey A & Arthur L Ii		2-00-09716-01-2600-00001
Kent, De	Bay Dr, Dover, De 19901	Smith Eleanor		2-00-09716-01-2700-00001
Kent, De	Bay Dr, Dover, De 19901	Kitt Properties Llc		2-00-09716-01-2800-00001
Kent, De	Bay Dr, Dover, De 19901	Kitt Properties Llc		2-00-09716-01-2900-00001
Kent, De	Bay Dr, Dover, De 19901	Kitt Properties Llc		2-00-09716-01-3000-00001
Kent, De	404 N Bay Dr, Dover, De 19901	Flickinger Ray L & Patricia A		2-00-09716-01-3100-00001
Kent, De	394 N Bay Dr, Dover, De 19901	Hewish John C & Mary L		2-00-09716-01-3200-00001
Kent, De	Bay Dr, Dover, De 19901	Sadusky Marie		2-00-09716-01-3300-00001
Kent, De	364 N Bay Dr, Dover, De 19901-7008	Nddjdi1 Llc		2-00-09716-01-3400-00001
Kent, De	356 N Bay Dr, Dover, De 19901-7008	Reavis Kelly H & Todd M		2-00-09716-01-3500-00001
Kent, De	322 N Bay Dr, Dover, De 19901-7008	Crenshaw Benjamin R Jr & Heather J		2-00-09716-01-3800-00001
Kent, De	316 N Bay Dr, Dover, De 19901-7008	Nagle Robert		2-00-09716-01-3900-00001
Kent, De	302 N Bay Dr, Dover, De 19901-7008	Yeung Thomas & Donna		2-00-09716-01-4100-00001
Kent, De	282 N Bay Dr, Dover, De 19901-7007	Wallace Donald L & Mary Helen		2-00-09716-01-4200-00001
Kent, De	276 N Bay Dr, Dover, De 19901	Cassel Frank A & Debra L		2-00-09716-01-4300-00001
Kent, De	264 N Bay Dr, Dover, De 19901	Cassel Frank A & Debra L		2-00-09716-01-4400-00001
Kent, De	252 N Bay Dr, Dover, De 19901	Carson Kit & Margaret		2-00-09716-01-4500-00001
Kent, De	240 N Bay Dr, Dover, De 19901-7007	Goldstein Barry & Debora		2-00-09716-01-4600-00001
Kent, De	224 N Bay Dr, Dover, De 19901-7007	Altimari Catherine P & Thomas J		2-00-09716-01-4700-00001
Kent, De	200 N Bay Dr, Dover, De 19901-7007	Cannan Samuel G		2-00-09716-01-4800-00001
Kent, De	188 N Bay Dr, Dover, De 19901-7006	Bateman Thomas & Anne		2-00-09716-01-4900-00001
Kent, De	176 N Bay Dr, Dover, De 19901-7006	Arnett John F & Faye B		2-00-09716-01-5000-00001
Kent, De	166 N Bay Dr, Dover, De 19901	Ruby Robert J		2-00-09716-01-5100-00001
Kent, De	152 N Bay Dr, Dover, De 19901	Mancinelli Gary E & Joan L		2-00-09716-01-5200-00001
Kent, De	140 N Bay Dr, Dover, De 19901-7006	Myers Eugene E & Sharon Louise		2-00-09716-01-5300-00001
Kent, De	130 N Bay Dr, Dover, De 19901	Burke Mary C		2-00-09716-01-5400-00001
Kent, De	122 N Bay Dr, Dover, De 19901	Goodwin Timothy & Elizabeth N		2-00-09716-01-5500-00001
Kent, De	112 N Bay Dr, Dover, De 19901-7006	Mariani Andrew L Jr		2-00-09716-01-5600-00001
Kent, De	104 N Bay Dr, Dover, De 19901-7006	Rising Bird Trust		2-00-09716-01-5700-00001
Kent, De	94 N Bay Dr, Dover, De 19901-7005	Hollingsworth Steven J		2-00-09716-01-5800-00001
Kent, De	86 N Bay Dr, Dover, De 19901-7005	Jones Joan M Ltr & Jeffrey L		2-00-09716-01-5900-00001
Kent, De	74 N Bay Dr, Dover, De 19901-7005	Egan David J & Mary E		2-00-09716-01-6000-00001
Kent, De	64 N Bay Dr, Dover, De 19901-7005	Keating James & Elaine I		2-00-09716-01-6100-00001
Kent, De	42 N Bay Dr, Dover, De 19901-7005	Rodgers Richard L		2-00-09720-01-2700-00001

Kent, De	30 N Bay Dr, Dover, De 19901-7005	Daviratanasilpa Svastijaya		2-00-09720-01-2800-00001
Kent, De	Bay Dr, Dover, De 19901	Malik Pavan	Lall Ashima	2-00-09720-01-2900-00001
Kent, De	20 N Bay Dr, Dover, De 19901-7005	Rodgers Richard Lamar		2-00-09720-01-3000-00001
Kent, De	12 N Bay Dr, Dover, DE 19901-7005	Martin, Edward T	Joyce A	2-00-09720-01-3100-00001
Kent, De	3083 Kitts Hummock Rd, Dover, De 19901-7041	Costello Michael F & Carol A		2-00-09720-02-0200-00001
Kent, De	3099 Kitts Hummock Rd, Dover, De 19901-7041	Costello Michael F & Carol A		2-00-09720-02-0500-00001
Kent, De	3104 Kitts Hummock Rd, Dover, De 19901-7039	Lord Frank L & Cheryl R		2-00-09720-02-0600-00001
Kent, De	63 S Bay Dr, Dover, De 19901-7001	Graham Stephen & Kristin		2-00-09720-02-0700-00001
Kent, De	71 S Bay Dr, Dover, De 19901-7001	Stapleford Kenneth R & Linda J		2-00-09720-02-0800-00001
Kent, De	81 S Bay Dr, Dover, De 19901-7001	Dever Thomas & Maria		2-00-09720-02-0900-00001
Kent, De	91 S Bay Dr, Dover, De 19901-7001	Conlin Barbara E		2-00-09720-02-1000-00001
Kent, De	99 S Bay Dr, Dover, DE 19901-7001	Higgins, David C	Maas, Gale E	2-00-09720-02-1100-00001
Kent, De	105 S Bay Dr, Dover, De 19901	Holoviak Stephen J & Sharon K		2-00-09720-02-1200-00001
Kent, De	115 S Bay Dr, Dover, De 19901-7002	Conti Steven T		2-00-09720-02-1300-00001
Kent, De	123 S Bay Dr, Dover, De 19901	Probst Ruth A		2-00-09720-02-1400-00001
Kent, De	129 S Bay Dr, Dover, De 19901-7002	Porter Sally W & Elizabeth O		2-00-09720-02-1500-00001
Kent, De	137 S Bay Dr, Dover, De 19901-7002	Bertino Kurt L		2-00-09720-02-1600-00001
Kent, De	143 S Bay Dr, Dover, De 19901-7002	Frederick Thomas E & Helen R		2-00-09720-02-1700-00001
Kent, De	151 S Bay Dr, Dover, De 19901-7002	Lank Michele		2-00-09720-02-1800-00001
Kent, De	159 S Bay Dr, Dover, De 19901	Mauger Corey E & Jennifer M		2-00-09720-02-1900-00001
Kent, De	167 S Bay Dr, Dover, De 19901-7002	Marcavage Joseph C Sr		2-00-09720-02-2000-00001
Kent, De	175 S Bay Dr, Dover, De 19901-7002	Doberstein Dorothy J	Capponi Lisa B	2-00-09720-02-2100-00001
Kent, De	181 S Bay Dr, Dover, De 19901-7002	Hoffman Carl J & Florence A		2-00-09720-02-2200-00001
Kent, De	187 S Bay Dr, Dover, De 19901-7002	Hench Thomas L & Janice B		2-00-09720-02-2300-00001
Kent, De	197 S Bay Dr, Dover, De 19901-7002	Burke Mary C		2-00-09720-02-2400-00001
Kent, De	203 S Bay Dr, Dover, De 19901-7003	Lemay Ronald Jr		2-00-09720-02-2500-00001
Kent, De	215 S Bay Dr, Dover, De 19901-7003	Condouris William	Neel Cynthia Marie	2-00-09720-02-2600-00001
Kent, De	225 S Bay Dr, Dover, De 19901	Ridley Donald T & Terri L		2-00-09720-02-2700-00001
Kent, De	233 S Bay Dr, Dover, De 19901-7003	Hewish John C & Mary Lou		2-00-09720-02-2800-00001
Kent, De	241 S Bay Dr, Dover, De 19901	Walentukonis Charles Richard & Betty J		2-00-09720-02-2900-00001
Kent, De	249 S Bay Dr, Dover, De 19901-7003	Delaware City Station Llc		2-00-09720-02-3000-00001
Kent, De	257 S Bay Dr, Dover, De 19901-7003	Brown Annette		2-00-09720-02-3100-00001
Kent, De	265 S Bay Dr, Dover, De 19901-7003	Baral Properties Delaware Llc		2-00-09720-02-3200-00001
Kent, De	Bay Dr, Dover, De 19901	Delaware State Of		2-00-10600-01-1500-00001
Kent, De	325 S Bay Dr, Dover, De 19901-7004	Mcfann L Gene		2-00-10600-01-1600-00001
Kent, De	347 S Bay Dr, Dover, De 19901-7004	Miller Keith D & Gail		2-00-10600-01-1800-00001
Kent, De	359 S Bay Dr, Dover, DE 19901-7004	Poultney, Sara		2-00-10600-01-1900-00001
Kent, De	Bay Dr	Spencer, Paul Michael		2-00-10600-01-2100-00001
Kent, De	S. Bay Dr	Delaware State Of		2-00-10600-01-2200-00001
Kent, De	2016 Kitts Hummock Rd, Dover, De 19901-7027	Delaware State Of	**So. BEACH PORTION**	2-00-10600-01-2301-00001

Total Parcels Required:	**77**
Perpetual HSDR:	77

	Owned by State of Delaware
	Parcel Already Covered by Easement

BOWERS

County Name	Situs Address Full	Owner 1	Owner 2	APN
Kent, De	320 N Flack Ave, Frederica, De 19946-1283	Foley Lawrence S		8-01-11416-01-0100-00001
Kent, De	N Flack Ave, Frederica, De 19946	Roman Joseph		8-01-11416-01-0101-00001
Kent, De	302 N Flack Ave, Frederica, De 19946-1283	Roman Joseph		8-01-11416-01-0200-00001
Kent, De	Bayshore Dr, Frederica, De 19946	Del-homes Inc		8-01-11513-01-0200-00001
Kent, De	224 N Bayshore Dr, Frederica, De 19946-1206	Kaplan Lieba T	Schulz David A	8-01-11513-01-0201-00001
Kent, De	Flack Ave, Frederica, De 19946	Delmarsh Llc		8-01-11513-01-0300-00001
Kent, De	216 N Bayshore Dr, Frederica, De 19946-1206	Tammi Lea M E		8-01-11513-01-0600-00001
Kent, De	172 N Bayshore Dr, Frederica, De 19946-1202	Lange Albert P Iii & Dorothy M		8-01-11513-01-0601-00001
Kent, De	196 N Bayshore Dr, Frederica, De 19946-1202	Hernandez Michele D		8-01-11513-01-0602-00001
Kent, De	204 N Bayshore Dr, Frederica, De 19946-1206	Rohrs Stephen C & Mary O		8-01-11513-01-0603-00001
Kent, De	184 N Bayshore Dr, Frederica, De 19946-1202	Saran Melinda		8-01-11513-01-0604-00001
Kent, De	N Bayshore Dr, Frederica, De 19946	Martin James D & Judith E		8-01-11513-01-0701-00001
Kent, De	156 N Bayshore Dr, Frederica, De 19946-1202	Martin James D & Judith E		8-01-11513-01-0704-00001
Kent, De	166 N Bayshore Dr, Frederica, De 19946-1202	Sheldon Bradley John & Davy Lu		8-01-11513-01-0705-00001
Kent, De	Bayshore Dr, Frederica, De 19946	Pankowski Bernard L		8-01-11513-01-0900-00001
Kent, De	Bayshore Dr, Frederica, De 19946	Thomas Richard Felix		8-01-11513-01-1000-00001
Kent, De	112 N Bayshore Dr, Frederica, De 19946-1202	Johnson Robert L	Healy Rosemarie	8-01-11513-01-1300-00001
Kent, De	104 N Bayshore Dr, Frederica, De 19946-1202	Bowersox Mark		8-01-11513-01-1400-00001
Kent, De	90 N Bayshore Dr, Frederica, De 19946-1201	Reitmeyer Daniel W & Patricia A		8-01-11513-01-1700-00001
Kent, De	74 N Bayshore Dr, Frederica, De 19946-1201	Russell John R & Geraldine V		8-01-11513-01-1800-00001
Kent, De	64 N Bayshore Dr, Frederica, De 19946	Ebbecke Marie	Devine Joan	8-01-11513-01-2100-00001
Kent, De	54 N Bayshore Dr, Frederica, De 19946-1201	Reisinger Timothy & Peggy		8-01-11513-01-2101-00001
Kent, De	46 N Bayshore Dr, Frederica, De 19946-1201	Ruth James M & Jean M		8-01-11513-01-2200-00001
Kent, De	40 N Bayshore Dr, Frederica, De 19946	Reisinger Bonnie L		8-01-11513-01-2300-00001
Kent, De	36 N Bayshore Dr, Frederica, De 19946-1201	Reisinger Bonnie L		8-01-11513-01-2400-00001
Kent, De	26 N Bayshore Dr, Frederica, De 19946	Shore Charles & Margaret L		8-01-11513-01-4000-00001
Kent, De	18 N Bayshore Dr, Frederica, De 19946-1201	Neiman Marie A		8-01-11513-01-4100-00001
Kent, De	Bayshore Dr, Frederica, De 19946	Neiman Marie A		8-01-11513-01-4200-00001
Kent, De	Bayshore Dr, Frederica, De 19946	Coulbourne Josephine V P	Fulkerson Vanessa L	8-01-11513-01-4300-00001
Kent, De	Bayshore Dr, Frederica, De 19946	Coulbourne Josephine V P	Robinson Matthew P	8-01-11513-01-4400-00001
Kent, De	21 N Bayshore Dr, Frederica, De 19946	Ehlen Marvin D & Rosemary T		8-01-11513-01-4500-00001
Kent, De	33 N Bayshore Dr, Frederica, De 19946	Oneill Kevin M	Vrahoretis Susan	8-01-11513-01-4600-00001
Kent, De	Flack Ave, Frederica, De 19946	Mammarelli Harriet E		8-01-11513-01-5200-00001
Kent, De	43 N Bayshore Dr, Frederica, De 19946	Mammarelli Harriet		8-01-11513-01-5400-00001
Kent, De	49 N Bayshore Dr, Frederica, De 19946	Kern Lee	Sharkey John	8-01-11513-01-5500-00001

Kent, De	55 N Bayshore Dr, Frederica, De 19946	Phillis William K & Barbara A		8-01-11513-01-5600-00001
Kent, De	78 Flack Ave, Frederica, De 19946	Stepanik Elizabeth Anne & Mark J		8-01-11513-01-5701-00001
Kent, De	60 Mulberry Dr, Frederica, De 19946-1212	Jarrell, Wayne C R		8-01-11513-01-5900-00001
Kent, De	60 Mulberry Dr, Frederica, De 19946-1212	Frech Randall R & Deborah L		8-01-11517-02-2500-00001
Kent, De	58 Mulberry Dr, Frederica, De 19946-1212	Hunsicker, Ronald N	Leann	8-01-11517-02-2600-00001
Kent, De	Mulberry Dr, Frederica, De 19946	Shelly Linda F & Jerry L		8-01-11517-02-3700-00001
Kent, De	36 Mulberry Dr, Frederica, De 19946-1212	Houseknecht Howard C & Debra		8-01-11517-02-3800-00001
Kent, De	28 Mulberry Dr, Frederica, De 19946-1212	Nicholas Steven R & Carolyn A		8-01-11517-02-3900-00001
Kent, De	22 Mulberry Dr, Frederica, De 19946-1212	Mcdevitt Robert J Sr & Mary T		8-01-11517-02-4300-00001
Kent, De	12 Mulberry Dr, Frederica, De 19946	Fawber Richard M		8-01-11517-02-4400-00001
Kent, De	Mulberry Dr, Frederica, De 19946	Baydream		8-01-11517-02-4900-00001
Kent, De	Cooper Ave, Frederica, De 19946	Orendorf Ralph O & Corrine P		8-01-11517-02-8000-00001
Kent, De	Portion of Main St Streetend	SHR 18		
Kent, De	Portion of Middle Dr Streetend	Between Parcels 59 and 25		
Kent, De	Portion of N. Bayshore Dr Streetend	Northern Terminus of Street		

Total Parcels Required: **50**
Perpetual HSDR: 50

Owned by State of Delaware
Parcel Already Covered by Easement

SOUTH BOWERS

County Name	Situs Address Full	Owner 1	Owner 2	APN
Kent, De	Bowers Rd, Milford, De 19963	Delaware State Of		5-00-11517-01-2900-00001
Kent, De	4228 S Bowers Rd, Milford, De 19963	Mancuso, Patrick		5-00-11517-01-3900-00001
Kent, De	4218 S Bowers Rd, Milford, De 19963	Diamoantoni, Laura E		5-00-11517-01-4000-00001
Kent, De	4210 S Bowers Rd, Milford, De 19963	Scwartz, Steven		5-00-11517-01-4100-00001
Kent, De	4196 S Bowers Rd, Milford, De 19963	Lechner David A & Sophanette P		5-00-11517-01-4200-00001
Kent, De	4188 S Bowers Rd, Milford, De 19963-7037	Diedoardo William J		5-00-11517-01-4300-00001
Kent, De	4174 S Bowers Rd, Milford, De 19963-7037	Adams Troy C & Kimberly M		5-00-11517-01-4400-00001
Kent, De	4152 S Bowers Rd, Milford, De 19963-7037	Laughlin Jane L		5-00-11517-01-4600-00001
Kent, De	S Bowers Rd, Milford, De 19963	Laughlin Jane L		5-00-11517-01-5000-00001
Kent, De	4132 S Bowers Rd, Milford, De 19963	Webb, James S Jr.	Thomas E. Sr.	5-00-12400-01-0300-00001

PERPETUAL ROAD EASEMENT REQUIRED FOR O&M ACCESS

End of S Bowers Road at Northern End of Project, Plus Nothern Part of Parcel 2900 (First Line on Chart)

Total Parcels Required: **11**

Perpetual HSDR: 10

Perpetual Road 1

Owned by State of Delaware

Parcel Already Covered by Easement

SLAUGHTER BEACH

County Name	Situs Address Full	Owner 1	Owner 2	APN
Sussex, De	643 Bay Ave, Milford, De 19963-4916	Wentland Joyce E Perry & Kenneth R		330-09.00-13.00
Sussex, De	625 Bay Ave, Milford, De 19963-4916	Hart William P & Mary Ann		330-09.00-23.00
Sussex, De	623 Bay Ave, Milford, De 19963-4916	Eskelsen Todd R & Ann M		330-09.00-24.00
Sussex, De	619 Bay Ave, Milford, De 19963-4916	Ostrowski Susan C		330-09.00-26.00
Sussex, De	611 Bay Ave, Milford, De 19963-4916	Griffith Terry L		330-09.00-30.00
Sussex, De	609 Bay Ave, Milford, De 19963-4916	Barnard Thomas E	Sarro Christina M	330-09.00-31.00
Sussex, De	531 Bay Ave, Milford, De 19963-4915	Le Guyader John L	Perovshek Carol A	330-09.00-69.00
Sussex, De	531 Bay Ave, Milford, De 19963-4915	Leguyader John L	Perovshek Carol A	330-09.00-70.00
Sussex, De	513 Bay Ave, Milford, De 19963-4915	Guarino Robert S		330-09.00-79.00
Sussex, De	473 Bay Ave, Milford, De 19963-4912	Huntzinger Caroline		230-01.00-34.00
Sussex, De	463 Bay Ave, Milford, De 19963-4912	Anspach Michael		230-01.00-39.00
Sussex, De	457 Bay Ave, Milford, De 19963	Mullen William A Jr (te) & Barbara E (te)		230-01.00-42.00
Sussex, De	419 Bay Ave, Milford, De 19963	Starr Wesley E & Jane P		230-01.00-76.00
Sussex, De	409 Bay Ave, Milford, De 19963-4912	Bunting Lucinda K (te)		230-01.00-81.00
Sussex, De	389 Bay Ave, Milford, De 19963-4910	Gibble Stephen R		230-01.00-121.00
Sussex, De	379 Bay Ave, Milford, De 19963-4910	Slaughter Beach Llc		230-01.00-126.00
Sussex, De	371 Bay Ave, Milford, De 19963-4910	Nelson Amy R		230-01.00-130.01
Sussex, De	367 Bay Ave, Milford, De 19963	Urbanczyk Joan S	Paradis Julia M	230-01.00-131.00
Sussex, De	365 Bay Ave, Milford, De 19963	Rogers, Ann Marie B		230-01.00-132.00
Sussex, De	363 Bay Ave, Milford, De 19963	Ridzon, Stephen H	Lauren H	230-01.00-133.00
Sussex, De	361 Bay Ave, Milford, De 19963-4910	Picazo Jose S		230-01.00-134.00
Sussex, De	None, Milford, De 19963	Draper Frank S (te) & Marilyn P (te)		230-01.00-138.00
Sussex, De	None, Milford, De 19963	Slaughter Beach		230-01.00-139.00
Sussex, De	351 Bay Ave, Milford, De 19963-4910	Draper Frank S (te) & Marilyn P (te)		230-01.00-140.00
Sussex, De	349 Bay Ave, Milford, De 19963	Draper Frank S (te) & Marilyn P (te)		230-01.00-140.01
Sussex, De	347 Bay Ave, Milford, De 19963	Myers, Michael W	Christine E Walsh	230-01.00-141.00
Sussex, De	345 Bay Ave, Milford, De 19963	Draper, Frank S (Trustee)	Marilyn P Draper, Trustee	230-01.00-142.00
Sussex, De	337 Bay Aveue, Milford, De 19963	Kent & Sussex Motor Inn, Incorporated		230-01.00-146.00
Sussex, De	335 Bay Ave, Milford, De 19963-4910	Dill John W K Jr & Sandra I		230-01.00-147.00
Sussex, De	331 Bay Ave, Milford, De 19963	Kemp, Michael J.		230-01.00-148.00
Sussex, De	329 Bay Ave, Milford, De 19963	Dickey, Sarah	Cowgill, Elizabeth	230-01.00-149.00
Sussex, De	327 Bay Ave, Milford, De 19963	Smith, Douglas H	Smith Theresa R	230-01.00-150.00
Sussex, De	325 Bay Ave, Milford, De 19963	Forest, John A J JR Trustee		230-01.00-151.01
Sussex, De	321 Bay Ave, Milford, De 19963	Heffernan, John Michael	Mitch, Alison M	230-01.00-151.00
Sussex, De	321 Bay Ave, Milford, De 19963	Heffernan, John Michael	Mitch, Alison M	230-01.00-152.00
Sussex, De	319 Bay Ave, Milford, De 19963-4910	Chickering F William	Ankrom Michael A	230-01.00-153.00
Sussex, De	317 Bay Ave, Milford, De 19963-4910	Hagan James Francis & Vivan	Upton-hagan Diane	230-01.00-154.00
Sussex, De	315 Bay Ave, Milford, De 19963-4910	Salmons H Irvin Jr		230-01.00-155.00
Sussex, De	313 Bay Ave, Milford, De 19963-4910	Tucker Walter L Iii & Gail		230-01.00-156.00
Sussex, De	311 Bay Ave, Milford, De 19963-4910	Gingrich John B		230-01.00-157.00
Sussex, De	309 Bay Ave, Milford, De 19963-4910	Summers George James & Mary Elizabeth		230-01.00-158.00

Sussex, De	307 Bay Ave, Milford, De 19963-4910	Yost Michael L & Beth N		230-01.00-160.00	
Sussex, De	305 Bay Ave, Milford, De 19963-4910	Warrington Mark S		230-01.00-161.00	
Sussex, De	303 Bay Ave, Milford, De 19963-4910	Teed George W & Marianne H	Rambleton Acres	230-01.00-162.00	
Sussex, De	301 Bay Ave, Milford, De 19963-4910	Smith Jean Ray (te)		230-01.00-163.00	
Sussex, De	301 Bay Ave, Milford, De 19963-4910	Smith Jean Ray (te)		230-01.00-164.00	
Sussex, De	297 Bay Ave, Milford, De 19963-4909	Geha Jean-claude & Julia M		230-01.00-165.00	
Sussex, De	295 Bay Ave, Milford, De 19963-4909	Frizzell Raymond Scott & Martha		230-01.00-166.00	
Sussex, De	293 Bay Ave, Milford, De 19963-4909	Pierson Ginger & Horace S		230-01.00-167.00	
Sussex, De	291 Bay Ave, Milford, De 19963-4909	Crxc Llc		230-01.00-168.00	
Sussex, De	287 Bay Ave, Milford, De 19963-4909	Haltom Carl M & Anne M		230-01.00-169.00	
Sussex, De	281 Bay Ave, Milford, De 19963-4909	Murphy Richard E Jr & Joanne H		230-01.00-170.00	
Sussex, De	285 Bay Ave, Milford, De 19963-4909	Gerwig Jeffrey C & Norma A		230-01.00-170.01	
Sussex, De	279 Bay Ave, Milford, De 19963-4909	Esposito Curtis Vinyard & Mary	Esposito Lyde Foster	230-01.00-171.00	
Sussex, De	277 Bay Ave, Milford, De 19963-4909	Mcspadden William H Margaret M	Lewis Warren D Mcspadden	230-01.00-172.00	
Sussex, De	277 Bay Ave, Milford, De 19963-4909	Mcspadden William H Margaret M	Lewis Warren D Mcspadden	230-01.00-173.00	
Sussex, De	271 Bay Ave, Milford, De 19963	Mcspadden Willia H Margaret M	Lewis Warren D Mcspadden	230-01.00-174.00	
Sussex, De	267 Bay Ave, Milford, De 19963-4909	Sipple Howard L Jr & Louise G		230-01.00-175.00	
Sussex, De	265 Bay Ave, Milford, De 19963-4909	Noplock Marie		230-01.00-176.00	
Sussex, De	263 Bay Ave, Milford, De 19963-4909	Hargrove John R Wilbur F Hagrove		230-01.00-177.00	
Sussex, De	261 Bay Ave, Milford, De 19963-4909	Wilson Barbara		230-01.00-178.00	
Sussex, De	257 Bay Ave, Milford, De 19963-4909	Desfosse-mcneela Nancy W		230-04.00-1.01	
Sussex, De	255 Bay Ave, Milford, De 19963	Cannon, Wendy L		230-04.00-2.01	p/o Lot 1
Sussex, De	253 Bay Ave, Milford, De 19963	Carroll, Gerald G	Carroll, Margaret E	230-04.00-2.00	
Sussex, De	251 Bay Ave, Milford, De 19963	Suchoboky, Peter S	Woerle-Suchoboky, Carol	230-04.00-4.00	
Sussex, De	249 Bay Ave, Milford, De 19963	Moulton, Debra S		230-04.00-5.00	
Sussex, De	247 Bay Ave, Milford, De 19963	Lanier, Ivan Veron	Luz, Eneida Bonilla	230-04.00-6.00	
Sussex, De	247 Bay Ave, Milford, De 19963	Lanier, Ivan Veron	Luz, Eneida Bonilla	230-04.00-7.00	
Sussex, De	241 Bay Ave, Milford, De 19963	Black, Joseph E	Black, Catherine K	230-04.00-8.00	
Sussex, De	237 Bay Ave, Milford, De 19963-4909	White, James L	Ethel M	230-04.00-9.00	
Sussex, De	235 Bay Ave, Milford, De 19963	Bradley, Phillip T	Bradley, Fran W	230-04.00-10.00	
Sussex, De	233 Bay Ave, Milford, De 19963	Mary Berk Jordan, Trustee		230-04.00-11.00	
Sussex, De	231 Bay Ave, Milford, De 19963	Massella, Ralph A		230-04.00-12.00	
Sussex, De	229 Bay Ave, Milford, De 19963-4909	Williams Ann		230-04.00-13.00	
Sussex, De	227 Bay Ave, Milford, De 19963-4909	Daviratanasilpa Svastijaya		230-04.00-14.00	
Sussex, De	225 Bay Ave, Milford, De 19963-4909	Wrzesnieski Charles		230-04.00-15.00	
Sussex, De	223 Bay Ave, Milford, De 19963-4909	Anderson Roy & Pam		230-04.00-16.00	
Sussex, De	219 Bay Ave, Milford, De 19963-4909	Hummer Paul M	Hubbell Lynda	230-04.00-17.00	
Sussex, De	217 Bay Ave, Milford, De 19963-4909	Evans Donald E		230-04.00-18.00	
Sussex, De	215 Bay Ave, Milford, De 19963-4909	Haines Donna M		230-04.00-19.00	
Sussex, De	213 Bay Ave, Milford, De 19963-4909	Linburg Joel L & Tina M		230-04.00-20.00	
Sussex, De	None, Milford, De 19963	Moore Norman Walter Jr		230-04.00-21.00	
Sussex, De	207 Bay Ave, Milford, De 19963	Marker Thomas & Andrea		230-04.00-22.00	
Sussex, De	207 Bay Ave, Milford, De 19963	Smith Wilbur O & Marjorie M		230-04.00-23.00	
Sussex, De	None, Milford, De 19963	Smith Wilbur O & Marjorie M		230-04.00-24.00	
Sussex, De	201 Bay Ave, Milford, De 19963-4909	Gilchrist Darrin	Webster Stephanie	230-04.00-25.00	

Sussex, De	201 Bay Ave, Milford, De 19963-4909	Jordon William Mark	Jordan Sharon Heller	230-04.00-26.00
Sussex, De	199 Bay Ave, Milford, De 19963	Depasquale Joseph & Catherine		230-04.00-27.00
Sussex, De	195 Bay Ave, Milford, De 19963	Bunting Lucinda K (te)		230-04.00-27.01
Sussex, De	195 Bay Ave, Milford, De 19963	White Thomas M & Linda B		230-04.00-27.02
Sussex, De	None, Milford, De 19963	Wells Dawn H Michael W Lankford		230-04.00-28.00
Sussex, De	None, Milford, De 19963	Serafin Edward W	Orzo Loretta	230-04.00-35.00
Sussex, De	117 Isaacs Shore Dr, Milford, De 19963-4930	Maupin Michael	Debaptiste Lela	230-04.00-36.00
Sussex, De	None, Milford, De 19963	Wells Mark J & Kellei S		230-04.00-39.00
Sussex, De	121 Isaacs Shore Dr, Milford, De 19963-4930	Ramos Carole A	Catanzariti Patricia Ann	230-04.00-40.00
Sussex, De	None, Milford, De 19963	Pepper Howard I	Wells Mark	230-04.00-42.00
Sussex, De	123 Isaacs Shore Dr, Milford, De 19963-4930	Krause William L	Barag Ellen M	230-04.00-43.00
Sussex, De	None, Milford, De 19963	Myers Cheryl C	Schaefer Pamela	230-04.00-44.00
Sussex, De	None, Milford, De 19963	Leese Larry E (te)		230-04.00-45.00
Sussex, De	None, Milford, De 19963	Leese Larry E (te)		230-04.00-46.00
Sussex, De	None, Milford, De 19963	Krause William L	Barag Ellen M	230-04.00-53.00
Streetend	South Delaware Avenue	Between Parcels 147 and 148		
Streetend	Cedar Avenue	Between Parcels 152 and 153		
Streetend	Sussex Avenue	Between Parcels 159 and 160		
Streetend	Maryland Avenue	Between Parcels 165 and 166		
Streetend	Virginia Avenue	Between Parcels 178 amd 1.01		

PERPETUAL ROAD EASEMENT REQUIRED FOR O&M ACCESS

Sandpiper Street

Total Parcels Required: **107**

Perpetual HSDR: 106

Perpetual Road: 1

Owned by State of Delaware

Parcel Already Covered by Easement

PRIME HOOK BEACH

County Name	Situs Address Full	Owner 1	Owner 2	APN
Sussex, De	9672 Shore Dr, Milford, De 19963	United States Of America		230-17.00-218.00
Sussex, De	8907 Shore Dr, Milford, De 19963-4612	Dilts Deborah L		230-10.00-1.00
Sussex, De	None - Roadbed and Access Point, Milton, De 19968	Wayne Jones Memorial Association	Portion of 10' Walkway Along Dune	230-10.00-18.00
Sussex, De	VACANT Milton, De 19968	Peacock Ronald W & Sharon M		230-10.00-2.00
Sussex, De	8923 Shore Dr, Milford, De 19963-4612	Weiner Richard E & Robin G		230-10.00-2.01
Sussex, De	8931 Shore Dr, Milford, De 19963-4612	Elmendorf David & Roshanak		230-10.00-3.00
Sussex, De	8939 Shore Dr, Milford, De 19963-4612	Cavalieri Trust	Cavalieri Albert P (te)	230-10.00-4.00
Sussex, De	8947 Shore Dr, Milford, De 19963-4612	Ruf Dave George Iii		230-10.00-5.00
Sussex, De	8953 Shore Dr, Milford, De 19963-4612	Waters Patrick F & Mary L		230-10.00-6.00
Sussex, De	8961 Shore Dr, Milford, De 19963-4612	Grzybowski Catherine A		230-10.00-7.00
Sussex, De	8969 Shore Dr, Milford, De 19963	Grzybowski Catherine		230-10.00-8.00
Sussex, De	8969 Shore Dr, Milford, De 19963	Skaf Rabih S & Dorothy W		230-17.00-1.00
Sussex, De	8979 Shore Dr, Milford, De 19963-4612	Krueger Brandon D		230-17.00-2.00
Sussex, De	None Given, Adjacent to Lot 3.01, Milton, De 19968	Larimore Robert W & Rose M		230-17.00-3.00
Sussex, De	8987 Shore Dr, Milford, De 19963-4612	Larimore Robert W & Rose M		230-17.00-3.01
Sussex, De	8999 Shore Dr, Milford, De 19963-4612	Huffman Lucy & Richard		230-17.00-4.00
Sussex, De	9005 Shore Dr, Milford, De 19963	Shalhoub Donald G		230-17.00-5.00
Sussex, De	9019 Shore Dr, Milford, De 19963-4611	Prather Dennis W		230-17.00-6.00
Sussex, De	9025 Shore Dr, Milford, De 19963-4611	Vandegrift Barbara P		230-17.00-8.00
Sussex, De	9033 Shore Dr, Milford, De 19963-4611	Morris Robert J & Mary K		230-17.00-9.00
Sussex, De	VACANT Milton, De 19968	M L Wilson Family Limited Partnership		230-17.00-10.00
Sussex, De	9043 Shore Dr, Milford, De 19963	M L Wilson Family Limited Partnership		230-17.00-11.00
Sussex, De	9047 Shore Dr, Milford, De 19963-4611	Miller William E & Lucinda K		230-17.00-12.00
Sussex, De	9053 Shore Dr, Milford, De 19963-4611	Korb Thomas E	Korb Barbara G	230-17.00-13.00
Sussex, De	9057 Shore Dr, Milford, De 19963-4611	Braverman Burt A	Kathleen Meredith	230-17.00-14.00
Sussex, De	9069 Shore Dr, Milford, De 19963-4610	James Daniel V Jr & Barbara E		230-17.00-15.00
Sussex, De	9073 Shore Dr, Milford, De 19963-4610	Hadaegh Behrouz	Velasco Sonya	230-17.00-16.00
Sussex, De	9083 Shore Dr, Milford, De 19963-4610	Chirtea Cynthia Rieger (te)		230-17.00-18.00
Sussex, De	9087 Shore Dr, Milford, De 19963-4610	Devore Terri T (te)		230-17.00-19.00
Sussex, De	9093 Shore Dr, Milford, De 19963-4610	Lynch Allan C Jr		230-17.00-20.00
Sussex, De	VACANT Milton, De 19968	Storm David H		230-17.00-21.00
Sussex, De	VACANT Milton, De 19968	Storm David H & Dean H		230-17.00-22.00
Sussex, De	9107 Shore Dr, Milford, De 19963-4609	Storm David H & Dean H		230-17.00-23.00
Sussex, De	9113 Shore Dr, Milford, De 19963-4609	Fletcher Bonnie D		230-17.00-24.00
Sussex, De	9117 Shore Dr, Milford, De 19963-4609	Haslup Louis S & Dawn L		230-17.00-25.00
Sussex, De	9123 Shore Dr, Milford, De 19963-4609	Sabo William J (te) & Antonette M (te)		230-17.00-26.00
Sussex, De	9127 Shore Dr, Milford, De 19963-4609	Hoff James G & Melanie S		230-17.00-27.00
Sussex, De	9133 Shore Dr, Milford, De 19963-4609	Harrie Karen P		230-17.00-28.00
Sussex, De	9137 Shore Dr, Milford, De 19963-4609	Capasso Richard C & Elizabeth A		230-17.00-29.00
Sussex, De	9143 Shore Dr, Milford, De 19963-4609	Guidry Philip N	Crossgates Darlene J	230-17.00-30.00
Sussex, De	9147 Shore Dr, Milford, De 19963-4609	Lofland Doris Peters (te)		230-17.00-31.00
Sussex, De	9165 Shore Dr, Milford, De 19963-4608	Rogers Richard A (te)	Chrisitne Ann Rogers	230-17.00-34.01

Sussex, De	9365 Shore Dr, Milford, De 19963	Dziengelski Thomas J & Barbara B		230-17.00-71.00
Sussex, De	9813 Shore Dr, Milford, De 19963	Hallett Robert Lee Iii & Eileen A		230-17.00-80.00
Sussex, De	9819 Shore Dr, Milford, De 19963-4601	Thien Paul A	Warriner Edward Douglas	230-17.00-81.00
Sussex, De	9825 Shore Dr, Milford, De 19963	Lilly Barbara J		230-17.00-82.00
Sussex, De	9829 Shore Dr, Milford, De 19963-4601	Aloi Eric J		230-17.00-82.01
Sussex, De	9861 Shore Dr, Milford, De 19963	Solanki Indukumar M		230-17.00-83.00
Sussex, De	9593 Shore Dr, Milford, De 19963-4655	Marcocci Carmen P	Vanderbeek Betty J	230-17.00-84.00
Sussex, De	9579 Shore Dr, Milford, De 19963-4655	Tarburton John F & Mary M		230-17.00-85.00
Sussex, De	9961 Shore Dr, Milford, De 19963	Lankford Hilda I W William H & Craig Allen		230-17.00-86.00
Sussex, De	9561 Bay Shore Dr, Milford, De 19963-4637	Sockolosky Joseph G Martha M &	Sockolosky Joseph G Jr	230-17.00-87.00
Sussex, De	9899 Bay Shore Dr, Milford, De 19963	Haggert Carl L & Nancy D		230-17.00-88.00
Sussex, De	9903 Bay Shore Dr, Milford, De 19963-4621	Ignatowicz Walter W & Mary Ann		230-17.00-88.01
Sussex, De	9893 Shore Dr, Milford, De 19963	Campanelli Carmen D (te) & Karyn K (te)		230-17.00-88.02
Sussex, De	VACANT, Milton, De 19968	Muncy Carolyn Elaine (te)		230-17.00-223.00
Sussex, De	VACANT, Milton, De 19968	Jones Theodore W		230-17.00-223.03
Sussex, De	29265 Clifton Shores Dr, Milford, De 19963-4659	Packard Dean A & Darian		230-17.00-224.00
Sussex, De	29275 Clifton Shores Dr, Milford, De 19963-4659	Curtis Barbara A	Binghi Lisa	230-17.00-241.00
Sussex, De	VACANT, 29287 Clifton Shores Dr, Milford, De 19963	Graham Ethel C (te)		230-17.00-242.00
Sussex, De	VACANT, 29301 Clifton Shores Dr, Milford, De 19963	Bryan Carlyn C & Ray J		230-17.00-243.00
Sussex, De	VACANT, 29315 Clifton Shores Dr, Milford, De 19963	Rhue E Brent (te) & Nancy C (te)		230-17.00-244.00
Sussex, De	VACANT, 29331 Clifton Shores Dr, Milford, De 19963	Ritter Eleanor Clifton		230-17.00-245.00
Streetend	Between Parcels 5 and 6			
Streetend	Between Parcels 14 and 15			
Streetend	Between Parcels 82.01 and 83			
Streetend	Bewteen Parcels 86 and 87			

PERPETUAL ROAD EASEMENT REQUIRED FOR O&M ACCESS

Sussex, De	None - Roadbed and Access Point, Milton, De 19968	Wayne Jones Memorial Association	Road Portion at End of Shore Drive	230-10.00-18.00

Total Parcels Required: **68**
Perpetual HSDR: 67
Perpetual Road: 1

Owned by State of Delaware
Parcel Already Covered by Easement

LEWES

County Name	Situs Address Full	Owner 1	Owner 2	APN
Sussex, De	Beachfront, Lewes, De 19958	City of Lewes		335-04.20-01.00

Owned by State of Delaware

Parcel Already Covered by Easement

Delaware DMU
Pickering Beach

2-00-08802-02-1300-00001
2-00-08802-02-1700-00001
2-00-08802-02-1200-00001
2-00-08802-02-1700-00001
2-00-08802-02-1700-00001
2-00-08802-02-1100-00001
2-00-08802-02-1000-00001
2-00-08802-02-1700-00001
2-00-08802-02-0900-00001
2-00-08802-02-0800-00001
2-00-08802-02-0700-00001
2-00-08802-02-0600-00001
2-00-08800-01-1200-00001
2-00-08802-02-0500-00001
2-00-08802-02-1700-00001
2-00-08800-01-1300-00001
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2-00-08802-03-2400-00001
2-00-08800-01-1200-00001
2-00-08800-01-1300-00001
Road Access

N

200 100 0 200 Feet

EXHIBIT B

Delaware DMU
Kitts Hummock Beach


Delaware DMU
North Bowers Beach
N
200 100 0 200 Feet

Delaware DMU
South Bowers Beach

8-01-11517-02-2200-00001
8-01-11517-02-5400-00001
8-01-11517-02-6300-00001
8-01-11517-02-6800-00001
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140 70 0 140 Feet

Delaware DMU
Slaughter Beach 1 of 5

330-5.00-41.00
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N

200 100 0 200 Feet

Delaware DMU
Slaughter Beach 2 of 5

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N

200 100 0 200 Feet

Delaware DMU
Slaughter Beach 3 of 5

Delaware DMU
Slaughter Beach 4 of 5

N

200 100 0 200 Feet

Delaware DMU
Slaughter Beach 5 of 5

230-4.00-7.00
230-4.00-8.00
230-4.00-9.00
230-4.00-10.00
230-4.00-11.00
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230-9.00-1.00

N

200 100 0 200 Feet

Delaware DMU
Prime Hook Beach 1 of 2

230-17.00-218.00
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230-10.00-1.00
230-10.00-2.00
230-10.00-2.01
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230-17.00-195.00
230-17.00-44.00

N

200 100 0 200 Feet

Delaware DMU
Prime Hook Beach 2 of 2

N

200 100 0 200 Feet

Delaware DMU
Lewes Beach 1 of 3

N

200 100 0 200 Feet

Delaware DMU
Lewes Beach 2 of 3

Delaware DMU
Lewes Beach 3 of 3

DEPARTMENT OF THE ARMY
BALTIMORE DISTRICT, CORPS OF ENGINEERS
2 HOPKINS PLAZA
BALTIMORE, MARYLAND 21201

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CENAB-OC 2 February 2018

MEMORANDUM THRU Division Counsel, North Atlantic Division, CENAD-OC (ATTN: Ms. Maureen McAndrew), 301 General Lee Avenue, Brooklyn, New York 11252

FOR HQUSACE, CECC-R (ATTN: Ms. Michaele Mandulak), 441 G Street NW, Washington, DC 20314

SUBJECT: Legal Opinion on the Use of Federal Navigation Servitude for Coastal Storm Damage Reduction Projects at seven locations along the Delaware Bay pursuant to the Delaware Beneficial Use of Dredged Material for the Delaware Feasibility Study

1. Reference:

a. CECC-R Memorandum, Subject: “Availability of the Navigation Servitude for Coastal Storm Damage Reduction Projects,” 19 March 2014

b. CECC-R Bulletin 14-5, Subject, “Availability of the Navigation Servitude for Coastal Storm Damage Reduction Projects”, 9 April 2014

c. Draft Feasibility Report entitled “Delaware Beneficial Use of Dredged Material for the Delaware Feasibility Study,” enclosed.

2. Background: In the opinion listed as reference 1.a, this agency established a new standard and process regarding USACE assertion of the navigation servitude for coastal storm damage reduction projects nationwide. The referenced opinion requires the same analyses when considering whether the navigation servitude exists on coastal storm damage reduction projects as the agency would apply for an ecosystem restoration project; i.e. district counsel must render a legal opinion whether the project has a nexus to navigation sufficient to assert the servitude. Reference 1.b further indicates that all such determinations may be Nationally Significant, so all such district opinions should be forwarded to the Real Estate Law Section of the Office of the Chief Counsel though Division Counsel for concurrence.

EXHIBIT C

3. Purpose of this Memo: The purpose of this memo is to provide the required district legal opinion on whether the doctrine of the federal navigation servitude can be asserted with respect to real estate necessary to construct, operate, and maintain a coastal storm damage reduction project located at seven locations along the Delaware Bay.

4. Summary of Project: This Coastal Storm Damage Reduction (CSDR) feasibility study is conducted in accordance with an October 2005 Senate Resolution and Disaster Relief Appropriations Act PL 113-2, and its associated reports, which together directed the USACE to formulate plans for CSRM via the beneficial use of dredged material.

The initial study authority for the Delaware Dredged Material Utilization (DMU) study is the 26 October 2005 resolution of the Committee on Environmental and Public Works of the United States Senate. The resolution requested a review of the possible beneficial use of dredged material from the Delaware River – Philadelphia to Trenton and Philadelphia to the Sea Federal Navigation Projects for uses including ecosystem restoration, navigation, stream restoration, sediment management, landfill cover material, and other allied purposes. Upon initiation of the study, Coastal Storm Risk Management (CSRM) was identified as an “other allied purpose” to be considered for the beneficial use of dredged material.

Partially in response to Hurricane Sandy, the passage of PL 113-2 mandated a CSRM feasibility study for the subject study area. The Delaware River Dredged Material Beneficial Utilization Study (DMU) State of Delaware Study Area report was identified as an “ongoing study” in the Second Interim Report of the Disaster Relief Appropriations Act (PL 113-2). PL 113-2 directed USACE to conduct a comprehensive study to address the flood risks of vulnerable populations in areas that were affected by Hurricane Sandy within the boundaries of the North Atlantic Division. The North Atlantic Coast Comprehensive Study (NACCS) identified the Delaware Bay shoreline and the Delaware Inland Bays as high risk areas requiring additional analysis.

The purpose of the feasibility report is to analyze CSRM issues in various Delaware communities with the intent to beneficially use dredged material. The report should present the findings of a feasibility investigation and recommend a solution to identified CSRM problems at various Delaware communities. The study investigates the feasibility of addressing CSRM problems via the beneficial use of dredged material. The areas studied were subjected to Cycle 1 and Cycle 2 screening. Cycle 1 screening was used to confirm that CSRM was the primary problem and dredged material was a feasible measure. Areas not meeting those criterial were screened out. In Cycle 2 screening, the measures were compared against planning objectives to screen out areas which were not in line with the study purpose.

As described in reference 1.c, the recommended plan consists of placing dredged material from the federal navigation channel to construct a coastal storm damage reduction project which involves the creation of dunes and/or berms (beachfill) at seven (7) selected areas. The proposed CSDR project area spans approximately 29 miles and includes seven locations along the Delaware Bay including Pickering Beach, Kitts Hummock, Bowers Beach, South Bowers Beach, Slaughter Beach, Prime Hook Beach and Lewes, Delaware. (An 8th location, Big Stone Beach, was considered for CSDR but is not proposed at this time.) Currently, the proposed 4-year periodic renourishment cycle for the project area is in line with the proposed 4-year operations and maintenance dredging cycle performed in Lower Reach E. Lower Reach E consists of Miah Maull and Brandywine reaches of the Delaware Bay main federal channel which are located in New Jersey. A real estate plan (REP) is required for the study feasibility report. One of the items required for the REP is a legal determination as to the applicability of navigation servitude to this project.

5. Navigation Nexus Analysis: As stated above, the material that will be used for this coastal storm risk management will be dredged from the Delaware River, Philadelphia to the Sea, federal navigation project. The existing project was authorized in 1910 (HD 733, 61st Cong., 2nd Session) and modified in 1930 (HD 304, 71st Cong., 3rd Session); 1935 (R&H Comm. Doc 5, 73rd Cong., 1st Session); 1938 (SD 159, 75th Cong., 3rd Session); 1945 (HD 580, 76th Cong., 3rd Session and HD 340, 77th Cong., 1st Session); 1954 (HD 358, 83rd Cong., 2nd Session) and 1958 (HD 185, 85th Cong., 1st Session). The navigation project channel dimensions are 40' deep, and 400' to 1000' wide. Dredging within that project presents the classic application of the navigation servitude.

The balance of this discussion will be for the placement of the dredged material for the coastal storm risk management project. The non-Federal sponsor for the proposed CSRM project is the State of Delaware, Department of Natural Resources. The real estate required for the construction phase and the operation and maintenance phase may include real estate interests below mean low water (MLW); real estate interests between MLW and mean high water (MHW); and real estate interests above MHW. (Because the proposed beachfill will consist of dredged material drawn from the federal channel, there are no borrow areas and therefore, no real estate is required for borrow activities.)

For both the construction and operation and maintenance phases, any lands on the Delaware side of the Delaware Bay below MLW are owned by the State of Delaware pursuant to the Submerged Lands Act 43 U.S. Code § 1301 et seq. and in accordance with *New Jersey v. Delaware*, 552 U.S. 597 (2008). This means that any portion of the proposed placement area (berm and beachfill) below MLW are owned by the non-Federal Sponsor and therefore no additional real estate is required for those areas.

For areas above MLW and below mean high water MHW an analysis is required of whether those areas are subject to the federal navigation servitude. To the extent that References 1.a and 1.b now require that a navigation nexus be demonstrated in order for the USACE to assert that the no compensation rule under the federal navigation servitude exists for a particular coastal storm damage reduction project, the proposed project does have that nexus to navigation. Although the purpose of the project is prevention of storm damage to the subject coastal communities (and not the prevention of damages to navigation interests), the use of the dredged material from the federal navigation channel provides a nexus to navigation. Although not quantified, there is some benefit to the interests of navigation (e.g. advance maintenance dredging) from using dredged material from the federal channel for this project.

Mildenberger v. U.S., 91 Fed. Cl. 217 at 247-53, *aff'd* 643 F.3d 938, in rejecting what is referred to as a false dichotomy between project elements that served a flood control purpose versus a navigation purpose, sustained the applicability of the servitude to the entire project where there was some evidence that a navigation interest was advanced by some aspect of the project. ("The federal navigation servitude, shielding government from riparian takings claims, applies if the governmental project bears any substantial relation to navigation; there is no requirement that navigation be the sole, or even the principal, purpose of the challenged public project.") Such is the case with the proposed project, and therefore the project could be constructed asserting the Navigation Servitude on those land interests.

Having concluded that the navigation servitude applies to submerged lands below the MHW for the construction of the proposed project, we must turn to the non-Federal sponsor's responsibilities (after they sign a PPA) to operate and maintain the project after construction. Reference 1.a, Paragraph 3.f, asserts the agency position that navigation servitude rights are not transferrable to the sponsor. Therefore, Delaware must demonstrate that they have the necessary property interests above MLW to operate and maintain the proposed project area, including the dunes and/or berms (beachfill) created by this project.

6. Recommendation and Opinion: It is the district opinion that navigation servitude may be invoked for construction of the proposed coastal storm damage reduction project, in utilization of the federal channel to be dredged, and in the CSRM footprint below MHW. However, the non-Federal sponsor will need to ensure they have the necessary property interests and rights to police and maintain the dunes and/or berms (beachfill) created with this project. USACE concurrence for utilization of navigation servitude for the submerged lands necessary for construction of the proposed project is requested, with the understanding that the State of Delaware already possesses those rights to a large extent and, if not, the State of Delaware must obtain any additional rights that are needed in order to operate and maintain the completed project.

7. Any questions may be directed to the undersigned at (410) 962-2528, or Craig Homesley, CENAB-RE Chief, Civil/IIS Projects Support Branch, at (410) 962-4944.

2/2/2018

X Patricia M. Ryan

Signed by: RYAN.PATRICIA.M.1259037626

PATRICIA M. RYAN
Assistant District Counsel

CF:
District Counsel, Philadelphia District, CENAP-OC (ATTN: Mr. John Kasbar), 100 Penn Square East, Philadelphia, Pennsylvania 19107
Chief, Civil/IIS Projects Support Branch, CENAB-RE (ATTN: Craig Homesley)

Feasibility Study Cost Estimate-MCACES Format
Real Estate Acquisition Requirements
Delaware River Dredged Material Beneficial Utilitzation Study (DMU), State of Delaware Study Area
Sussex and Kent Counties, Delaware
Exhibit D

	Private			Commercial			Public			Requirement		
	#	$/per	req	#	$/per	req	#	$/per	req	Base	Contingency	Total
0102------- ACQUISITIONS												
010201--- By Government												
010202--- By Non-Federal Sponsor (NFS)												
01020201 Survey and Legal Descriptions	194	750	145,500	0		0	15	750	11,250	156,750	31,350	188,100
01020102 Title Evidence	194	900	174,600	0		0	15	900	13,500	188,100	37,620	225,720
01020203 Negotiations	195	1,200	234,000	0		0	15	1,200	18,000	252,000	50,400	302,400
010203--- By Government on Behalf of NFS												
010204--- Review of NFS												
01020401 Survey and Legal Descriptions	194	150	29,100	0		0	15	150	2,250	31,350	6,270	37,620
01020402 Title Evidence	194	150	29,100	0		0	15	150	2,250	31,350	6,270	37,620
01020403 Negotiations	194	150	29,100	0		0	15	150	2,250	31,350	6,270	37,620
SUBTOTAL										690,900	138,180	829,080
0103------- CONDEMNATIONS												
010301--- By Government												
010302--- By Non-Federal Sponsor (NFS)	25	7,500	187,500	0		0	0		0	187,500	93,750	281,250
010303--- By Government on Behalf of NFS												
010304--- Review of NFS	25	2,000	50,000	0		0	0		0	50,000	25,000	75,000
SUBTOTAL										237,500	118,750	356,250
0105------- APPRAISALS												
010501--- By Government												
010502--- By Non-Federal Sponsor (NFS)	194	3,000	582,000	0		0	15	3,000	45,000	627,000	313,500	940,500
010503--- By Government on Behalf of NFS												
010504--- Review of NFS	194	500	97,000	0		0	15	500	7,500	104,500	52,250	156,750
SUBTOTAL										731,500	365,750	1,097,250
0106------- PL 91-646 ASSISTANCE												
010601--- By Government												
010602--- By Non-Federal Sponsor (NFS)			0			0			0	0	0	0
010603--- By Government on Behalf of NFS												
010604--- Review of NFS	0		0	0		0	0		0	0	0	0
SUBTOTAL										0	0	0
0107------- TEMPORARY PERMITS/LICENSES/RIGHTS-OF-WAY												
010701--- By Government			0			0			0	0	0	0
010702--- By Non-Federal Sponsor (NFS)			0			0			0	0	0	0
010703--- By Government on Behalf of NFS			0			0			0	0	0	0
010704--- Review of NFS	0		0	0		0	0		0	0	0	0
010705--- Other			0			0			0	0	0	0
010706--- Damage Claims			0			0			0	0	0	0
SUBTOTAL										0	0	0
0115------- REAL ESTATE PAYMENTS												
011501--- Land Payments												
01150101 By Government										0	0	0
01150102 By Non-Federal Sponsor (NFS)			8,242,194						0	8,242,194	4,121,097	12,363,291
01150103 By Government on Behalf of NFS										0	0	0
01150104 Review of NFS	194	500	97,000				15	500	7,500	104,500	52,250	156,750
011502--- PL 91-646 Assistance Payments										0	0	0
01150201 By Government										0	0	0
01150202 By Non-Federal Sponsor (NFS)										0	0	0
01150203 By Government on Behalf of NFS										0	0	0
01150204 Review of NFS										0	0	0
011503--- Damage Payments										0	0	0
01150301 By Government										0	0	0
01150302 By Non-Federal Sponsor (NFS)			1,647,806							1,647,806	823,903	2,471,709
01150303 By Government on Behalf of NFS										0	0	0
01150304 Review of NFS										0	0	0
SUBTOTAL										9,994,500	4,997,250	14,991,750
Account 02 Facility/Utility Relocations (Construction cost only)											0	0
TOTAL LERRD										**$11,654,400**	**$5,619,930**	**$17,274,330**

EXHIBIT D

ASSESSMENT OF NON-FEDERAL SPONSOR'S
REAL ESTATE ACQUISITION CAPABILITY
DELAWARE RIVER DREDGED MATERIAL BENEFICIAL UTILIZATION STUDY (DMU)
STATE OF DELAWARE STUDY AREA
SUSSEX AND KENT COUNTIES, DELAWARE

1. Legal Authority

a. Does the sponsor have legal authority to acquire and hold title to real property for project purposes?

Yes.

b. Does the sponsor have the power of eminent domain for this project?

Yes.

c. Does the sponsor have "quick-take" authority for this project?

Yes.

d. Are there any lands/interests in land required for the project located outside the sponsor's political boundary?

No.

e. Are any of the lands/interests in land required for the project owned by an entity whose property the sponsor cannot condemn?

Yes. Two of the project areas contain lands owned by the United States under the management of the United States Fish and Wildlife Service.

2. Human Resource Requirements:

a. Will the sponsor's in-house staff require training to become familiar with the real estate requirements of Federal projects including P.L. 91-646, as amended?

No.

b. If the answer to 2a is yes, has a reasonable plan been developed to provide such training?

N/A

EXHIBIT E

c. Does the sponsor's in-house staff have sufficient real estate acquisition experience to meet its responsibilities for the project?

Yes.

d. Is the sponsor's projected in-house staffing level sufficient considering its other workload, if any, and the project schedule?

Yes. Their acquisition team consists of four individuals performing the required property surveys and a three-person team preparing and distributing the necessary easements.

e. Can the sponsor obtain contractor support, if required, in a timely fashion?

Yes.

f. Will the sponsor likely request USACE assistance in acquiring real estate?

No.

3. Other Project Variables:

a. Will the sponsor's staff be located within reasonable proximity to the project site?

Yes.

b. Has the sponsor approved the project/real estate schedule/milestones?

Yes.

4. Overall Assessment:

a. Has the sponsor performed satisfactorily on other USACE projects?

Yes.

b. With regard to this project, the sponsor is anticipated to be: highly capable/fully capable/moderately capable/marginally capable/insufficiently capable?

Fully capable.

5. Coordination

a. Has this assessment been coordinated with the sponsor?

Yes.

b. Does the sponsor concur with this assessment?

Yes.

Prepared by:

SACHS.HEATHER.M.1228757663

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Heather Sachs
Realty Specialist

Reviewed and approved by:

HOMESLEY.CRAIG.R.1231317925

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Craig R. Homesley
Chief, Civil/IIS Projects Support Branch
Real Estate Division
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