
**Continuing Authorities Program
Section 111 Shore Damage Mitigation Project
Draft Detailed Project Report/Environmental
Assessment**

Mispillion Inlet, Milford, Sussex County, Delaware



**U.S. ARMY CORPS OF ENGINEERS
PHILADELPHIA DISTRICT
1650 ARCH STREET
PHILADELPHIA, PA 19103**

APRIL 2026



**US Army Corps
of Engineers®**
Philadelphia District



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DRAFT
FINDING OF NO SIGNIFICANT IMPACT
MITIGATION OF SHORE DAMAGE ATTRIBUTABLE TO NAVIGATION WORKS
(CONTINUING AUTHORITIES PROGRAM SECTION 111)
MISPELLION INLET, SUSSEX COUNTY, DELAWARE

The U.S. Army Corps of Engineers (USACE), Philadelphia District has prepared an Integrated Detailed Project Report/Environmental Assessment (DPR/EA) for the Shore Damage Mitigation Project, Mispillion Inlet, Milford, Sussex County, Delaware, in accordance with the National Environmental Policy Act of 1969, as amended. The draft IFR/EA addresses shoreline erosion and damages along the beaches adjacent to the Mispillion Inlet in Delaware from the construction of a USACE jetty associated with the Mispillion River Federal Navigation Project (Mispillion River Project). The study is authorized by Section 111, Rivers and Harbors Act (RHA) of 1968. Section 111 gives USACE the authority to investigate, study, plan, and implement measures (structural or nonstructural) to prevent or mitigate damage to shorelines attributable to Federal navigation projects.

The Tentatively Selected Plan (TSP) is a one-time beach nourishment (Alternative G). A 1,700-foot-long berm will be constructed with a width of 150 feet and a crest elevation of +5 feet, based on the North American Vertical Datum of 1988 (NAVD88). Approximately 80,500 cubic yards of truck hauled sand would be used for construction. It is estimated that the beach nourishment would have a longevity of 10 years. Longevity is defined here as the number of years before the beach conditions will have eroded back to the pre-project conditions and where a subsequent periodic nourishment operation would typically be required.

The study objectives are to:

- Develop a plan to mitigate for the shoreline erosion caused by the Mispillion River Project, which restores the shoreline to a reasonable condition through the 2030-2080 period of analysis.
- Restore habitat for threatened and endangered species to a reasonable condition, through the 2030-2080 period of analysis.
- Repair southern beaches and clean up the accumulation of debris and establishment of phragmites that collected due to the wave shadow effect of jetty, as a one time or O&M operation for the 2030-2080 period of analysis

A total of 10 alternatives, plus the “no action alternative” were considered. The purpose of a Section 111 project is to identify and recommend a justified level of work for the prevention or mitigation of damages attributed to Federal navigation works (EP 1105-2-58). The TSP is the least cost alternative to prevent damage to an existing navigation project. As the least-cost alternative that meets the project's purpose and need, the Beach Nourishment plan directly addresses the authority of Section 111. It provides a necessary level of protection to the federal channel, ensuring its continued viability and safe use. The plan is supported by the non-federal sponsor, Delaware Department of Natural Resources and Environmental Control (DNREC), and is considered the

most prudent and feasible solution. A summary assessment of the potential effects of TSP is listed in Table 1.

Table 1: Summary of Potential Effects of the TSP

	Insignificant effects	Insignificant effects as a result of mitigation	Resource unaffected by action
Aesthetics	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
Air quality	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Aquatic resources/wetlands	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Invasive species	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
Fish and wildlife habitat	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Threatened/Endangered species/critical habitat	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Historic properties	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
Other cultural resources	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
Floodplains	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Hazardous, toxic & radioactive waste	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
Hydrology	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Land use	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Navigation	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Noise levels	<input checked="" type="checkbox"/>	<input type="checkbox"/>	
Public infrastructure	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Socioeconomics	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Soils	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Tribal trust resources	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
Water quality	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Examples of BMPs USACE would implement to minimize impacts include:

- To avoid impacts, vessel mooring, pipeline, and heavy equipment would avoid areas of natural, stable/uneroded habitat in the salt marsh, dune, upper beach, and berm to the maximum extent possible. Additional measures can be taken to reduce impacts to these habitats, such as using marsh mats and cribbing.
- USACE would work with resource agencies to develop best management practices, to minimize the impact of construction and avoid areas of natural habitat (upper beach and berm) that have not been affected by erosion.
- Onshore habitat impacted during construction would be restored.
- Work would not be conducted from April 15 to August 30 to avoid impacts on horseshoe crabs, eggs, and larvae.
- To avoid impacts on anadromous species, in-water work would not take place from March 15 to May 31.
- To avoid impacts on American eels, in-stream work would not take place from March 1 to May 15.
- Seasonal restrictions (likely from mid-March to mid-September) would help to reduce entrainment of listed species from the intake to fluidize the quarry sand.
- While it is assumed that most mobile species such as sturgeons and sea turtles would be able to avoid the temporary sea water intake, it would be appropriately screened to avoid entrainment of larger species such as sturgeon or sea turtles.
- To avoid adverse impacts to the red knots activity during a critical stage of their migration, no work would occur from April 15 to June 7.
- Seasonal restriction from March 15 to September 15 for construction activities would help to avoid adverse impacts to the American oystercatchers.
- Although there is no current legislation for the protection of diamondback terrapin nesting habitat, the following BMPs would be considered to ensure the protection and continuation of the species:
 - Sandy areas above the high tide line would be avoided to the maximum extent possible.
 - If possible, proposed construction would avoid nesting season (between mid-May to mid-July), if nesting season cannot be avoided, the following measures could be implemented to minimize impacts: 1) place secure opaque fencing around the work area to exclude nesting females or alternatively 2) have a biologist on site throughout the project to deter nesting terrapins from using the work area.
 - If any work occurs when hatchlings typically emerge from nests in late summer (early-August to mid-September) or when those that over-wintered in the nest are likely to emerge (mid-March to end of May), a biologist could be on site during spoil placement to guide emerging hatchlings out of the work area.
- While the material placement would change the size and slope of the berm, it is meant to mimic and restore natural conditions, to the maximum extent practicable, in an area that was eroded due to the Federal navigation project. Additionally, while the sand will be truck-hauled material will be compatible with existing sand. Details of the slope and grain size will be developed during the design phase.

Public review of the draft IFR/EA and FONSI is being conducted. All comments submitted during the public review period will be considered in the Final EA and included in the Correspondence Appendix.

The Coastal Barrier Resources Act (CBRA) of 1982 prevents most new federal expenditures in protected areas. There are two CBRS units in the study area. The TSP is consistent with the CBRA general exception that allows for stabilization projects for fish and wildlife resources and habitats (16 U.S.C. 3501(b)) and nonstructural projects for shoreline stabilization that are designed to mimic, enhance, or restore a natural stabilization system (16 U.S.C. 3505(a)(6)(G)). USACE is conducting CBRA consultation with U.S. Fish and Wildlife Service (USFWS) to confirm that the TSP is consistent with the exception under CBRA.

Under the Clean Air Act, Sussex County is in marginal nonattainment for the 2008 8-hour ozone Standard (primary and secondary). Kent and Sussex Counties are in attainment for all other priority pollutants. The Record of Non-Applicability is being coordinated with the USEPA and DNREC for their review to confirm compliance with Section 309 of the Clean Air Act.

Pursuant to the Clean Water Act (CWA) of 1972, as amended, the discharge of dredged or fill material associated with the TSP has been found to be compliant with section 404(b)(1) Guidelines (40 CFR 230).

Under the TSP, all state water quality standards will be met. USACE is requesting a DNREC water quality certification pursuant to CWA Section 401.

USACE has determined that the TSP is consistent, to the maximum extent practicable, with the enforceable policies of the Delaware Coastal Management Program.

Pursuant to Section 7 of the Endangered Species Act (ESA) of 1973, as amended, the Corps determined that the TSP plan may affect but is not likely to adversely affect the federally listed species or their designated critical habitat. USACE is conducting ESA Section 7 consultation with USFWS and National Marine Fisheries Service (NMFS).

Coordination with USFWS and NMFS under Fish and Wildlife Coordination Act (FWCA) will be ongoing through the completion of the IFR/EA and construction.

Pursuant to Section 305 (b)(2) of the Magnuson-Stevens Fishery Conservation & Management Act (MSA), USACE has prepared an Essential Fish Habitat (EFH) Assessment and is coordinating it with NMFS for their review.

Pursuant to Section 106 of the National Historic Preservation Act (NHPA) of 1966, as amended, the Corps determined that the restoration project would have no effect on historic properties. Full compliance will be achieved upon review and concurrence of a “no effect” determination by the Delaware State Historic Preservation Office (DESHPO).

No compensatory mitigation is required as part of the TSP.

All applicable environmental laws have been considered and coordination with appropriate agencies and officials will be completed following review of the draft Environmental Assessment. Based on this draft Environmental Assessment, the upcoming reviews by other federal, state and local agencies, Tribes, input of the public, and the review by my staff, it is my determination that the preferred plan would not cause significant adverse effects on the quality of the human environment; therefore, preparation of an Environmental Impact Statement is not required.

Date

Ryan A. Baum
Lieutenant Colonel, Corps of Engineers
District Commander

Mitigation of Shore Damage Attributable to Navigation Works (SECTION 111) an Integrated Detailed Project Report

Executive Summary

ES.1 Introduction

The draft detailed project report and environmental assessment (DPR/EA) addresses shoreline erosion and damages along the beaches adjacent to the Mispillion Inlet in Delaware from the construction of a U.S. Army Corps of Engineers (USACE) jetty associated with the Mispillion River Federal Navigation Project (Mispillion River Project). The study is authorized by Section 111, Rivers and Harbors Act (RHA) of 1968. Section 111 gives USACE the authority to investigate, study, plan, and implement measures (structural or nonstructural) to prevent or mitigate damage to shorelines attributable to Federal navigation projects.

The Federal share of costs for any one project may not exceed \$15,000,000. Additionally, the costs of implementing measures must be shared in the same proportion as the cost-sharing provisions that were applicable to the Federal project causing the shore damage. In this case, construction of the Mispillion Inlet navigation project was funded at 100% Federal expense. The non-federal sponsor is the DNREC. The DRP study cost sharing is 100% federal. The Federal Interest Determination (FID) for this study was approved in January of 2021 by North Atlantic Division (NAD).

ES.2 Purpose and Need

The purpose of this study is to evaluate and address the impacts of the Mispillion Inlet jetty that was constructed by the USACE between 1893-1939.

The study is needed to develop solutions for the shoreline erosion north of Mispillion Inlet that occurred after the jetties at the northern and southern portions of the inlet were constructed. Without intervention the shorelines are expected to continue to erode, thereby increasing the risk of another breach along the shoreline north of Mispillion Inlet. Previous breaches in 1977, 1987, and 2009 allowed the Mispillion River to take a “short-cut” through the breach causing a reduction in tidal flows and velocities through Mispillion Inlet and increased shoaling. Due to the adverse impacts, the breaches were closed by the construction of a rock dike and subsequent repairs and extensions constructed by DNREC. A breach could potentially impact wetland and shorebird nesting, foraging, and resting habitat. Shoaling of Cedar Creek and Mispillion Inlet could potentially impede the operations of Delaware Launch Services, located on Cedar Creek. Delaware Launch Services is the only launch service that provides safe transport of personnel and supplies to tanker vessels anchored in Delaware Bay and the nearby Atlantic Ocean.

ES.3 Plan Formulation

The USACE follows the 6-step planning process as outlined in Engineering Regulation 1105-2-103). This process provides a structured approach to a plan recommendation which provides a framework for sound decision-making.

The plan formulation process in the initial part of the study consisted of identifying potential coastal storm risk management (CSRM) measures based upon the study problems and opportunities. Measures were evaluated in relation to the problems and opportunities, as well as the four planning criteria for effectiveness, efficiency, acceptability, and completeness. These management measures were then ranked and grouped into alternatives. The rank of each measure was based on their contributions to the problem/opportunity matrix combined with how well they scored against the four planning criteria. The “No Action” plan was also considered. The No Action plan provides no additional measures to provides no mitigating shoreline damage caused by the Mispillion River Federal Navigation Project or FNP. The No Action plan represents the future without project conditions against which alternative plans will be evaluated for economic purposes. No Action plan assumes no additional measures to provide flood risk management in the study area by local interests will be undertaken.

Section 111 studies do not require a traditional cost benefit economic analysis but rather support the least cost plan to restore the shoreline. Section 111 authorizes a justified level of work for prevention or mitigation of damages to both non-Federal public and privately owned shores to the extent that such damage can be directly identified and attributed to Federal navigation works. Works for prevention or mitigation of shore damages such as those caused by riverbank erosion or vessel generated wave wash cannot be addressed under this authority. The target degree of mitigation is the reduction of shore damage to the level which would have existed without the influence of navigation works at the time such navigation works were accepted as a federal responsibility. Section 111 does not authorize restoring shorelines to historic dimensions.

ES.4 Tentatively Selected Plan

Plan G is the Tentatively Selected Plan (TSP) for this Section 111 project. This plan integrates a beach nourishment component that strategically places sediment along the shoreline north of the rock dike. This approach of a one-time placement will provide a robust, and environmentally sensitive solution for mitigating coastal erosion and enhancing shoreline resilience. This report details the rationale for this selection and outlines the key features of Plan F.

This component involves the placement of approximately 80,500 cubic yards of compatible sand onto the existing beach. The sand will be trucked in from a local quarry and placed along the north end of the shoreline north of the jetties. The TSP includes a design berm width of 150 feet over 1,700 feet of shoreline with an additional 300-foot taper. This immediate influx of sediment will restore the beach to a wider, more protective configuration, providing a buffer against wave action and storm surge to prevent another breach over the dike. The proposed project is a one-time nourishment operation that is estimated to last approximately 10 years; however, the value of the nourishment operation will extend farther into the future since the additional sediment will have prevented additional erosion over the life of the nourishment operation.

Extend Nourishment Lifespan: The lifespan of the Section 111 beach nourishment project will be significantly extended by the reduction in wave energy, decreasing the frequency and expense of future nourishment cycles. According to modeling, the nourishment period could be extended by 10 years. Under Section 111 authority, periodic nourishment is not an option.

ES.5 Project Costs

Total Project Costs (First Cost): Total project costs depend on the methodology to transport truck-hauled sand from the staging area on Cedar Creek to the beach nourishment site. If barges are used (mechanical), total project first costs are \$10,925,850 (Table ES-1). If hydraulic pumping is used (hydraulic), total project first costs are estimated at \$9,598,245 (Table ES- 2).

The initial construction costs account for all design and implementation costs associated with construction of the initial beach profile. The initial construction costs were estimated to be \$13,665,138 (mechanical) or \$12,318,372 (hydraulic) and the DRP study costs are estimated at \$1,200,000. This brings the total project costs (First Cost) to \$14,861,380 (mechanical) or \$13,518,372 (hydraulic).

Operations and Maintenance (Future Renourishment Costs): \$0

The TSP includes the construction of an engineered beach profile along Mispillion Inlet but does not include future renourishment. Although long-term renourishment will be needed for the engineered beach profile to continue performing as intended, such renourishment efforts cannot be fully achieved through Section 111 due to the \$15 million federal expenditure limit for this authority. The TSP is limited to a one-time placement of material with no future renourishment, accordingly. However, it should be noted that if the design and implementation of the project ultimately costs less than the federal expenditure limit, as the current estimate suggests, then any remaining funding can be applied to future renourishment efforts. Any renourishment costs above the federal limit would be borne by the non-Federal sponsor. The non-Federal sponsor cannot commit to such efforts at this time; thus, it is unreasonable to assume that they would ultimately take place. Consequently, for the purpose of this document it is assumed that no renourishment will take place and that there will be no operations and maintenance costs.

Table ES-1. Total Project First Costs for Barging Sand from the Staging Area to the Beach Nourishment Site

Section 111 Shore Damage Mitigation Study Summary	
Projected Costs and Cost-Sharing for the TSP	
Beach Nourishment (Mechanical) 80,500 Cubic Yards	
Projects First Cost (Fiscal Year 26 Price Levels)	
Construction Costs and Contingencies	\$10,925,850
Planning, Engineering and Design	\$1,477,710
Construction Management	\$1,013,178
Lands and Damages	\$248,400
Total Project Cost	\$13,655,138
Cost Sharing (Fiscal Year 26 Fully Funded Price Levels)	
Fully Funded Project Cost (Month Year)	\$13,655,138
Federal Cost Share – 100%	\$13,655,138
Non-Federal Cost Share – 0%	\$0

Table ES- 2. Total Project First Costs for Pumping the Sand from the Staging Area to the Beach Nourishment Site

Section 111 Shore Damage Mitigation Study Summary	
Projected Costs and Cost-Sharing for the TSP	
Beach Nourishment (Hydraulic) 80,500 Cubic Yards	
Projects First Cost (Fiscal Year 26 Price Levels)	
Construction Costs and Contingencies	\$9,598,248
Planning, Engineering and Design	\$1,477,710
Construction Management	\$1,013,178
Lands and Damages	\$248,400
Total Project Cost	\$12,318,373
Cost Sharing (Fiscal Year 26 Fully Funded Price Levels)	
Fully Funded Project Cost (Month Year)	\$12,318,373
Federal Cost Share – 100%	\$12,318,373
Non-Federal Cost Share – 0%	\$0

ES.6 Plan Implementation

The recommended shoreline protection plan integrates a beach nourishment component, which involves a one-time, strategic placement of sediment along the shoreline just north of the dike. This approach is considered sustainable as it is designed to be effective for approximately 10 years, providing a robust and environmentally sensitive solution to mitigate coastal erosion and enhance the area's resilience. DNREC has expressed its full support for this selected plan.

Subject to funding, construction is projected to begin in late 2028 and is expected to be completed within an 8 to 12-month period. For the implementation, two different pumping methods are being proposed to move the sand onto the beach nourishment area north of the existing northern jetty: hydraulic or mechanical pumping. The selection between these methods is a key aspect of the construction sequence along with the project cost.

There are two major risks identified that could impede or derail the project's approval or construction:

- Logistical and technical challenges of the chosen sand placement method.
- Potential for adverse weather conditions, which could cause delays and complications during the construction phase.

This Environmental Assessment (EA) was developed by the USACE in partnership with the DNREC, adhering to all applicable regulations, including the Department of Defense's 2025 National Environmental Policy Act (NEPA) procedures.

Following initial scoping in April 2024 and an interagency meeting on November 16, 2024, the draft EA has been made available for public review and comment. The document was distributed to the U.S. Environmental Protection Agency (EPA), U.S. Fish and Wildlife Service (USFWS), National Marine Fisheries Service (NMFS), and other stakeholders.

Coordination with the Delaware State Historic Preservation Office (DESHPO) and Federally Recognized Tribes is underway. The final report will include feedback from the public, stakeholders, and tribes, with responses to comments provided in Appendix C.

ES.7 Reviews

It is anticipated that issues/areas of controversy will be resolved or mitigated by the final report.

ES.8 Real Estate Requirements

Real estate requirements are governed by USACE policy ER 405-1-11, emphasizing acquisition of only the minimum property interest necessary for construction, beneficial use of the dredged material. No fee simple acquisition is anticipated, as the project focuses on mitigation rather than full ownership transfer.

Key real estate will be refined during Design and Implementation (DI) based on the selected alternative, include:

- Temporary Work Area Easement- Primarily temporary beach nourishment/ placement easements and construction/work area easements over state-owned parcels for sand placement, staging, access, and pipeline corridors.

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Draft
Integrated Detailed Project Report/Environmental Assessment
For The Mispillion River Federal Navigation Project

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1.0 Introduction

The Mispillion River Federal Navigation Project (Mispillion River Project) study was conducted under the CAP Authority of Section 111, Rivers and Harbors Act (RHA) of 1968 as amended. Section 111 provides for prevention or mitigation of erosion-damaged shores caused by Federal navigation works. This report is the result of engineering and environmental evaluations to investigate the effects that jetties, structures, and maintenance of the Mispillion River Project have on shoreline erosion (Figure 1). This study provides a Tentatively Selected Plan (TSP) that is both technically viable and consists of a justifiable level of work for the prevention or mitigation of damages to non-Federal public and privately owned shores directly attributable to the Mispillion River Project. The non-Federal sponsor for the project is the Delaware Department of Natural Resources and Environmental Control (DNREC).

1.1 USACE Planning Process

The USACE Planning Process is guided by federal law, including the Water Resources Development Act (WRDA) and the National Environmental Policy Act (NEPA), and emphasizes a systems approach to planning. This section outlines the key phases of this process as applied to this study. The USACE Planning Process is structured around six main phases, designed to ensure a robust and transparent decision-making process. These phases are not strictly linear; rather, they are iterative, with information gained in later phases often informing earlier ones. The process focuses on identifying the justified level of work for preventing damages for potential solutions alongside other important considerations like environmental sustainability and social effects.

The following are the six steps involved in the USACE planning process:

1. Identify Problems & Opportunities
 - Evaluate existing conditions, problems, and opportunities.
 - Develop objectives and confirm the study area.
2. Inventory & Forecast Conditions
 - Establish "without-project" and "with-project" conditions.
 - Assess environmental, biological, and cultural resource impacts.
3. Formulate Alternative Plans
4. Evaluate Alternative Plans
 - Evaluate technical feasibility of plans.
 - Prepare cost estimates for each alternative.
5. Compare Alternative Plans
 - Select the least-cost plan as the TSP.
6. Select a Plan
 - Address public views through outreach.
 - Conduct required reviews (District Quality Control [DQC], Agency Technical Review [ATR], public).
 - Prepare the integrated Detail Project Report/Environmental Assessment (DRP/EA).

- Develop other supporting plans (e.g., Real Estate Plan).

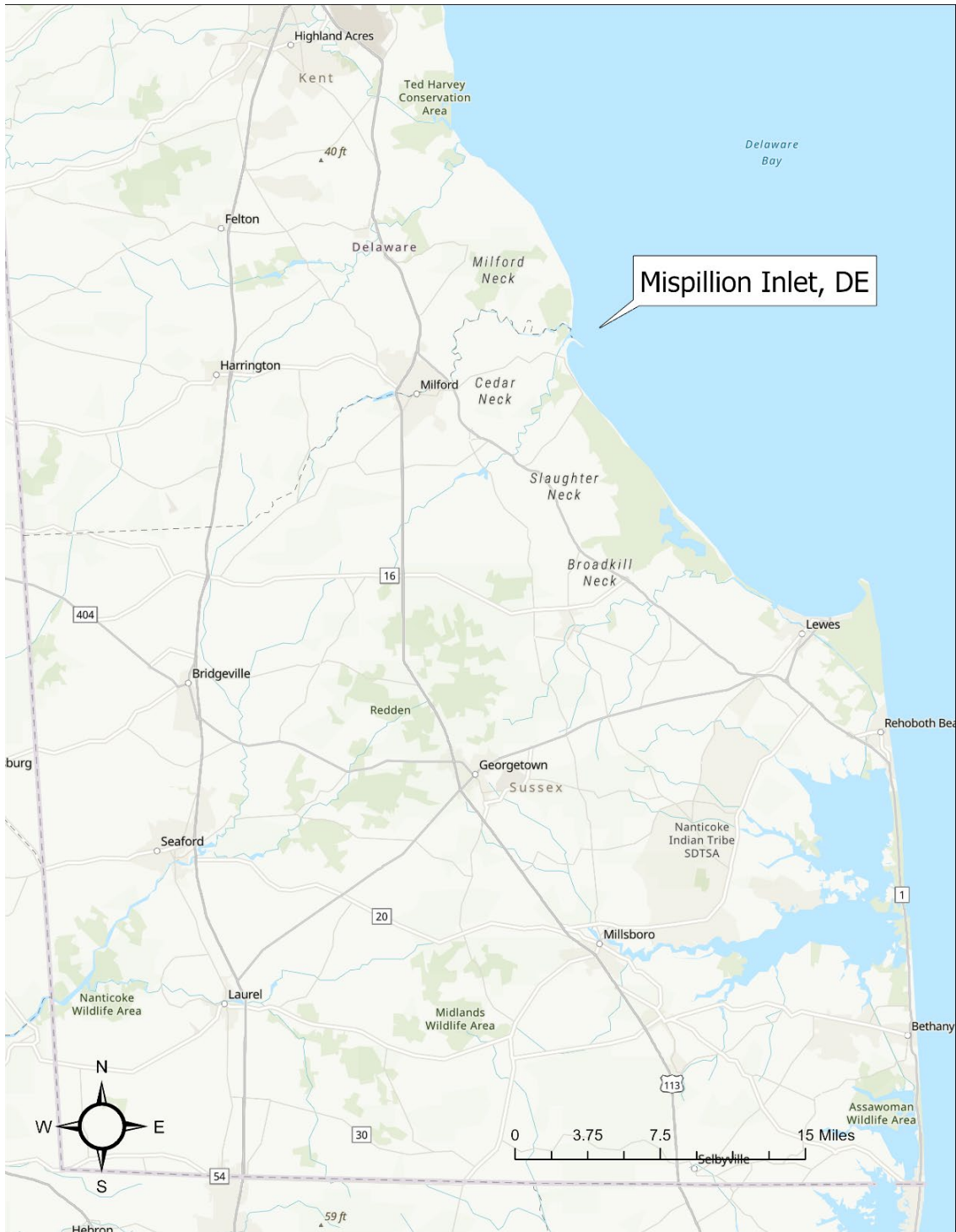


Figure 1. General Study Location related to DE and NJ

1.2 Study Authority

The study is authorized under Section 111 of the River and Harbor Act (RHA) of 1968 as amended. Section 111 provides authority to USACE to investigate, study, plan, and implement measures (structural or nonstructural) to prevent or mitigate damage to shorelines attributable to federal navigation project (FNPs). Non-Federal sponsors must share in the mitigation costs in the same proportion they share in the costs for the navigation project causing the damage. The Federal share of costs for the design, construction, and implementation project may not exceed \$15,000,000. Specific congressional authorization is required for a meritorious project for which the Federal share of costs would exceed this limit. The costs of implementing measures must be shared in the same proportion as the cost-sharing provisions that were applicable to the Federal project causing the shore damage. In this case, construction of the Mispillion Inlet navigation project is funded at 100% Federal expense (EP-1105-2-58).

Section 111 studies do not require a traditional cost benefit economic analysis. Section 111 authorizes a justified level of work for prevention or mitigation of damages to both non-Federal public and privately owned shores to the extent that such damage can be directly identified and attributed to Federal navigation works (EP-1105-2-58). For prevention or mitigation of shore damages such as those caused by riverbank erosion or vessel generated wave wash cannot be addressed under this authority. The target degree of mitigation is the reduction of shore damage to the level which would have existed without the influence of navigation works at the time such navigation works were accepted as a federal responsibility. Section 111 does not authorize restoring shorelines to historic dimensions.

1.3 Study Area (Planning Area)

The study area lies within the Delaware Bay shoreline of the State of Delaware. The study area includes the Mispillion Inlet and adjacent shorelines in Kent and Sussex Counties, Delaware, approximately 20 miles due west of Cape May Point, NJ where the Delaware Bay meets the Atlantic Ocean (Figure 1). The Mispillion River extends generally west and south about 11 miles from the inlet (measured along the channel) to the head of tide in Milford, DE.

Mispillion Inlet forms the confluence of the Mispillion River and Cedar Creek with Delaware Bay (Figure 2). The Mispillion Inlet Federal navigation project includes a pair of jetties and a channel with dimensions of 80 feet (width) and 6 feet (depth) below mean lower low water (MLLW). Inside of the inlet, the Cedar Creek Federal navigation project branches off to the southwest.



Figure 2. Detailed Image of the Mispillion Inlet Federal Navigation Project

1.4 Background and History

Cedar Creek and Mispillion Creek started as two separate creeks. Between 1842 and 1868, Cedar Creek was connected to Mispillion Creek via a dredged channel, for unknown reasons (Figure 3). Moffat and Nichol (2008) hypothesized that the channel was created in 1859, when local interests constructed a 560-foot timber pile and brush jetty north of the inlet, in the first effort to stabilize Mispillion Inlet. The original Cedar Creek outlet to Delaware Bay was closed by 1918 (Figure 3).



Figure 3. 1842 Nautical Chart Showing Cedar Creek and Mispillion River as Two Separate Creeks (a), 1868 Nautical Chart with the “Cedar Creek Outlet” into Mispillion River and 1918 Historic Nautical Chart

Construction of the Federal navigation project by USACE in the Mispillion Inlet was a gradual process that extended over 46 years (Moffat and Nichol 2008). The Mispillion River Project was modified several times over the years, progressively increasing the impact on the adjacent shorelines over time. Existing features of the Mispillion River Project were constructed during the period from 1893 until 1939. The sequence of incremental additions to the project includes:

- 1893: inner 500 ft of north jetty constructed
- 1899: inner 300 ft of south jetty constructed
- 1906: north jetty extended to 1,600 ft long
- 1908: south jetty extended to 2,200 ft long
- 1914: extensions made north jetty 3,000 ft long and south jetty 5,100 ft long
- 1920: south jetty completed to 5,850 ft length
- 1939: north jetty completed to 6,500 ft length

Historic shoreline mapping indicates that the jetties associated with the Mispillion River Project impacted littoral drift patterns in the study area (Figure 4). These impacts, which are most obvious as erosion north of the inlet, have led to several breaches of the barrier over the past four decades.

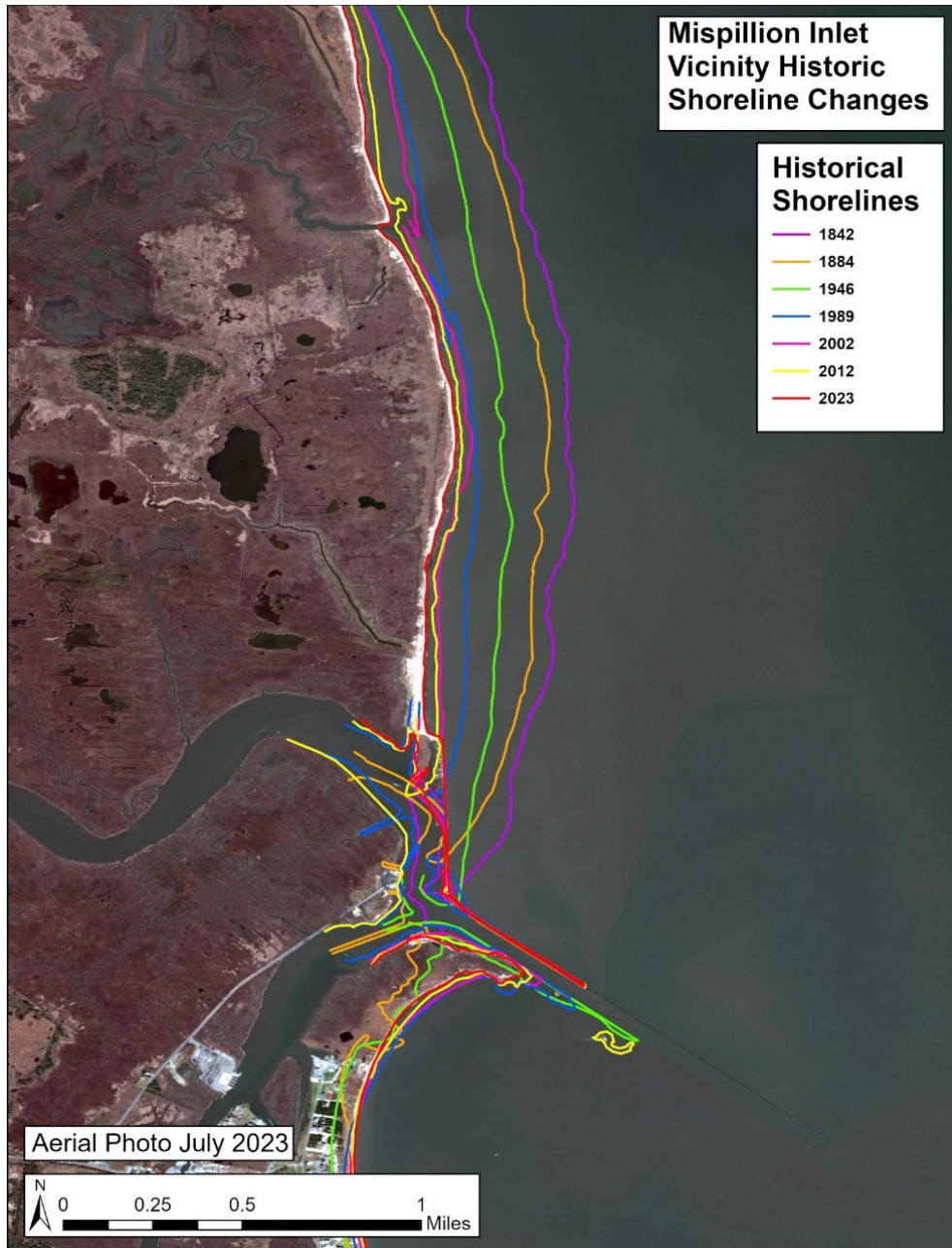


Figure 4. Mispillion Inlet Shoreline Changes

The initial breach at “Conch Bar” in the barrier occurred during a storm in 1977. This breach was closed by construction of a rock dike in 1985 by the USACE. However, continued shoreline erosion and storm conditions led to a further breach in 1987, followed by extension of the dike southward to close the new breach in 1993. Additional breaching occurred north and south of the first dike closure, which was followed by additional dike construction in 1995, 2009, and 2016-2018 by DNREC.

In 2009, a breach was discovered in the breakwater protecting Mispillion Inlet. The tidal flow through the breach was identified as the primary cause of the beach erosion. The navigation channel was dredged in September 2009, and the sediment was deposited on the beach north of the inlet to mitigate the erosion and restore the habitat. Concurrently, a borrow site adjacent to the south jetty was identified and approximately 32,000 cubic yards (CY) of sand were pumped to the damaged dike, which was breached earlier that year (DNREC 2011). Approximately 450 days following the placement, approximately half of the sand remained. Subsequent visits indicated that most of the material had over washed into the Mispillion River (DNREC 2011).

The breaches were closed because they created an undesirable "shortcut" for the tidal flow between Delaware Bay and the Mispillion River, diverting water away from the main jettied inlet. This diversion caused several significant problems. It led to lower velocities in the jettied inlet and increased shoaling within both the Mispillion River and the Cedar Creek navigation project. This sediment was also transported offshore, forming hazardous new shoals that were exposed at low tide and endangered safe navigation. Furthermore, the breaches allowed waves to pass through and damage docks and shorefront properties along the river, while also increasing the flood risk to developed areas upstream. Secondary impacts of the breaches contributed to deterioration of important horseshoe crab (*Limulus polyphemus*) spawning habitat and feeding and resting habitat for the threatened red knot (*Calidris cantus rufa*) and other migratory birds. Furthermore, the extensive work in 2016 by the USFWS to restore normal tidal circulation and wetlands in the Prime Hook National Wildlife Refuge south of Mispillion Inlet on Cedar Creek may be jeopardized by breach-induced shoaling in Cedar Creek.

Mispillion Inlet, located along the Delaware Bay coastline, has a dynamic history shaped by natural processes and human intervention. Historically, the inlet's position has fluctuated, with periods of closure and reopening driven by storm events and sediment transport. Recognizing the importance of maintaining navigable waterways for commerce and recreation, Congress authorized the Mispillion River Project, which the USACE constructed and modified from 1893-1939. The navigation channel involved dredging to deepen and widen the channel, ensuring access to vessels. The channel has been stabilized with timber jetties and stone dike and regularly maintained with dredging to combat the natural tendency for the inlet to migrate and shoal. Which has led to multiple breaches in the barrier island requiring additional intervention. Figure 5 shows inlet migration and shoaling from 1958 through 1981.

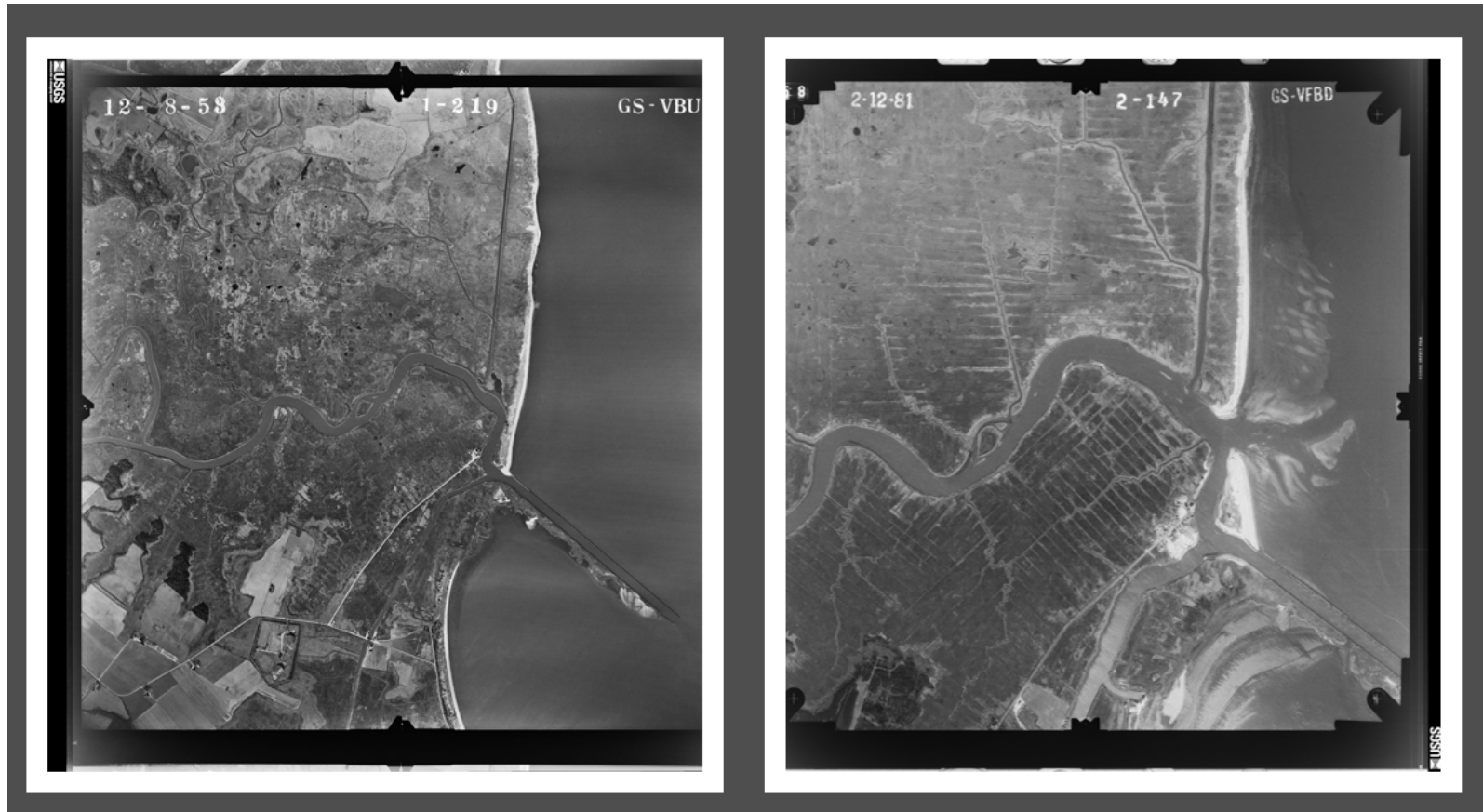


Figure 5. Inlet Migration and Shoaling at Mispillion Inlet between 1958 and 1981

In 2017, the DNREC extended the dike system along the inlet's northern side (Figure 6). This project was a direct response to a major 2016 storm that caused a breach, threatening nearby communities and infrastructure. While the extension was intended to stabilize the shoreline and prevent future breaches, continued erosion is evident north of Conch Bar (Figure 6), suggesting the beach will likely experience high rates of erosion in the future.



Figure 6. A view facing south towards the 2017 DNREC Dike Extension and Conch Bar

The most recent 2016-2018 construction was a collaboration between the USFWS, National Fish & Wildlife Foundation, The Nature Conservancy, and Delaware Wild Lands to raise and lengthen the rock dike, add several groins on the west side of the dike (Figure 2), and place sandy sediment to serve as habitat for horseshoe crab spawning and migratory bird feeding. The cost was approximately \$7.8 million.

1.5 Purpose and Need

The purpose of the study is to investigate the impact (i.e., erosion on shorelines north of the jetty and accumulation of debris on the beaches south of the jetty) of the jetties associated with the Mispillion River Project, specifically the jetties constructed in 1893, on the adjacent shorelines and recommend a solution to mitigate these impacts.

The study is needed to stop shoreline erosion at the Mispillion Inlet. Without intervention, the shorelines are expected to continue to erode and increase the risk of another breach along the shoreline north of Mispillion Inlet. Previous breaches in 1977, 1987, and 2009 allowed the Mispillion River to take a “short-cut” through the breach causing a reduction in tidal flows and velocities through Mispillion Inlet and increased shoaling. Due to the adverse impacts of the breaches, they were closed by the construction of a rock dike and subsequent repairs and extensions. A breach would impact wetlands and shorebird nesting, foraging, and resting habitat, including for the threatened red knot.

Shoaling of Cedar Creek and Mispillion Inlet could impede the operations of Delaware Launch Services, located on Cedar Creek. Delaware Launch Services is the only launch service that provides safe transport of personnel and supplies to tanker vessels anchored in Delaware Bay and the nearby Atlantic Ocean. Reports of vessel groundings and associated damages have been reported during lower tide stages and prolonged blowout tide periods. The U.S. Coast Guard (USCG) has expressed concern that further shoaling in the channel could delay the response of oil spill emergency cleanup and containment contractors during lower tide stages.

1.6 Problems and Opportunities

Problems

Problems are the undesirable conditions within the study area that the study aims to resolve. A primary issue is the increased shoreline erosion occurring adjacent to the Mispillion River Inlet, which is a direct consequence of the Federal navigation project. This erosion is not just a loss of land; it is the root cause of several significant environmental and economic impacts.

The continuous erosion directly leads to the loss of critical habitat for federally-listed species that rely on this specific coastal environment. Furthermore, the altered shoreline dynamics impact tidal hydraulics, leading to increased and unpredictable shoaling patterns within the waterways. This not only disrupts natural water flow but also poses a navigation risk. On the south side of the inlet, the area has been degraded by the accumulation of debris and the encroachment of invasive *Phragmites*, further diminishing the area's ecological and aesthetic value.

Opportunities

Opportunities arise directly from the identified problems, presenting a clear path forward to reverse these undesirable conditions and restore the study area's health and stability. By taking targeted action, we can address the multifaceted challenges posed by shoreline erosion and a potential breach. The key opportunities include:

- **Differentiate Causes of Erosion:** Investigate how the Mispillion River Inlet jetties interrupt natural longshore transport to distinguish between natural and project-related causes of erosion.
- **Assess Breach Impacts:** Analyze the potential for increased shoaling in Cedar Creek that could result from a breach north of the inlet.
- **Protect Economic & Environmental Interests:** Safeguard against the impacts of a breach, including protecting Delaware Launch Services from increased shoaling to avoid disruptive and costly future Operations & Maintenance (O&M) dredging.
- **Reduce Flood Risk:** Mitigate the increased storm flood risk for the DuPont Nature Center, the Mispillion River Inlet community, and the upstream community of Milford.
- **Preserve Critical Habitat:** Protect a globally significant horseshoe crab spawning habitat—one of the most important in all of Delaware Bay—from the impacts of continued shoreline erosion.
- **Implement Solutions:** Identify and advance readily implementable measures to alleviate the ongoing erosion at Mispillion River Inlet.

1.7 Objectives and Constraints

Objectives are defined as the desired timing, effect, duration, and location for a study outcome. The study objectives will be evaluated over a 50-year period of analysis from 2030 to 2080. Study objectives are listed below.

- Develop a plan to mitigate for the shoreline erosion of the beachfront along Mispillion Inlet due to the presence of the jetties that restores the shoreline to a reasonable condition through the 2030-2080 period of analysis.
- Restore habitat for threatened and endangered species to mitigate shoreline loss due to the presence of the jetty that restores shorelines to a reasonable condition through the 2030-2080 period of analysis.
- Repair southern beaches and clean up the accumulation of debris and establishment of phragmites that collected due to the wave shadow effect of jetty as one time or O&M operation for the 2030-2080 period of analysis

Constraints are defined as limits to the planning process and issues to avoid with the planning and implementation. They can be related to resources like time, money or personnel, technical abilities or planning limitations related to formulation or the study area conditions.

Planning constraints include:

- Maintain existing federal navigation capability.
- Avoid induced flooding and damages to adjacent shorelines and natural areas.
- Avoid impacts to performance of existing navigation and other constructed features.

- Avoid Federal expenditures in a Coastal Barrier Resources Act (CBRA) system unit without receiving concurrence from USFWS on the use of an exception.
- Avoid negative impacts to state- and federally-listed endangered and threatened species.

1.8 Study Scope

The scope of the study is defined by the Study Authority, purpose, need, objectives, and constraints. As stated in Section 1.2, Section 111 provides authority to USACE to investigate, study, plan, and implement measures to prevent or mitigate shoreline damage caused by a Federal navigation project. Section 111 does not authorize restoring shorelines to historic dimensions, but targets mitigating shoreline damage to the level which would have existed without the Federal navigation project.

Section 111 studies do not require a traditional cost benefit economic analysis but the least cost plan to restore the shoreline. The total costs for the study are outlined in the Project Management Plan (PMP).

2.0 Existing and Future Without Project Conditions

The Mispillion River Federal Navigation Project provides an entrance channel 6 feet deep and 80 feet wide from Delaware Bay to the landward end of the jetties. Along the Mispillion River, the channel dimensions are 6 feet deep and 60 feet wide and extends approximately 10 miles upstream to Milford, Delaware. The Cedar Creek Federal Navigation Project provides a channel 5 feet deep, 80 feet wide and 3,730 feet long from the confluence of Cedar Creek with the Mispillion River to the state launching ramp, and 5 feet deep and 50 feet wide thereafter for 2,470 feet to a point 1,000 feet upstream of the State Route 36 Bridge.

The Mispillion Inlet Federal Navigation Project includes jetties that extend almost 6,000 ft into Delaware Bay. The jetties have effectively stabilized the shoreline along Slaughter Beach south of the inlet. However, it appears that initial construction and subsequent modification of the Mispillion Inlet jetties between 1893 and 1939 created a physical barrier to possible northward transport of sand along this segment of the Delaware Bay shoreline. Described in Section 1.3 and demonstrated by historical shoreline mapping.

Figure 4 illustrates shoreline changes adjacent to the shoreline history of Mispillion Inlet from 1842 to the present reveals a significant increase in erosion following engineering interventions. Before the construction of the Federal Navigation Project (FNP) between 1893 and 1939, the beach north of the inlet retreated at a rate of 6 to 7 feet per year, totaling a loss of approximately 300 feet. However, following the completion of navigation works in 1946, the erosion rate accelerated to between 10 and 14 feet per year, resulting in an additional loss of roughly 900 feet. The shorelines in the study area are classified as “estuarine wash over barriers” (Maur Meyer, 1978). These barriers (i.e., “beaches”) consist of a relatively narrow and vertically thin veneer of sand and gravel that is derived from older (pre-Holocene) headlands that exist along portions of the Delaware Bay shoreline.

Historically, the estuarine washover barriers on Delaware Bay have migrated landward and upward over older sediments in response to sea level change. When compared to nearby open-ocean

beaches in Delaware, the nearshore zone of Delaware Bay in the vicinity of Mispillion Inlet is a relatively low-energy environment in terms of wave energy, with corresponding lower rates of longshore sand transport under “normal” conditions. Potentially larger transport rates can occur in the vicinity of Mispillion Inlet during storm events. It appears that net littoral transport is from south to north at this location, based on the relatively small change rates of shoreline change south of the jetty along Slaughter Beach in comparison to the high rates of shoreline change north of the jetty at Conch Bar (Figure 4).

A sand-starved shoreline on Delaware Bay might not respond like a sand-rich ocean shoreline. There may not be sufficient sand in the Delaware Bay nearshore to create the same, typical impact seen at many ocean coast inlets with jetties, (i.e., with updrift accretion and downdrift erosion.) Clearly, there was a pre-project erosion trend along the beach north of Mispillion Inlet that was exacerbated by construction of the navigation works. The apparently “stable” beach (no appreciable gain or loss of shoreline) south of the inlet, since the jetties have been in place, might represent an accretion. Without the jetties, the Slaughter Beach and downdrift sides of the inlet might have retreated at a similar rate, e.g., 6 to 7 feet per year.

Current maintenance dredging with the Government-owned and operated Dredges Currituck and Murden has cost-effectively removed the relatively small but critical shoaling from the interior channel and the entrance to the Delaware Bay. Dredged material is placed in an area to the north of the entrance, keeping sediments in the system and supporting the adjacent beaches. The jetties have a failed but functional condition rating in the national Coastal Navigation Structures Asset Management database, based on a Level 1 Operational Condition Assessment.

Mispillion River and Cedar Creek support the only launch service that provides safe transport of personnel and supplies to tanker vessels anchored in Delaware Bay and the nearby Atlantic Ocean. Reports of vessel groundings and associated damages have occurred during lower tide stages and prolonged blow-out tide periods. The USCG has expressed concern that further shoaling in the channel could delay the response of oil spill emergency clean-up and containment contractors during lower tide stages.

Future Without Project. The "without-project" conditions represent a forecast of the future state of affairs if the US Army Corps of Engineers (USACE) does not undertake a project. These conditions were established to assess the potential consequences of inaction and understand the impact of the problem if left unaddressed. Notably, the Section 111 authority under the Continuing Authorities Program (CAP) differs from other Civil Works study authorities in its approach to without-project conditions and determining Federal Interest. Typically, other study authorities require a quantitative assessment of monetary and environmental damages to serve as a baseline for evaluating alternatives. In contrast, Section 111 assumes that Federal Interest is inherent due to the causal link between a FNP and associated damages. As a result, a formal economic analysis was not necessary for this study, and the future without-project conditions were described qualitatively instead.

2.1 Natural Environment

Delaware is located in an ecological transition zone at the southern limit of northern species and the northern limit of southern species. The study area is in the Middle Atlantic Coastal Plain, Delaware River Terraces and Uplands Ecoregion (Level IV) (USEPA, 2013). Ecoregions are areas with similar ecosystems and environmental resources (i.e., type, quality, and quantity). Ecoregions are mapped based on spatial analysis of geology, physiography, vegetation, climate, soils, land use, wildlife, and hydrology.

The Delaware River Terraces and Uplands Ecoregion is a narrow region that has been heavily modified by urban development. It spans both sides of the Delaware River estuary, from southeastern Pennsylvania to Southeastern Delaware and southwestern New Jersey along the full length of the Delaware Bay.

2.1.1 Terrestrial Habitat

Existing. Delaware Bay beach/shoreline habitat is nationally significant for horseshoe crabs and shorebirds. These habitats support a variety of fish and wildlife, including spawning horseshoe crabs, foraging migratory shorebirds, beach nesting birds, and nesting diamondback terrapins (*Malaclemys terrapin*).

Delaware estuary sandy beaches are a thin veneer of sand (Maurmeyer, 1978) constantly shaped by wind and waves (see Section 1.9). Prior to the completion of the Federal navigation channel in 1983, the area was likely characterized by shallow water, extensive shoaling, and shifting beach habitat (USFWS, 2024). However, the naturally, dynamic conditions responsible for sustaining habitat quality and function have been reduced, resulting in beach erosion and the reduction of shoaling. This has resulted in the sand beach habitat being replaced by peat or clay dominated banks. The breaches that have occurred since the late 1970s have resulted in converting several hundred acres of degraded salt marsh into open water. The northern extension of the rock dike completed in 2017 reduced the threat of a future breach, but the potential still exists because of the inland migration/erosion of the Conch Bar shoreline (USFWS, 2024).

Construction of the Mispillion River Project also caused sand to deposit and form extensive shoals and pocket beaches nearshore and along the south side of the inlet (i.e., the Outer Islands). These features partly offset the loss of dynamic beaches that would have occurred without the Federal navigation project and provided some spawning habitat for horseshoe crabs and diamondback terrapins, and forage and nesting habitat for shorebirds, but have severely eroded since 1939 (USFWS, 2024).

The north end of Cedar Beach is covered by several feet thick layers of organic detritus comprised of marine algae and salt marsh vegetation. USFWS has also observed this detritus at Conch Bar (USFWS, 2024). The detritus displaces horseshoe crab spawning and shorebird foraging habitat.

Despite the impacts from construction of the Federal Navigation Project, Mispillion Inlet is still known for its high densities of horseshoe crabs and shorebirds that feed on them, including the Federally threatened red knot. Horseshoe crabs remain on the bay bottom for most of their lives and return to the lower Delaware Bay beaches annually during spring and summer to spawn. In late spring, the red knot and other shorebirds feed on the freshly laid horseshoe crab eggs to fuel

their northward migration. As such, maintaining sand along the nearshore area is critical to sustain quality and function of these habitats for fish and wildlife (USFWS, 2024).

Future Without Project. While sand in the estuarine system may nourish the marsh in localized areas, significant portions of the marsh platform and vegetation have been affected by mosquito ditching and the Grecos Canal, making the marsh less resilient to tidal and wave energy and less effective at trapping and accreting sediments. Beach erosion and salt marsh degradation will continue in the future without the project. Additionally, sea level change may aggravate beach erosion and marsh degradation. According to the NOAA Sea Level Rise viewer, with an average accretion rate of 4 mm/year and a sea level change of approximately 1.5 ft to 2.0 ft by 2080 (intermediate sea level change scenario), the beach areas north and south of the inlet would start to become inundated (Figure 7). With an accretion rate of 4 mm/year and a sea level change of approximately 3.5 ft by 2080, most of the study area would be inundated (high sea level change scenario) (Figure 8).

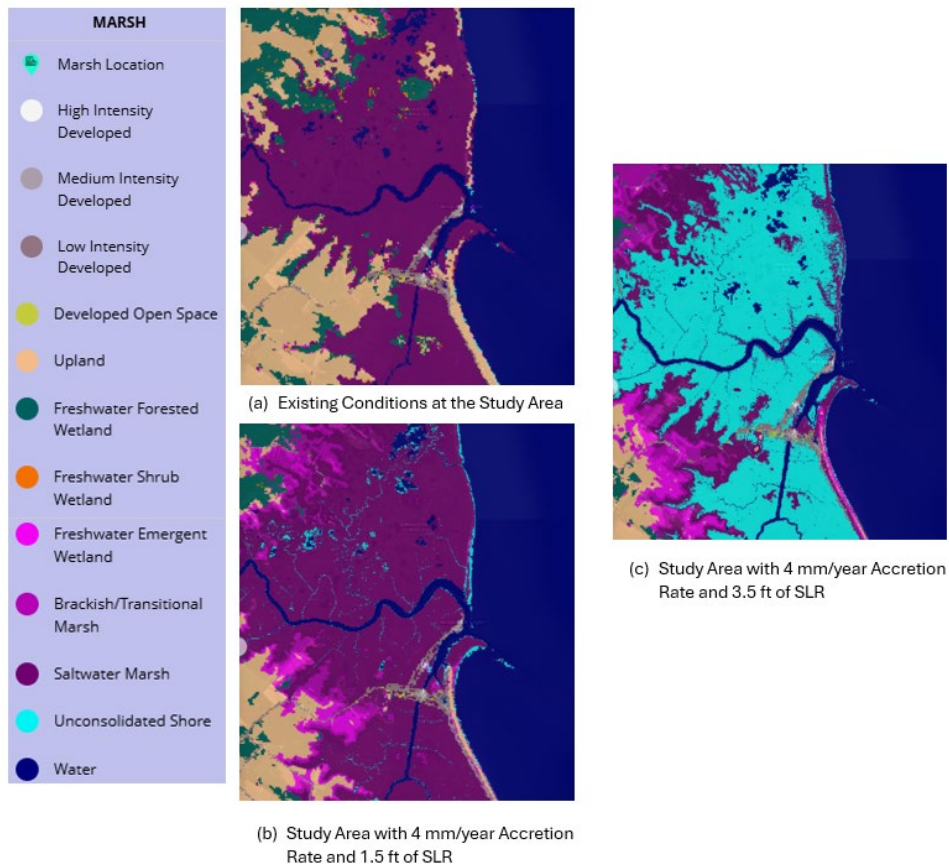


Figure 7. Existing and Future Marsh Conditions in the Study Area Based on the NOAA SLR Viewer (NOAA 2025)

In the future without the project, the shoreline could erode past the landward tip of the dike and significantly increase the risk of a breach. This would result in the loss of beach, dune, and salt marsh habitat north of the inlet. This is further discussed in Section 2.2.2.2 and shown in Figure 9.



Figure 8. Future without Project Projected Shoreline Changes over 50-years (2025—2075)

2.1.2 Vegetation

Existing. Vegetated habitat in the study area is dominated by sandy beaches bordered by beachgrass-panicgrass dune grasslands, overwash dune grassland, North Atlantic low salt marsh and high salt marsh, and reed tidal marsh (UD 2026). Agricultural fields and cultivated lawn also occur in the study area. Finally, the study area includes subaqueous land or subtidal waters (Coxe 2012).

Overwash Dune Grassland is an herbaceous community located on low-lying areas of dunes, which are influenced by storm tides. Typically, this community is dominated by saltmeadow cordgrass (*Spartina patens*) or Olney’s three-square bulrush (*Schoenoplectus pungens*). Seaside goldenrod (*Solidago sempervirens*), dune sandbur (*Cenchrus tribuloides*), bristly foxtail (*Setaria parviflora*), and seashore saltgrass (*Distichlis spicata*).

Beaches in the study area are bordered by beachgrass-panicgrass Dune Grasslands, which are dominated by both beachgrass (*Ammophila breviligulata*) and panicgrass (*Panicum amarum*). This maritime grassland community usually occurs on foredunes (the part of the sand dunes closest to the Delaware bay) and receives the force of wind and salt spray. It is not typically influenced by storm tides.

Expansive salt marshes landward of the dunes were likely predominantly Cattail Brackish Tidal Marsh prior to 1937; however, these have converted to North Atlantic high and low saltmarsh due to an increasing amount of salinity in the marshes of the wildlife area.

North Atlantic High Salt Marsh receives irregular tidal flooding above the mean high tide level. Saltmeadow cordgrass can be associated or co-dominant with seashore saltgrass. Other plants that may be found include sea-lavender (*Limonium carolinianum*), salt marsh false foxglove (*Agalinus maritima*), glasswort (*Salicornia* spp.), sea pink (*Sabatia stellaris*), narrow loosestrife (*Lythrum lineare*), Olney's three-square bulrush, seaside goldenrod, salt marsh fleabane (*Pluchea odorata*), swamp rose mallow (*Hibiscus moscheutos*) and southern bayberry (*Morella cerifera*).

North Atlantic Low Salt Marsh is located between mean sea level and mean high water level and is more regularly flooded. The dominant species, smooth cordgrass (*Spartina alterniflora*), can occur in short and tall forms, depending on the frequency of flooding. The tall form occurs in areas with daily tidal flooding. Other plant species present include may include sea, glasswort, salt shrub (*Baccharis halimifolia*), marsh elder (*Iva frutescens*), Virginia saltmarsh mallow (*Kosteletzkya virginica*), swamp rose, water-hemp ragweed (*Amaranthus cannabinus*), sweetscent (*Pluchea odorata*), saltmeadow cordgrass, salt marsh rush (*Juncus gerardii*), giant cordgrass (*Spartina cynosuroides*), Roemer's bulrush (*Juncus roemerianus*), coastal salt grass and eastern reed grass (*Phragmites australis*).

Reed Tidal Marsh, dominated by common reed (commonly called "*Phragmites*") is a recent arrival to the marshes. *Phragmites* will form monocultures, or pure stands, which have very little value to wildlife and disrupt the complex ecological processes of the marsh.

Future Without Project. Sea level change would result in the conversion and change in distribution of vegetated habitat; however, under the intermediate level rise scenario, most salt marsh would remain salt marsh (Figure 7). As the beaches become inundated the risk of a breach would increase. A breach would result in salt marsh loss (Figure 8). Under the high sea level change scenario, salt marsh would become a large expanse of unconsolidated shoreline; this may look like mudflats or possibly sandy beach and the upland areas would become salt marsh (Figure 7).

2.1.3 Wildlife

Existing. Shorebirds found on sandy beaches in the study area include sanderling (*Calidris alba*), common tern (*Sterna hirundo*), dunlin (*Calidris alpina*), American oystercatcher (*Haematopus palliatus*), ruddy turnstone (*Arenaria interpres*), short-billed dowitcher (*Limnodromus griseus*), long-billed dowitcher (*Limnodromus scolopaceus*), black skimmer (*Rynchops niger*), semipalmated sandpiper (*Calidris pusilla*), great black-backed gull (*Larus marinus*), herring gull (*Larus argentatus*), and white-rumped sandpiper (*Calidris fuscicollis*). Horseshoe crabs and

diamondback terrapins are also found on Delaware's sandy beaches. Protected species are discussed in Section 2.1.6.

Delaware Bay sandy beaches are nationally significant for horseshoe crabs and shorebirds. The Delaware Estuary hosts the largest concentration in the Western Hemisphere of spawning horseshoe crabs. The Mispillion Inlet is a high-use area for horseshoe crabs, red knots, and other shorebirds (Dey et al. 2011). Horseshoe crabs remain on the bay bottom (subtidal areas) for most of their lives, feeding on benthic worms, mollusks, and crustaceans, returning to the lower Delaware Bay beaches annually during spring and summer to spawn. In late spring, shorebirds, including the red knots (Federally threatened), dunlins, ruddy turnstones, sanderlings, short- and long-billed dowitchers, black-bellied plovers (*Pluvialis squatarola*), and semi-palmated and least sandpipers stop at the inlet to feed on the freshly laid horseshoe crab eggs to fuel their northward migration.

In May 2009, the majority of the red knots in the Delaware Bay were observed in Mispillion Inlet. Based on a ground count, approximately 27,000 were counted in the interior Mispillion Inlet versus a few hundred elsewhere in Delaware. It is suspected that this may have been a pre-departure staging event prior to the first mass departure for the northward migration. Mispillion River Inlet also accounted for approximately 95 percent of the horseshoe crab egg densities in Delaware in 2009 (Dey et al. 2011). The Mispillion Inlet was also the most productive clapper rail (*Rallus crepitans*) nesting site in a 2019 clapper rail survey (DE DFW 2019). The delta areas near tidal creek mouths have consistently remained horseshoe crab spawning hotspots from 2002 through 2010 (Lathrop et al., 2013) despite exhibiting habitat degradation with changes in sand bars eroding and shifting. The states of Delaware and New Jersey have conducted a standardized horseshoe crab survey in the Delaware Bay each year since 1999. The 2019 survey results indicate that there has been a slight decrease in female spawning activity bay wide through the 21 years surveyed, but that this decrease is not statistically significant. This same trend occurred in Delaware, but not in New Jersey (Zimmerman et al. 2020). Male spawning activity has shown a significant increase over the 21 years of surveys, and this same trend occurred in Delaware and New Jersey over the time series. Sex ratio in 2019 was 5.5:1(M:F). Sex ratios during the 21-year time series ranged from 3.1:1 to 5.6:1" (Zimmerman et al. 2020).

In addition to their ecological importance as a food source for migratory shorebirds, horseshoe crabs are an important commercial fishery. Horseshoe crabs provide bait for commercial American eel (*Anguilla rostrata*) and conch (i.e., whelk) fisheries and their blood is used in the development of drugs and vaccines by the biomedical industry. The biomedical industry returns most crabs to the water with an assumed 15 percent mortality rate (ASMFC 2020).

A wide variety of birds, dune and beach-associated tiger beetles, sand specialist native bees, butterflies, and moths are associated with maritime dune and grasslands (i.e., beachgrass-panicgrass and overwash dune grassland vegetation communities in the study area). Birds that use maritime dune and grassland habitat include northern bobwhite (*Colinus virginianus*), prairie warbler (*Setophaga discolor*), field sparrow (*Spizella pusilla*), eastern kingbird (*Tyrannus tyrannus*), eastern towhee (*Pipilo erythrophthalmus*), brown thrasher (*Toxostoma rufum*), peregrine falcon (*Falco peregrinus*), American kestrel (*Falco sparverius*), and American

oystercatcher (*Haematopus palliatus*). Butterflies, moths, and bees that occur in dune habitat include monarch butterfly (*Danaus plexippus*), eastern cactus-boring moth (*Melitara prodenialis*), and sweat bees (*Lasioglossum nymphale* and *L. marinum*).

Species associated with low and high salt marsh habitat include clapper rail, Nelson's sparrow (*Ammospiza nelsoni*), saltmarsh sparrow (*Ammodramus caudacutus*), seaside sparrow (*Ammodramus maritimus*), snowy egret (*Egretta thula*), willet (*Tringa semipalmata*), and diamondback terrapins. Additionally, the federally listed threatened eastern black rail (*Laterallus jamaicensis ssp. jamaicensis*) is known to occur near the inlet area.

Future Without Project. Sea level change would result in changes to the distribution and amount of beach, salt marsh, and tidal marsh habitat throughout the study area. This, in turn, would result in changes in the distribution of wildlife that use the study area for habitat.

Without the project, erosion would continue, increasing the risk of a breach. Results in the loss of beach, dune, and salt marsh habitat north of the inlet which serve as forage and nesting habitats for a variety of shorebirds, including for the threatened red knot. Changes in the interior Mispillion Inlet could particularly be a concern for red knot, as this part of the inlet may be one of the most important foraging grounds for red knot in their northward migration. Mispillion Inlet also accounted for approximately 95 percent of the horseshoe crab egg densities. Changes in the interior of the inlet would also change the distribution or result in the loss of habitat for marine invertebrates, such as horseshoe crabs, insects, and terrapins that use the project area (see Section 2.1.5).

2.1.4 Aquatic Habitat

Existing. DNREC collected hydrodynamic and water quality data (water level, salinity, turbidity, pH, and specific conductivity) for a period of 40 days from November 3 through December 18, 2006. This time period covered a nor'easter (November 22-23, 2006) which resulted in elevated water levels that caused moderate local flooding.

Average salinity in the mainstem of the Delaware Bay has been estimated at 27.5 ppt. Average salinity in Cedar Creek was 16.5 ppt as measured by DNREC from November 3, 2006, through December 18, 2006 (Moffat and Nichol 2007). Salinity in the creek fluctuates with the tides. Salinity is typically higher at high tide, when higher salinity water from the mainstem of the Delaware Bay floods the Mispillion River and Cedar Creek. Local freshwater discharge lowers the salinity during low tide. The maximum salinity, 25.6 ppt, was measured during the pre-Nor'easter days of early November; the minimum salinity, 1.2 ppt was measured in early December when low water elevations were lower than normal.

In the mainstem of the Delaware Bay, the bottom sediment is characterized as a mixture of medium and coarse sands with some fine sands and a small percentage of silts and clays. Sediments in the interior of the inlet, where Cedar Creek and the Mispillion River converge, have been characterized as coarse sand. Sediments outside of the Inlet have been characterized as medium to coarse sand with some silts and clays. Sediments in Cedar Creek have been characterized as approximately 90% silt/clay. Sediments in the Mispillion River were characterized as having more variability but still dominated by silt/clay (Moffat and Nichol 2008).

Future Without Project. Sea level change would result in an increase in aquatic habitat and a decrease of intertidal wetland habitat as it transitions to unconsolidated shoreline. Without the project, erosion would continue, increasing the risk of a breach (see Section 2.1.1). This would result in the reconfiguration of the Mispillion Inlet.

2.1.5 Aquatic Species

Existing. The Delaware Estuary also supports over 200 fish species, both residents and migrants (Miller et. Al, 2012). Specifically, these include freshwater species that occasionally enter brackish water; estuarine species that remain in the estuary their entire life cycle; anadromous and catadromous species passing through different salinity reaches of the estuary; marine species which regularly spend time in the estuary; marine species that utilize the estuary as a nursery and/or spawning area; and adventitious visitors of oceanic origin.

The Mispillion River, Cedar Creek, and the Delaware Bay and Estuary serve as important habitat for many aquatic species and their forage including horseshoe crab, American shad (*Alosa sapidissima*), blueback herring (*Alosa aestivalis*), alewife (*Alosa pseudoharengus*), striped bass (*Morone saxatilis*), American eel, blue crab (*Callinectes sapidus*), black drum (*Pogonias cromis*) and other assorted bait fishes and invertebrates.

Ribbed mussels (*Geukensia demissa*) have an important association with smooth cordgrass in tidal low salt marsh habitat. Ribbed mussels attach to smooth cord grass, forming dense beds and helping the marsh to increase elevation. The mussels also fertilize the plants.

The Delaware Bay is one of the most important areas for horseshoe crabs in the world, containing important habitats for spawning, staging, and rearing for various life stages. Horseshoe crabs also play a valuable ecological role in the food web within the Delaware Estuary. In addition to being a vital food source for the red knot, horseshoe crab eggs and larvae are a food source for a number of other species including striped bass, white perch (*Morone americana*), weakfish (*Cynoscion regalis*), American eel, silver perch (*Bairdiella chrysoura*), summer flounder (*Paralichthys dentatus*), and winter flounder (*Pseudopleuronectes americanus*) (Steimle et al. 2000). Without the Federal navigation project, a broader, deeper, and more gradual sloping beach surface would likely be present and provide habitat for horseshoe crab spawning and shorebird foraging.

The Mispillion River provides spawning habitat for anadromous species including blueback herring, alewife, and white perch. Alewife and blueback herring, often collectively referred to as 'river herring,' are listed by the National Marine Fisheries Service as a Species of Concern. These species are also important to both commercial and recreational fisheries and form an important forage base for other animal species. The Mispillion River is used by large numbers of American eel. Some commercially and recreationally important fisheries include striped bass, weakfish, summer flounder, croaker (*Micropogonias undulatus*), and menhaden (*Brevoortia tyrannis*) (McHugh, 1981).

There are at least 31 species that are commercially harvested from the Delaware Estuary. Catadromous species, such as the American eel, spend their lives within the estuary, but migrate to the ocean to spawn. Species such as the spottail shiner (*Notropis hudsonius*) and the channel catfish (*Ictalurus punctatus*) are year-round residents of fresh and brackish waters and do not

migrate to any significant degree to spawn. Species such as the Atlantic silverside (*Menidia menidia*) and bluefish (*Pomatomus saltatrix*) spend their lives in higher salinity waters and spawn in the bay. Atlantic menhaden and Atlantic croaker spawn offshore and use the bay as a nursery area.

Other notable fish inhabitants include several species of sharks, skates and rays, including sand tiger (*Carcharias taurus*) and sandbar (*Carcharhinus plumbeus*) sharks, the cow-nosed stingray (*Rhinoptera bonasus*) and clear-nose skate (*Raja eglanteria*). The lower portion of the Delaware Bay has been designated as a Habitat Area of Particular Concern (HAPC) for the sandbar shark. Pregnant females enter the bay between late spring and early summer, give birth and depart shortly after while neonates (young of the year) and juveniles (ages 1 and over) occupy nursery grounds until migration to warmer waters in the fall (Rechisky and Wetherbee, 2003). Neonates return to their natal grounds as juveniles and remain there during the summer. Tagging studies done by Merson and Pratt (2001) found that sandbar sharks use the southwestern portion of the bay as pupping grounds and the entire bay for summer feeding nursery area.

Future Without Project. Sea level change would result in an increase in aquatic habitat and a decrease of intertidal wetland habitat as it transitions to unconsolidated shoreline. Without the project, erosion would continue, increasing the risk of a breach (see Section 2.1.1). This would result in the reconfiguration of the Mispillion Inlet. Aquatic species distribution would adapt with these changes in habitat.

2.1.6 Rare, Threatened, and Endangered Species

Existing Conditions. The Endangered Species Act (ESA) declares the intention of Congress to conserve threatened and endangered species and the ecosystems on which those species depend. A query of the U.S. Fish and Wildlife Information for Planning and Conservation (IPaC) database conducted on December 29, 2025, indicates that the following threatened species, proposed endangered species, and proposed critical habitat have the potential to occur at the study area:

- Tricolored bat (*Perimyotis subflavus*) – proposed Federal endangered, State endangered
- Eastern black rail (*Laterallus jamaicensis ssp. jamaicensis*) – Federal threatened, State endangered
- Rufa red knot (*Calidris canutus rufa*) – Federal threatened, State endangered
- Rufa red knot – proposed Federal critical habitat
- Monarch butterfly (*Danaus plexippus*) - proposed Federal
- Seabeach amaranth (*Amaranthus pumilus*) – Federal threatened

The tricolored bat was proposed for federally listing as endangered on September 14, 2022 (87 FR 56381) and has the potential to occur in the study area. Tricolored bat typically overwinter in caves or mines and spend the remainder of the year in forested habitats. The Tricolored bat is not likely to occur in the study area because of the lack of habitat (USFWS, 2024).

The federally listed threatened eastern black rail is known to occur near the inlet area. Eastern black rails nest in tidal salt marshes and are closely associated with densely vegetated high marsh habitat that is infrequently flooded (USFWS, 2024).

The Mispillion Inlet provides critically important habitat for the federally-listed threatened red knot. Red knot and other migrating shorebirds stopover in Delaware to acquire food resources, including horseshoe crab eggs, and gain weight to optimize their body condition before completing their migration to Arctic nesting grounds. The federally listed threatened red knot is known to occur in the inlet area. Delaware Bay beaches including those surrounding the inlet are significant stopover and forage habitat for migrating red knots. Three subunits of proposed red knot critical habitat occur in the study area, “Main Harbor” (DE-3A), “Rawley Island Roost” (DE-3B) and “Slaughter Beach” (DE-3C) (USFWS, 2024).

The proposed-threatened monarch butterfly (*Danaus plexippus*) may occur in the area. Vegetated areas of maritime dunes and grasslands serve as habitat for this species.

The federally threatened seabeach amaranth (*Amaranthus pumilus*) may be present in the area. Seabeach amaranth is an annual plant that occurs on barrier beaches. Its primary habitat consists of overwash flats and areas characterized by accumulating sand or the upper strands on stable beaches. However, the Service has no records of seabeach amaranth occurring in the inlet area (USFWS, 2024).

The state-endangered American oystercatcher (*Haematopus palliatus*) has been documented breeding at this site. American oystercatchers start arriving in Delaware in March, start nesting in April, and migrate south by September. This species lays their eggs directly on the sand but will also nest in salt marshes. Other state-listed migratory birds that have been documented at the site include:

- Black Skimmer (*Rynchops niger*)
- Saltmarsh Sparrow (*Ammodramus caudacuta*)
- Least Tern (*Sterna antillarum*)

Female diamondback terrapins could nest in the study area. Female diamondback terrapins typically emerge from the water between mid-May to mid-July to lay their eggs above the high tide line. Hatchlings either emerge from the nest after hatching in summer/early fall or overwinter in the nest until the following spring.

A query of the National Marine Fisheries Service Endangered Species Act (ESA) mapper on December 30, 2025, indicates the following threatened and endangered species have the potential to occur in the study area:

- Atlantic sturgeon (*Acipenser oxyrinchus oxyrinchus*) - Federal threatened and endangered, State endangered
- Atlantic sturgeon critical habitat
- Shortnose sturgeon (*Acipenser brevirostrum*) – Federal endangered, State endangered
- Green sea turtle (*Chelonia mydas*) - Federal threatened, State endangered
- Kemp’s ridley sea turtle (*Lepidochelys kempii*) – Federal endangered, State endangered
- Leatherback sea turtle (*Dermochelys coriacea*) – Federal endangered, State endangered
- Loggerhead sea turtle (*Caretta caretta*) – Federal threatened, State endangered
- Atlantic right whale (*Eubalaena glacialis*) – Federal endangered, State endangered

- Fin whale (*Balaenoptera physalus*) - Federal endangered, State endangered

Adult, subadult, and juvenile Atlantic sturgeon use the Delaware Bay for migration and foraging and could occur at any time of year. Adult Atlantic sturgeon migrate upriver in natal rivers to spawn.

Adult shortnose sturgeon use the Delaware Bay for migration and foraging may be present from April through November.

Sea turtles use the Delaware Bay for migration and foraging. Sea turtles are expected in the Delaware Bay near the project area in low densities (0.00 – 0.100 sea turtles/sq km) at the following times:

- Green: June through October (peak in August and September)
- Kemp's ridley: June through October (peak in June through August)
- Leatherback: July through October (peak in August through October)
- Loggerhead: June through October (but not as close to shore as the other species)

Because the study would occur in estuarine waters and on an estuarine beach, it is unlikely that whales would occur in the study area.

Because rare species are present, this project is within a State Natural Heritage Site. State Natural Heritage Sites are identified as "Designated Critical Resource Waters" by USACE.

Future Without Project. Sea level change would result in an increase in aquatic habitat and a decrease of intertidal wetland habitat as it transitions to unconsolidated shoreline. Without the project, erosion would continue, increasing the risk of a breach from the estuary to the Mispillion River (see Section 2.1.1). This would result in the reconfiguration of the Mispillion Inlet. It may specifically affect the interior beaches which serve as an important forage and nest habitat for shorebirds, including red knots, on their northward migration (see Section 2.1.3).

2.1.7 Essential Fish Habitat

Existing Conditions. The Magnuson-Stevens Fishery Conservation and Management Act, as amended by the Sustainable Fisheries Act of 1996 requires all Federal agencies to consult with the National Marine Fisheries Service (NMFS) on all actions, or proposed actions, permitted, funded, or undertaken by the agency, that adversely affect Essential Fish Habitat (EFH). A query of the NMFS EFH Mapper was conducted on December 30, 2025, to determine the species and life stages with EFH designated in the study area. Table 1 presents the managed species and their life stage that EFH is identified for in the Mispillion study area. Habitat parameters identified as EFH in the study area are provided in Appendix C.

Table 1. Species/Life Stages with Essential Fish Habitat (EFH) Designated and the Time of Year Present in the Study Area

Species	Eggs Abundance/ Presence	Larvae Abundance/ Presence	Juveniles Abundance/ Presence	Adults Abundance/ Presence	Description of HAPC
Atlantic butterfish (<i>Peprilus triacanthus</i>)		Common: Mar-Jun; Rare: Aug	Common: Jul-Dec	Common: Apr-Sep	
Atlantic herring (<i>Clupea harengus</i>)			Common: Mar-May; Rare: June-Nov	Common: Nov-Jan	
Black sea bass (<i>Centropristis striata</i>)			Common: May- Aug; Rare: Mar – Apr, Sept-Nov	Common: Mar-Nov	
Bluefish (<i>Pomatomus saltatrix</i>)			Abundant: May-Oct; Rare: Nov	Common: May-Oct; Rare: Nov	
Clearence skate (<i>Raja eglanteria</i>)			Apr-Oct	Common: Apr-Oct	
Little skate (<i>Leucoraja erinacea</i>)			Winter, Spring	Winter, Spring	
Longfin inshore squid (<i>Doryteuthis pealeii</i>)	Most abundant in spring			Spring, Summer	
Red hake (<i>Urophycis chuss</i>)				Common: Nov-Mar Rare: Apr	
Sand tiger shark (<i>Carcharias taurus</i>)		Summer (<i>Neonates</i>)	Summer	Summer	Lower portions of Delaware Bay to areas adjacent to the mouth of Delaware Bay for all life stages. The inshore extent of the HAPC reflects a line drawn from Port Mahon east to Egg Point Island (39°11'N lat.), and from Egg Point Island southeast to Bidwell Creek. The HAPC excludes an area rarely used by sand tiger sharks, which is north of a line between Egg Point Island and Bidwell Creek that includes Maurice Cove. The

					HAPC spans the mouth of Delaware Bay between Cape Henlopen and Cape May and also includes adjacent coastal areas offshore of Delaware Bay and areas south (between the Indian River inlet and Cape Henlopen, Delaware).
Sandbar shark (<i>Carcharhinus plumbeus</i>)		Summer (<i>Neonates</i>)	Year-round		important nursery and pupping grounds which have been identified in shallow areas and at the mouth of Great Bay, New Jersey, in lower and middle Delaware Bay, Delaware; at least from 15 to 35 ppt; water depth ranging from 0.8 to 23 m; and in sand and mud
Scup (<i>Stenotomus chrysops</i>)			Common: Aug-Sept Rare: May- Aug, Oct	Common: Apr- Dec	
Smoothhound shark complex (<i>Atlantic stock</i>) (<i>Mustelus spp.</i>)		Spring, Summer (<i>Neonates</i>)	Spring, Summer	Spring, Summer	
Summer flounder (<i>Paralichthys dentatus</i>)			Common May-Oct Rare: Mar- Apr, Nov-Dec	Common May- Oct Rare: Mar-Apr, Nov-Dec	native species of macroalgae, seagrasses, freshwater and tidal macrophytes in any size bed, as well as loose aggregations
Windowpane flounder (<i>Scophthalmus aquosus</i>)			Common: Jan-Dec	Common: Jan- Dec	
Winter skate (<i>Leucoraja ocellata</i>)			Winter, Spring	Winter, Spring	

The Mispillion River, Cedar Creek, the Delaware Bay and Estuary, and the surrounding coastal bays, creeks, inlets, marshes, submerged aquatic vegetation (SAV), shellfish, and mudflats have been designated as EFH for various life stages of 15 species managed by the New England Fishery Management Council (NEFMC), Mid-Atlantic Fishery Management

Council (MAFMC), South Atlantic Fishery Management Council (SAFMC), and NMFS. These areas provide feeding, spawning, resting, nursery, and staging habitat for a variety of commercially, recreationally, and ecologically important species.

Habitat Areas of Particular Concern (HAPCs) are a subset of EFH that are either rare, particularly susceptible to human-induced degradation, especially important ecologically, or located in an environmentally stressed area. Subtidal areas within the study area have been designated as HAPC for sandbar shark and sand tiger shark. SAV has been designated as HAPC for summer flounder.

Future Without Project. Sea level change and a future breach would result in an increase in aquatic habitat and a decrease of intertidal wetland habitat/tidal saltmarsh habitat, as it transitions to unconsolidated shoreline. While fish distribution could adapt with these changes in habitat, saltmarsh provides prey and nursery habitat. A loss in tidal saltmarsh could result in a local decrease in fisheries productivity. A breach could also result in short-term increases in turbidity.

2.1.8 Migratory Bird Act and the Bald and Golden Eagle Protection Act

Existing Conditions. Despite the overall reduction in habitat represented by the inlet over time and that shorebirds thrive best along dynamic coastal beaches, it is important to note that management of the current configuration of the inlet does provide significant benefits to wildlife. For example, the rock dike and breakwall create a low energy, sheltered environment that provide important habitat. The waters of Mispillion Inlet provide relatively shallow and protected conditions, resulting in waters that warm earlier that trigger earlier and greater amounts of horseshoe crab spawning, relative to other areas in the Delaware Bay. Importantly, spawning occurs at densities that ensure that successive spawning horseshoe crabs displace the eggs of previous horseshoe crabs from approximately 15 cm deep to the surface where they are then accessible to foraging birds and fish. Without these high densities and redistribution, horseshoe crab eggs would not be available to fish and wildlife. Migrating shorebirds rely on this foraging opportunity. In May of each year, the Mispillion Inlet area can become one of a few areas in Delaware Bay where the greatest concentrations of shorebirds occur. These birds arrive at or near fat-free weight and must regain fat deposits to successfully migrate to the Arctic and initiate nesting. Horseshoe crab eggs provide an easily digested abundant food resources to allow this weight gain. For example, red knots arrive weighing 100-120 g and need to reach approximately 180 g if successful breeding can be expected (Robinson et al. 2003, Baker et al. 2004).

More than thirty bird species in the study area are protected under the Migratory Bird Act (MBTA) and the Bald and Golden Eagle Protection Act (BGEPA). The USFWS identifies Birds of Conservation Concern as migratory nongame bird species likely to become candidates for listing under the ESA without additional conservation action. Appendix C provides the breeding season for birds of conservation concern that are also protected under the MBTA and BGEPA. Most birds of conservation of concern breed in the study area in the spring and summer. One notable exception is the bald eagle.

Due to the concentration of shorebirds using the area, the Mispillion Inlet area is recognized as a part of the Delaware Bay Western Hemisphere Shorebird Reserve Network Site of Hemispheric

Importance, the Delaware Bay Wetland of International Significance by the Ramsar Convention on Wetlands, and the Delaware Coastal Zone Important Bird Area of Global Significance. With shorebird populations undergoing widespread declines (Smith et al. 2023), management of critical migratory stopover and foraging habitats like the ones present at the Mispillion Inlet represent an opportunity to impact population levels for these declining species. The red knot is an example of a species that can benefit from restoration of this area. The beaches of Mispillion River are surveyed daily on an annual basis by the Delaware Shorebird Project (DSP) between May 1 and June 3 as are other beaches along the bayshore. The DSP includes an extensive international team that has been doing this work since the mid-1990s. The survey includes collecting shorebird flock sizes on the individual beaches in the Mispillion Inlet area as well as catching shorebirds, gathering data on individual birds, and marking birds with unique alphanumeric coded flags that allow statistical analysis of populations using Delaware Bay.

The Mispillion Inlet has historically supported some of the highest concentrations of red knot in Delaware Bay, but the DSP has observed reduced numbers in recent years. More specifically, decreases in flock size and duration of time spent by marked birds have been observed in the inlet, and red knots seem to be favoring restored beaches in New Jersey that have more of the dynamic nature preserved. To show some of the importance of the inlet area to shorebirds, Table 2 from DSP data shows peak single survey flock counts within Mispillion Inlet for red knot, ruddy turnstone (*Arenaria interpres*), and semipalmated sandpiper

Table 2. Flock Counts at Mispillion Inlet

Year	Red knot	Ruddy turnstone	Sanderling	Semipalmated sandpiper
2016	1,162	11,620	5,075	21,700
2017	1,214	6,102	720	23,020
2018	1,000	1,777	60	10,686
2019	639	4,085	10	3,533
2020	469	8,464	371	4,509
2021	1,041	3,806	200	8,489
2022	138	3,149	179	39,930
2023	827	9,577	2,600	12,200

The federally listed threatened piping plover (*Charadrius melodus*) is not known to nest in this area, and historical data are not available for the species from the Delaware Bay shore. However, recent evidence shows piping plover nest on Delaware Bay beaches. Fowler Beach is located within the Prime Hook National Wildlife Refuge and approximately 5.5 miles south from the inlet was restored in 2015-2016. Nesting has not been recorded prior to restoration, and the beach now consistently supports the largest number of piping plover nests in the state. In 2023, 24 nests were observed, and 20 chicks successfully fledged. The restored beach also provides habitat for several other avian species of interest. For example, in 2020 three pairs of State-listed endangered American oystercatcher (*Haematopus palliatus*) were observed nesting and a colony of approximately 65 State-listed endangered least tern (*Sterna antillarum*) was present. These

numbers show the potential response of species of conservation concern when a beach profile is restored, and possible benefits associated with habitat restoration along Conch Bar and Big Stone Beach.

Future Without Project. Sea level change would result in changes to the distribution of wetland habitat throughout the study area. This would result in changes in the distribution of migratory birds that use the study area for habitat.

Without the project, erosion would continue, increasing the risk of a breach. This would result in the loss of beach, dune, and salt marsh habitat north of the inlet which serve as forage and nesting habitats for a variety of migratory birds and particularly the red knot as described in Sections 2.1.3 and 2.1.6.

2.2 Physical Environment

2.2.1 Climate and Weather

Existing Conditions. The mid-latitude location of the study area and proximity to the Atlantic Ocean influences its climate, which is characterized by cold winters and warm summers. Moderating influences of the Atlantic Ocean and Delaware Bay tend to lessen temperature extremes. Slight variations in average (1991–2020) temperatures across this small, relatively flat state range from 53°F in the north to 58°F along the coast in the south. The statewide annual average (1991–2020) precipitation is 45.9 inches, with large interannual variability ranging from 27.4 inches in 1930 to 60.1 inches in 1948. Annual average snowfall ranges from 9 to 20 inches.

The jet stream is often located near the state, particularly in winter and spring. Storm systems associated with the jet stream bring frequent precipitation and fluctuating temperatures. The state often experiences strong winter storms known as nor'easters, which derive their energy from the contrast between cold air in the continental interior and warmer air over the western Atlantic Ocean.

The prevailing wind direction reported at the Brandywine Shoal Light in Lower Delaware Bay is from the northwest. The most frequent and strongest wind directions (greater than 26 knots) are from the northwest. However, relatively strong winds (greater than 18 knots) occur from all directions. The wind regime varies from season to season, with the stronger winter winds prevailing from the northwest and the majority of the summer winds prevailing from the south. However, some of the strongest winds (highest velocity) observed throughout the year are from the northeast.

Temperatures in Delaware have risen more than 3°F since the beginning of the 20th century. The number of very hot days in Dover has been highly variable, with no long-term trend since 1910. By contrast, the number of very warm nights at Dover has been increasing since the early 1960s, reaching a peak during the 2015–2019 period. The number of freezing days has been generally below the long-term average since the early 1990s. Statewide, total annual precipitation has shown a slight upward trend since 1895 and has been above average since the mid-1990s). The number of 2-inch extreme precipitation events at Dover has generally been above average since the early 1990s. The state's coastline is highly vulnerable to damage from coastal and tropical storms.

Nor'easters, the most common coastal storms, bring strong winds, heavy precipitation, and coastal flooding. They are most active from mid-winter through spring, with peak activity during March. The Ash Wednesday nor'easter of March 6–8, 1962, was the worst in Delaware history and illustrates the potential danger of such storms. The strong northeast winds, broad fetch (upwind distance traveled), and high angle of wave approach caused record flooding and beach erosion in Delaware and along the eastern seaboard beach that were not protected by a wide beach, and dunes were destroyed.

February 2010 brought multiple snowstorms to Delaware, which closed schools, disrupted transportation, and contributed to several snowfall records (greatest daily snow depth, greatest monthly snowfall, and greatest seasonal snowfall). During a blizzard in January 2016, gusts up to 75 mph caused dangerous storm surge and flooding. Tropical storms and hurricanes occasionally affect Delaware in late summer and fall.

Hurricanes Irene (2011) and Sandy (2012) caused significant economic and infrastructure damage to the state. Hurricane Sandy, which made landfall in New Jersey as a post-tropical storm, caused record flooding along the Atlantic and Delaware Bay coasts. Tornadoes and heavy rains trailing Hurricane Irene resulted in power outages for at least 119,000 residents and damages in the millions of dollars for the state. Total annual precipitation is projected to increase for Delaware, with the greatest increase occurring in winter and spring. This change is characteristic of a large area of the North Hemisphere in the higher mid-latitudes that is projected to see increases in both total precipitation and extreme precipitation events. On average, the state experiences about 2 days each year with 2 or more inches of rain. State-level projections show an increase of 0.5 to 1 day each year with 2 inches of rainfall by the end of the century. These precipitation projections may also result in increased flooding risks throughout the state.

Since 1900, global average sea level has increased by about 7–8 inches. The rise on Delaware's coast has been greater due to land subsidence. Sea level change has important future cross-sector implications for public health, water resources, coastal ecosystems and wildlife, agriculture, and transportation infrastructure. Demographic trends may increase the risks of coastal flooding. Due to the relocation of retirees, coastal communities show increases in their vulnerable elderly populations. Sea level change has also caused an increase in tidal floods associated with nuisance-level impacts. Nuisance floods are events in which water levels exceed the local threshold (set by NOAA's National Weather Service) for minor impacts. These events can damage infrastructure, cause road closures, and overwhelm storm drains. As sea level has risen along the Delaware coastline, the number of tidal flood days (all days exceeding the nuisance-level threshold) has also increased, with the greatest number (15) occurring at Lewes in 2009 and 2017 (Runkle et al., 2022).

Future Without Project. In the future, weather trends are expected to continue with or without the project. This includes:

- Increases in mean temperature, including increases in very hot days and very warm nights
- Decreases in the number of freezing days
- Increases in precipitation and extreme precipitation events
- Sea level change and land subsidence.

2.2.2 Water Resources

2.2.2.1 Vertical Datum and Tides

In accordance with ER 1110-2-8160 the Mispillion Inlet Project is designed to North American Vertical Datum of 1988 (NAVD88), the current orthometric vertical reference datum within the National Spatial Reference System (NSRS) in CONUS. The study area is subject to tidal influence and is directly referenced to National Water Level Observation Network (NWLON) tidal gages and coastal hydrodynamic tidal models established and maintained by the U.S. Department of Commerce (NOAA). The current NWLON National Tidal Datum Epoch (NTDE) is 1983-2001.

The Brandywine Shoal Light NWLON tidal gage is used to reference tidal water levels to NAVD88 (Table 3). Daily tidal fluctuations in the study area are semi-diurnal, with a full tidal period that averages 12 hours and 25 minutes; hence there are nearly two full tidal cycles per day. The mean tidal range in the Delaware Bay at Brandywine Light Shoal is 5.3 feet. The tidal datums at Lewes, DE are also shown in Table 3 since this tidal station is used to define the historical rate of sea level change for the study due to its longer historical record.

Table 3. Tidal Datum Relationships

Datum¹	Brandywine Shoal Light (Feet, NAVD88)	Lewes (Feet, NAVD88)
Mean Higher High Water (MHHW)	2.60	2.02
Mean High Water (MHW)	2.16	1.60
North American Vertical Datum of 1988 (NAVD88)	0.00 ²	0.00
Mean Sea Level (MSL)	-0.29	-0.40
Mean Low Water (MLW)	-2.74	-2.47
Mean Lower Low Water (MLLW)	-2.90	-2.63
Mean Tide Range (MN)	5.34	4.07

Notes: ¹Tidal datums based on 1983-2001 Tidal Epoch, ²NAVD88 based on NOAA's VDATUM Software

2.2.2.2 Sea Level Change

In accordance with ER 1100-2-8162, potential effects of relative sea level change (RSLC) were analyzed over a 50-yr economic analysis period and a 100-yr planning horizon. ER 1100-2-8162 states that planning studies will formulate alternatives over a range of possible future rates of SLC and consider how sensitive and adaptable the alternatives are to SLC.

ER 1100-2-8162 requires planning studies and engineering designs to consider three future sea level change scenarios: low, intermediate, and high. The historic rate of SLC represents the “low” rate. The “intermediate” rate of SLC is estimated using the modified National Research Council (NRC) Curve I. The “high” rate of SLC is estimated using the modified NRC Curve III. The “high” rate exceeds the upper bounds of IPCC estimates from both 2001 and 2007 to accommodate the potential rapid loss of ice from Antarctica and Greenland, but it is within the range of values published in peer-reviewed articles since that time.

Historical RSLC for this study, 1.24 ft over 100 years (3.77 mm/yr) is based on NOAA tidal records from 1919-2026 at Lewes, DE (Table 4). Figure 9 shows historical RSLC at Lewes, DE.

Several metrics for sea level are presented, the monthly mean sea level, 5-year moving average, and 19-year moving average. It is apparent that over long-time scales (19 years) mean sea level is steadily increasing. However, over shorter time scales mean sea level may increase or decrease. The monthly mean sea level goes up and down every year, capturing the seasonal cycle in mean sea level. The 5-year moving average, orange line in Figure 9 captures the interannual variation (2 or more years).

Table 4. USACE Sea Level Change Scenarios (Derived from Lewes, DE)

Year	USACE - Low (ft, MSL¹)	USACE - Int (ft, MSL¹)	USACE - High (ft, MSL¹)
1992	0.00	0.00	0.00
2000	0.10	0.10	0.12
2025	0.41	0.42	0.62
2030	0.47	0.60	1.01
2040	0.59	0.80	1.45
2050	0.72	1.02	1.96
2060	0.84	1.25	2.56
2070	0.96	1.51	3.22
2080	1.09	1.78	3.96
2090	1.21	2.07	4.77
2100	1.34	2.37	5.66
2130	1.71	3.40	8.77

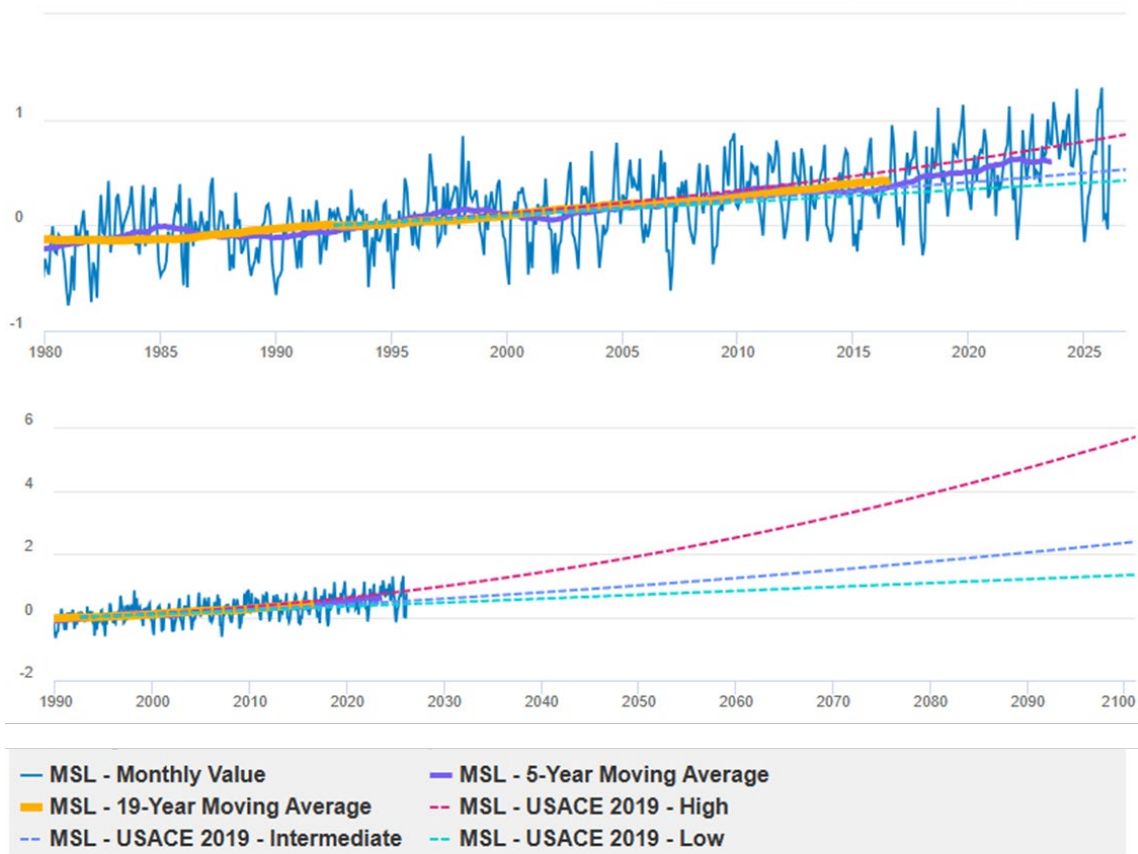
Notes: SLC rate used in equation based on 3.77 mm/yr (1.24 ft/100 yrs)

Sea Level Data and Projections: Lewes, DE (8557380)



NOAA Tide Gauge

Feet above Mean Sea Level Datum
(1983-2001 epoch)



SLC rate used in equation based projections: 3.77 mm/yr (1.24 ft/100 yrs)
SLC source: NOAA-NOS Tides & Currents Trend (Feb 1919 - Dec 2024)
MSL record span: 1919 to 2026 (107 years)
Missing data: The MSL record for this gauge has a gap of 5 or more years

Figure 9. Historical Sea Level Change at Lewes, DE

2.2.2.3 Storm Surge

Storm surge is the increased water level above the predicted astronomical tide due to storm winds over the ocean and the resultant wind stress on the ocean surface. The principal factor that creates flood risk for the study area is storm surge. The magnitude of the storm surge is calculated as the difference between the predicted astronomic tidal elevation and the actual water surface elevation at any time. Wind blowing over the ocean surface can generate storm surge. However, the largest and most damaging storm surges develop as a result of either tropical cyclones (hurricanes and tropical storms) or extra-tropical cyclones (“nor’easters”).

North Atlantic Coast Comprehensive Study (NACCS) modeling results are used to define wave and baseline water level Annual Exceedance Probabilities (AEP) and in the development of the alternatives (Table 5). The NACCS modeling study provides nearshore wind, wave, and water

level estimates and the associated marginal and joint probabilities critical for effective coastal storm risk management. This modeling effort involved the application of a suite of high-fidelity numerical models within the Coastal Storm Modeling System (CSTORM-MS) to 1050 synthetic tropical storms and 100 historical extra-tropical storms. Documentation of the numerical modeling effort is provided in Cialone et al. 2015 and documentation of the statistical evaluation is proved in Nadal Caraballo et al. 2015. Products of the study are available for viewing and download on the Coastal Hazards System (CHS) website: <https://chs.erd.c.dren.mil/>.

NACCS Save Point #15247 is located about 2,000 feet offshore and is used to characterize the water levels and AEP for the project (Table 5).

Table 5. NACCS Water Level Annual Exceedance Probability

Return Period (years)	Average Annual Exceedance Probability	NACCS Save Point #15247 (ft, NAVD88)
1	100.0%	4.5
2	50.0%	5.2
5	20.0%	6.1
10	10.0%	6.6
20	5.0%	7.2
50	2.0%	8.7
100	1.0%	10.1
200	0.5%	11.4
500	0.2%	13.1

2.2.2.4 Waves

Waves within Delaware Bay may be generated by local winds or propagate from the ocean through the mouth of the Bay. Further away from the mouth of the Bay the wave direction is associated with the wind direction and prevailing fetch. Two NOAA National Data Buoy Center (NDBC) stations are available inside Delaware Bay, 44054 and 44055. Station 44054 is located near the mouth of the Bay and is exposed to a combination of local winds and waves that propagate through the mouth of the Bay. Station 44055 is located farther up the Bay and is primarily exposed to locally generated waves

2.2.2.5 Currents

Tidal currents along the beach north and south of Mispillion Inlet are weak due to the jetties and the currents are dominated by wave generated currents during storm events (Moffatt & Nichol, 2007).

2.2.2.6 Longshore Sediment Transport

The shorelines adjacent to Mispillion Inlet are classified as “estuarine washover barriers” (Maurmeyer, 1978). These barriers (i.e., “beaches”) consist of a relatively narrow and vertically thin veneer of sand and gravel that is derived from older (pre-Holocene) headlands that exist along

portions of the Delaware Bay shoreline. Historically the estuarine washover barriers on Delaware Bay have migrated landward and upward over older sediments in response to sea level change. When compared to nearby open-ocean beaches in Delaware, the nearshore zone of Delaware Bay in the vicinity of Mispillion Inlet is a relatively low-energy environment in terms of wave energy, with corresponding lower rates of longshore sand transport under “normal” conditions. Potentially larger transport rates can occur in the vicinity of Mispillion Inlet during storm events.

Longshore sediment transport (LST) is the process by which incident waves, and to a lesser degree, tidal currents, mobilize sandy sediment in the swash zone and transport it in the longshore direction. The project area experiences LST in either longshore direction at different times, depending on the incident wave direction at any given time. Over long periods, transport in one direction will usually dominate transport in the other direction, with the dominant direction referred to as the direction of “net” transport.

2.2.2.7 Water Quality

Existing. The study area includes three watersheds, Lower Cedar Creek, Lower Mispillion River, and Delaware River Basin Zone 6 watersheds. A query of the EPA’s Assessment, Total Maximum Daily Load (TMDL) Tracking and Implementation System (ATTAINS) found that both watersheds are impaired. The Lower Cedar Creek and Lower Mispillion River watersheds are impaired for aquatic life and swimming and boating due to the presence of bacteria and other microorganisms, the presence of excessive nitrogen and/or phosphorous concentrations, and low oxygen concentrations. The Delaware River Basin Zone 6 is impaired for fish and shellfish consumption, with mercury and PCBs as identified issues. It is in “good” condition for swimming and boating (USEPA, 2025a).

TMDLs have been implemented so that these waterbodies will meet and continue to meet water quality standards for that particular pollutant. TMDLs are the maximum amount of a pollutant allowed to enter a waterbody, in order to attain the pollutant reduction targets (USEPA, 2025b).

Future Without Project. In the future, with the establishment of TMDLs, water quality in the study area is expected to improve with or without the project.

2.2.2.8 Waters of the U.S.

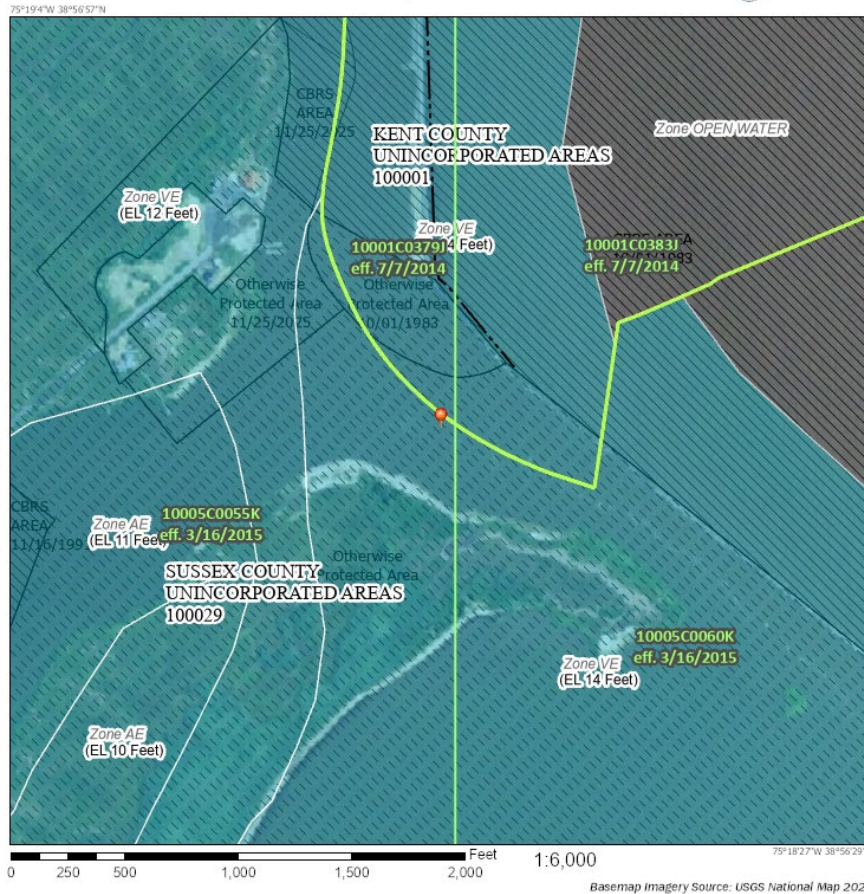
Existing. Because rare species are present, the study area is within a State Natural Heritage Site. State Natural Heritage Sites are identified as "Designated Critical Resource Waters" by USACE.

Future Without Project. In the future without the project, the study area would continue to be a State Natural Heritage Site and Designated Critical Resource Waters.

2.2.2.9 Floodplains

Existing. The study area is within Federal Emergency Management Agency (FEMA) special flood hazard areas identified as Zone AE with base flood elevations 10 feet and 11 feet and Zone VE with a base flood elevation of 12 and 14 feet (Figure 10).

National Flood Hazard Layer FIRMette



Legend

SEE FIS REPORT FOR DETAILED LEGEND AND INDEX MAP FOR FIRM PANEL LAYOUT

SPECIAL FLOOD HAZARD AREAS

- Without Base Flood Elevation (BFE) Zone A, X, A99
- With BFE or Depth Zone AE, AO, AH, VE, AR
- Regulatory Floodway

OTHER AREAS OF FLOOD HAZARD

- 0.2% Annual Chance Flood Hazard. Areas of 1% annual chance flood with average depth less than one foot or with drainage areas of less than one square mile Zone X
- Future conditions 1% Annual Chance Flood Hazard Zone X
- Area with Reduced Flood Risk due to Levee. See Notes, Zone X
- Area with Flood Risk due to Levee Zone D

OTHER AREAS

- NO SCREEN Area of Minimal Flood Hazard Zone X
- Effective LDMRs
- Area of Undetermined Flood Hazard Zone D

GENERAL STRUCTURES

- channel, culvert, or Storm Sewer
- Levee, Dike, or Floodwall

OTHER FEATURES

- Cross Sections with 1% Annual Chance Water Surface Elevation
- Coastal Transect
- Base Flood Elevation Line (BFE)
- Limit of Study
- Jurisdiction Boundary
- Coastal Transect Baseline
- Profile Baseline
- Hydrographic Feature

MAP PANELS

- Digital Data Available
- No Digital Data Available
- Unmapped

The pin displayed on the map is an approximate point selected by the user and does not represent an authoritative property location.

Figure 10. FEMA Floodplain

Future Without Project. In the future without the project, the study area would remain in the floodplain.

2.2.3 Geology

2.2.3.1 Shoreline Change

Existing. As described in Section 1.4, historic shoreline mapping indicates that the Federal navigation works at Mispillion Inlet (i.e., the jetties) have interrupted littoral drift patterns in the study area. Figure 4 illustrates shoreline changes adjacent to Mispillion Inlet from 1842 to the present. Figure 11 shows the shoreline changes from 2002 through 2024. The shoreline change data indicate that during periods that predate the construction of the Mispillion Inlet navigation works (i.e., 1893 to 1939), the beach north of the inlet retreated at rates between 6 and 7 feet per year for a loss of approximately 300 feet prior to the construction of the navigation works. For periods after 1946 the rates of shoreline retreat increased to 10 to 14 feet per year, for a loss of approximately 900 feet after the construction of the navigation works. The shorelines in the study area are classified as “estuarine wash over barriers” (Maurmeyer, 1978). These barriers (i.e., “beaches”) consist of a relatively narrow and vertically thin veneer of sand and gravel that is derived from older (pre-Holocene) headlands that exist along portions of the Delaware Bay

shoreline. Historically the estuarine wash over barriers on Delaware Bay have migrated landward and upward over older sediments in response to sea level change. When compared to nearby open-ocean beaches in Delaware, the nearshore zone of Delaware Bay in the vicinity of Mispillion Inlet is a relatively low-energy environment in terms of wave energy, with corresponding lower rates of longshore sand transport under “normal” conditions. Potentially larger transport rates can occur in the vicinity of Mispillion Inlet during storm events. It appears that net littoral transport is from south to north at this location, based on the relatively small change in shoreline location south of the jetty along Slaughter Beach.

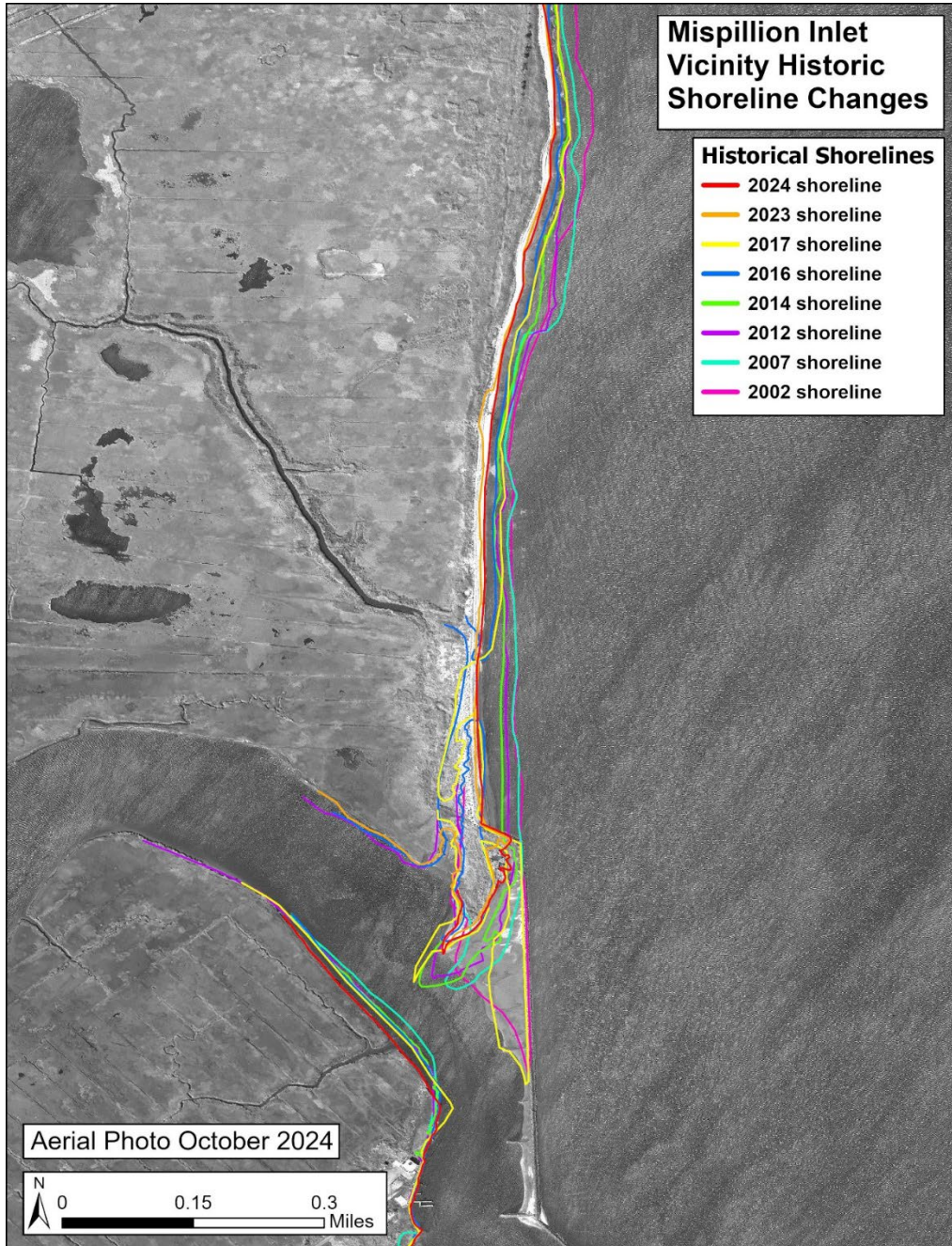


Figure 11. Mispillion Inlet Shoreline Changes from 2002-2024

A sand-starved shoreline on Delaware Bay might not respond like a sand-rich ocean shoreline. There may not be sufficient sand in the Delaware Bay nearshore to create the same, typical impact seen at many ocean coast inlets with jetties, i.e., with updrift accretion and downdrift erosion. Clearly there was a pre-project erosion trend along the beach north of Mispillion Inlet that was exacerbated by construction of the navigation works. The apparently “stable” beach (no appreciable gain or loss of shoreline) south of the inlet, since the jetties have been in place, might represent an accretion. Without the jetties, the Slaughter Beach and downdrift sides of the inlet might have retreated a similar rate, e.g., 6 to 7 feet per year.

Future Without Project. Projecting the future shoreline positions based on a rate of 9.1 ft/yr, based on historic shoreline changes (Figure 8), shows that by the year 2050, the shoreline will erode past the landward tip of the dike significantly increasing the risk of a breach.

2.2.3.2 Soils

Existing Conditions. Based on the Geologic Map of Kent County, Delaware (2007), prepared by the Delaware Geological Survey (DGS), the area is situated in the Coastal Plain Physiographic Province, which is characterized by undifferentiated and interlayered sedimentary deposits. Specifically, the site is mapped as underlain by Holocene Age marsh deposits. These materials are described as structureless to finely laminated, black to dark gray, organic-rich, silty clay to clayey silt, with discontinuous beds of peat and rare shells. The deposit ranges from 1 to 40 feet thick and is generally mapped where there is salt-tolerant marsh grass present.

To the north and west of the site, based on the information presented on the Geology of the Milford and Mispillion River Quadrangles (1997), Delaware, prepared by the Delaware Geological Survey (DGS), the site is specifically mapped as being underlain by the Lynch Heights Formation. The Lynch Heights Formation is described as a heterogeneous unit of light gray to brown and light yellowish-brown, medium to fine sand with discontinuous beds of coarse sand, gravel, silt fine to very fine sand, and organically rich clayey silt to silty sand. The upper parts of the Lynch Heights formation commonly consist of fine, well sorted sand. Small scale cross-bedding within the sands is common. Some interbedded clayey silts and silty sands are burrowed. Beds of shell are rarely encountered. Sands are quartzose, slightly feldspathic, and typically micaceous where very fine to fine grained. The Lynch Heights formation underlies a terrace parallel to present Delaware River that has elevations between 30 and 50 feet. The Lynch Heights formation is interpreted to be a fluvial to estuarine unit of fluvial channel, tidal flat, tidal channel, beach, and bay deposits (Ramsey 2007). Overall thickness rarely exceeds 20 feet (Ramsey 1997).

Soil Map Summary. Figure 12 provides the Soil Map of Kent and Sussex County, Delaware for the study area. The mapping was obtained from the United States Department of Agriculture Natural Resources Conservation Service Web Soil Survey. Due to the study area overlapping two different counties, the conducted soil survey data provides two sets of information. Any soil data that is similar between the two are combined in Table 6. None of the mapped soils are classified as prime farmland soils.



Figure 12. Soil Map—Kent County, Delaware, and Sussex County, Delaware

Table 6. Soil Map Survey Data

Map Unit Symbol	Map Unit Name	Landform Characteristic
AbC	Acquango – Beaches complex, 0 to 10 percent slopes.	Dunes, backshores
AcC	Acquango sand, 5 to 10 percent slopes, occasionally flooded.	Dunes
TP	Transquaking and Mispillion soils, very frequently flooded, tidal.	Tidal marshes
UzC	Udorthents, 0 to 10 percent slopes.	Flats, knolls
W	Water	N/A
SuA	Sunken mucky silt loam, 0 to 2 percent slopes, occasionally flooded, tidal.	Submerged upland tidal marshes, flats
Be	Beaches, very frequently flooded.	Beaches

The soils in the immediate vicinity of the recommended beach nourishment are the Acquango – Beaches complex, which consists of fine sandy soils, Transquaking and Mispillion soils consisting of dark brown muck or peaty muck over layers of dark gray silty clay loam and Udorthents which is a distinctive type of soil, often referred to as "man-made" or "disturbed" soils.

Future Without Project. In the future with or without the project, sea level change would result in inundation of soils and sediments throughout the project area. This would result in reclassification or redistribution of solids and sediments throughout the study area.

2.2.4 Land Use

Existing. Land use in the study area is primarily open water (greater than 50%), Approximately 2% of the study area is cultivated crops. About 3% of the study area is developed. Table 7 is provides land use in the study area.

Table 7. Land Cover in the Study Area

Land Cover	Percentage
Open Water	49.0
Perennial Ice/Snow	0
Developed, Open Space	0.4
Developed, Low Intensity	1.4
Developed, Medium Intensity	0.8
Developed, High Intensity	0.3

Land Cover	Percentage
Barren Land (Rock/Sand/Clay)	0.7
Deciduous Forest	0
Evergreen Forest	0.3
Mixed Forest	0.2
Shrub/Scrub	<0.1
Grassland/Herbaceous	<0.1
Pasture/Hay	0
Cultivated Crops	1.9
Woody Wetlands	3.5
Emergent Herbaceous Wetlands	41.5

Future Without Project. Sea level change may result in the flooding and inundation of developed areas in the study area. As this is not a heavily developed area, land use would adapt with sea level change in the future with or without the project.

2.2.5 Coastal Zone

Delaware has the lowest average elevation of all the U.S. states and experiences land subsidence. Its shoreline spans more than 250 miles. The entire state is classified as a coastal zone due to the proximity of inland areas to tidal waters: no geographic location within the state is more than 8 miles from tidal waters.

2.2.6 Coastal Barrier Resources

The Coastal Barrier Resources Act (CBRA) of 1982 prevents most new federal expenditures in protected areas. The Coastal Barrier Resources Act restricts Federal funding and financial assistance that would encourage or subsidize development in areas designated as Coastal Barrier Resources System (CBRS) units. There are two CBRS units in the study area, the Broadkill Beach System Unit (H00) is a 5,575-acre unit extending north and west from the north jetty, and sections of the Broadkill Beach. Otherwise Protected Area (H00P) extends south from the north jetty and includes the Mispillion Inlet Federal Navigation Project. In 2022, the Service proposed updates to CBRS unit boundaries to increase accuracy and precision of mapping, and to account for changes due to natural forces. Reclassification and additions to H00 and H00P units are recommended as part of these updates and will become effective if the revised maps are adopted into law by Congress. Existing and proposed unit boundaries can be viewed using the CBRS Projects Mapper (<https://fwsprimary.wim.usgs.gov/cbrs-projects-mapper/>). Exceptions to the Coastal Barrier Resources Act exist for certain activities related to maintaining or improving existing Federal navigation channels, and for activities consistent with fish and wildlife management, protection, and enhancement, or shoreline stabilization using non-structural approaches.

2.2.7 Air Quality

Existing. Ambient air quality is monitored by the DNREC Division of Air and Waste Management and is compared to the National Ambient Air Quality Standards (NAAQS) throughout the state, pursuant to the Clean Air Act of 1970.

Six principal "criteria" pollutants are part of this monitoring program, which include ozone (O₃), carbon monoxide (CO), sulfur dioxide (SO₂), nitrogen dioxide (NO₂), particulate matter (PM₁₀ and PM_{2.5}), and lead (Pb). Sources of air pollution are broken into stationary and mobile categories. Stationary sources include power plants that burn fossil fuels, factories, boilers, furnaces, manufacturing plants, gasoline dispensing facilities, and other industrial facilities. Mobile sources include vehicles such as cars, trucks, boats, and aircraft. The Clean Air Act requires that all areas of the country be evaluated and then classified as attainment or non-attainment areas for each of the National Ambient Air Quality Standards.

Areas can also be found to be "unclassifiable" under certain circumstances. The 1990 amendments to the act required that areas be further classified based on the severity of non-attainment. The classifications range from "Marginal" to "Extreme" and are based on "design values." The design value is the value that determines whether an area meets the standard. For the 8-hour ozone standard for example, the design value is the average of the fourth highest daily maximum 8-hour average concentration recorded each year for three years. Ground-level ozone is created when nitrogen oxides (NO_x) and volatile organic compounds (VOCs) react in the presence of sunlight. NO_x is primarily emitted by motor vehicles, power plants, and other sources of combustion. VOCs are emitted from sources such as motor vehicles, chemical plants, factories, consumer and commercial products, and even natural sources such as trees. Ozone and the pollutants that form ozone (precursor pollutants) can also be transported into an area from sources hundreds of miles upwind. Sussex County Delaware is in non-attainment for 8-hour ozone (2008) and is classified as "marginal."

Future Without Project. In the future, air quality in the study area is expected to improve with the implementation of the State Implementation Plan (SIP) with or without the project. The SIP is a collection of regulations and documents to implement, maintain, and enforce the NAAQS.

2.2.8 Hazardous, Toxic, and Radioactive Wastes (HTRW)

Existing. A search of the EPA Superfund National Priority List (EPA, 2026) and DNREC Environmental Navigator (DNREC, 2026) indicate the following occur within a mile of the study area:

- 3 leaking underground storage facilities
- 58 non-public wells
- 1 remediation site
- 91 septic permits
- 58 septic site evaluations
- 2 underground storage tank facilities.

Future Without Project. In the future, the presence or absence of HTRW in the study area is not anticipated to change significantly from existing conditions.

2.3 Built Environment

Existing. As discussed in the land use section (Section 2.2.4), only about 3% of the study area is developed. The built environment includes several primary roads, including:

- Cedar Beach Road/Bay Avenue (Route 36)
- Lighthouse Road (Route 203)

Utilities for the residences and businesses include water and electric service.

Future Without Project. Sea level change may result in the flooding and inundation of infrastructure. The built environment would adapt with sea level change with land use changes, in the future with or without the project.

2.4 Cultural Resources

Identification of cultural resources on USACE Civil Works projects is an important part of the overall Federal responsibility. Numerous laws pertaining to identification, evaluation, and protection of cultural resources, Indigenous rights, curation and collections management, and the protection of resources from looting and vandalism establish the importance of cultural resources to our Nation's heritage. With the passage of these laws, the historical intent of Congress has been to ensure that the Federal government protects cultural resources. Guidance is derived from several cultural resources laws and regulations, including but not limited to Sections 106 and 110 of the National Historic Preservation Act (NHPA) of 1966 (as amended); Archaeological Resources Protection Act (ARPA) of 1979; Native American Graves Protection and Repatriation Act (NAGPRA); and 36 CFR Part 79, Curation of Federally Owned and Administered Archeological Collections. Implementing regulations for Section 106 of the NHPA and NAGPRA are 36 CFR Part 800 and 43 CFR Part 10, respectively. All cultural resources laws and regulations should be addressed under the requirements of the National Environmental Policy Act (NEPA) of 1969, as amended. USACE summarizes the guidance provided in these laws in ER 1130-2-540.

Area of Potential Effect. For the purposes of this EA, there are three proposed Areas of Potential Effect (APEs): 1) The proposed sand source will be from an existing upland facility; 2) Staging, sediment preparation and barge loading at the DuPont Nature Center; and 3) barge docking, sediment pumping and beach nourishment limits of disturbance.

Existing. Since the sand will be coming from an existing commercial facility, there is little likelihood for the proposed action to affect an historic property eligible for or listed on the National Register of Historic Places (NRHP). The property at the DuPont Nature Center has been previously disturbed and little likelihood exists for the proposed staging and preparation work to impact a historic property eligible for or listed on the NRHP. The area for the proposed beach nourishment is highly dynamic and has been impacted by both previous beach nourishment and erosion; therefore, the piping of new sediments and the movement and placement of the sand along the nearshore area will have little likelihood of impacting a historic property eligible for or listed on the NRHP. The USACE has determined that the proposed selected alternative will have No Effect on historic properties.

Future Without Project. In the future with or without the project, sea level change would result in inundation of soils and sediments throughout the project area. This could result in impacts to historic properties that may exist further inland in the study area.

2.5 Economic Environment

Existing. The Mispillion Inlet study area is located approximately 6 miles from the center of the town of Milford in Sussex County, DE. All referenced data is derived from the 2023 American Community Survey 5-Year Estimate, or the 2020 Decennial Census as conducted by the U.S. Census Bureau (USCB, 2025). Milford is a small city with an estimated population of 11,190 permanent residents. Table 8 below shows population in terms of median age, persons under 18, and persons over 65 in comparison to Sussex County and the state of Delaware.

The table shows notable differences in age distribution between Milford, Sussex County, and Delaware. The median age of Milford (39.9) is lower than Sussex County (50.8) and Delaware (41.1). The proportion of persons under 18 in Milford (2,600) is relatively higher compared to the proportion of persons 65 and over (2,502). In contrast, Sussex County has a larger proportion of persons 65 and over (68,555) compared to persons under 18 (43,516).

Table 8. Age and Sex Characteristics

Category	Milford	Sussex County	Delaware
Total Population	11,190	237,378	989,948
Median Age	39.9	50.8	41.1
Persons Under 18	2,600	43,516	206,405
Persons 65 and Over	2,502	68,555	194,577

Table 9 highlights variations in racial and ethnic composition across the three geographic areas. Sussex County is relatively homogenous, with both Milford and Delaware both being more diverse.

Table 9. Racial and Ethnic Demographics

Category	Milford	Sussex County	Delaware
White	55.5%	74.1%	60.4%
Black or African American	23.6%	10.7%	22.1%
American Indian and Alaska Native	0.7%	0.8%	0.5%
Asian	1.9%	1.3%	4.3%
Native Hawaiian and Other Pacific Islander	0.0%	0.0%	0.0%
Some Other Race	9.4%	6.0%	4.9%
Two or More Races	8.9%	7.2%	7.7%

Table 10 indicates disparities in educational attainment and economic indicators between Milford, Sussex County, and Delaware. The percentage of individuals with a high school graduate or higher degree is lower in Milford (86.9%) compared to Sussex County (95.4%) and Delaware (91.4%). Furthermore, the median household income in Sussex County (\$114,316) is substantially higher

than Milford (\$55,265) and Delaware (\$82,855). The poverty rate in Milford (20.3%) is also notably higher compared to Sussex County (5.4%) and Delaware (10.5%).

Table 10. Education & Economic Characteristics

Category	Milford	Sussex County	Delaware
High School Graduate or Higher	86.8%	95.4%	91.4%
Bachelor’s Degree or Higher	30%	40%	35.3%
Median Household Income	\$55,265	\$114,316	\$82,855
Per Capita Income	\$35,066	\$56,471	\$44,219
Persons in Labor Force	57.8%	68.6%	61.8%
Poverty Rate	20.3%	5.4%	10.5%
Total Housing Units	4,865	142,280	448,735
Vacant Housing Units	8.2%	30.8%	13.9%
Owner-Occupied Housing Units	57.1%	79.9%	70.8%
Renter-Occupied Housing Units	42.9%	20.1%	29.2%

The table also shows a higher proportion of renter-occupied units in Milford (42.9%) compared to Sussex County (20.1%) and the state of Delaware (29.2%), perhaps reflective of the lower socioeconomic status of the area, or the influx of seasonal renters during the warmer months.

The primary industry by workforce numbers in Milford in 2022 was Health Care and Social Assistance. The top 10 industries in Milford are provided in Table 11 (Milford, 2025). The study area is mostly open land with residential properties, marinas, the DuPont Nature Center, and Delaware Launch Services.

Table 11. Top Ten Industries in Milford, DE by the Percent of Work Force

Industry	Percent of Work Force
Health Care & Social Assistance	15.8%
Manufacturing	14.3%
Retail Trade	13.1%
Construction	9.6%
Educational Services	8.6%
Accommodation & Food Services	8.6%
Other Services, Except Public Administration	5.8%
Transportation & Warehousing	4.2%
Public Administration	4.0%
Professional, Scientific, & Technical Services	4.0%

Source: Milford, 2025

Cedar Creek is home to the Delaware Bay Launch Service, which is the only launch service that can provide safe transport of personnel and supplies to large vessels anchored in the Delaware Bay and nearby Atlantic Ocean. The Inlet also provides important access to the Bay for commercial and recreational fishermen. Shoaling is a problem for many of the commercial vessels using the

Inlet. The launch service reports frequent delays while waiting to clear the shoal at the Inlet mouth. In October 2005, the launch boat “Big Stone Express” ran aground on the shoal, resulting in \$10,000 of damage to the vessel (USACE, 2006).

Future Without Project. Without the project, shoreline erosion would continue, increasing the risk of a breach (see Section 2.1.1). This would result in the reconfiguration of the Mispillion Inlet which would likely impact on the Delaware Bay Launch Service operations and commercial and recreational fishing. Impacts on Delaware Launch Services could in turn impact commerce (i.e., cargo vessels) on the Delaware River.

3.0 Plan Formulation and Evaluation

This section describes the process of developing and evaluating alternative plans to address the shoreline erosion and related problems identified in this study. The USACE follows the six-step planning process outlined in Engineering Regulation (ER) 1105-2-100, which provides a logical and systematic framework for sound decision-making. The steps are:

1. Identifying problems and opportunities.
2. Inventorying and forecasting conditions.
3. Formulating alternative plans.
4. Evaluating alternative plans.
5. Comparing alternative plans.
6. Selecting a recommended plan.

Steps 1 and 2 were detailed in Sections 1.0 and 2.0 of this report. This section focuses on steps 3 and 4: the formulation and evaluation of alternatives.

3.1 Planning Framework

The primary objective of this study, conducted under the Section 111 authority, is to identify the least-cost, environmentally acceptable, and technically feasible plan that mitigates shore damage directly attributable to the Mispillion Inlet (FNP). Unlike traditional USACE DRP studies that require a comprehensive economic analysis to identify a traditional benefit-cost ratio or a National Economic Development (NED), the Section 111 authority does not require a formal benefit-cost analysis. Federal interest is presumed due to the causal link between the FNP and shoreline damage. Therefore, the planning process focuses on identifying the most cost-effective means of restoring the shoreline to a condition that would exist without the influence of the FNP, while remaining within the program's federal cost limit.

3.1.1 Assumptions

The formulation and evaluation of alternative plans are based on several key planning, technical, and economic assumptions. These assumptions provide a consistent basis for comparing alternatives and are critical to understanding the scope and limitations of this study.

3.1.1.1 General Planning Assumptions

Period of Analysis: The economic period of analysis is 50 years, with a base year of 2030 and an end year of 2080. A longer 100-year horizon (2030-2130) is used for evaluating long-term trends, such as sea-level change.

Federal Interest: Consistent with the Section 111 authority, Federal Interest is assumed due to the established causal link between the Mispillion Inlet Federal Navigation Project and the identified shoreline damages. A traditional benefit-cost analysis is not required to justify the project.

Future Without-Project Condition: It is assumed that in the absence of a federal project, no major new shore protection measures would be undertaken by the non-federal sponsor or local interests. Shoreline erosion would continue at rates observed in the historical analysis.

3.1.1.2 Economic and Cost Assumptions

Cost Estimates: All project costs are presented in Fiscal Year 2026 (FY26) price levels and include appropriate contingencies for design and construction uncertainties.

Federal Cost Limit: The total federal expenditure for the recommended plan, including study, design, and construction costs, is assumed to remain below the \$15,000,000 statutory limit for the CAP Section 111 program.

Operations, Maintenance, and Renourishment: A critical assumption of this study is that the recommended plan will consist of a one-time sediment placement only. No federally funded future renourishment is included in the plan. Any subsequent renourishment needed to maintain the beach profile would be the sole responsibility of the non-federal sponsor.

Environmental Assumptions Habitat Function: It is assumed that the restoration of a sandy beach profile will create viable and functioning habitat for horseshoe crab spawning and shorebird foraging, particularly for the federally-listed red knot.

Minimization of Impacts: It is assumed that the use of environmental construction windows and standard best management practices (BMPs) will be effective in avoiding and minimizing adverse impacts to water quality, wildlife, and threatened or endangered species during project implementation.

3.2 Measures and Alternatives

The planning team used the objectives and constraints to formulate measures and alternatives, along with contributions from project partners, stakeholders, and the public. The measures are individual actions, features, or activities that address one or more of the study objectives. Based on the problems and opportunities identified, a comprehensive list of potential management measures was developed. Management measures are the building blocks of alternative plans. The management measures for the initial array are listed below and formed the basis of the initial plan formulation. The planning team formulated a reasonable range of measures, with significantly different approaches to address the defined water resources needs and the planning objectives established during scoping. A total of 11 measures were initially developed to address the problems, opportunities, objectives and constraints (POOCs) within the study area, namely the interruption of longshore sediment transport across Mispillion Inlet as a result of the jetties.

1. **No Action** - The "No Action" requirement under NEPA (National Environmental Policy Act) for Federal Civil Works projects is a mandatory component of environmental impact assessments. For Civil Works Projects, "No Action" typically means: No federal

investment or construction, continuation of existing conditions, processes continue without intervention and existing infrastructure remains as-is (with normal maintenance). This measure would see the continued erosion of the shoreline, loss of habitat, and possibly the loss of function of the inlet launch facilities.

2. **Beach Nourishment with an Offshore Borrow Source** - This measure would place sand from an offshore sand source in Delaware Bay directly on the beach to mitigate erosion caused by the FNP
3. **Beach Nourishment with Beneficial Reuse of Dredged Material** - This measure would place sand from the Delaware Deepening Federal Navigation Channel maintenance directly on the beach to mitigate erosion caused by the FNP.
4. **Beach Nourishment with Truck Fill**- This measure would place sand trucked in from an approved onshore/upland quarry directly on the beach to mitigate erosion caused by the FNP. The truck fill option may also need additional handling through ferrying or bypassing across Mispillion Inlet once it is stockpiled at the staging location.
5. **Beach Nourishment with Periodic Nourishment**- This measure would place sand from any of the sources described above to mitigate erosion caused by the FNP. The difference between this measure and other placement measures is that it involves multiple placements of sand over the project life.
6. **Northern Dike Extension**- This measure would extend the existing stone dike to prevent flanking and further erosion of the shoreline.
7. **Inlet Jetty Repairs**- The current jetty is in disrepair and needs structural repairs to keep sediment from being transported into the channel in order to maintain the navigation feature.
8. **Inlet Sediment Bypass**- This measure is similar to a beach nourishment but would involve the transfer of material from the south side of the inlet fillet area to the northern eroded shoreline.
9. **Training Dikes on the River Side** – This measure would involve stone and concrete dikes placed on the interior of the inlet complex to maintain the position of the Mispillion Inlet away from the shoreline to reduce erosion.
10. **Erosion Control Features**- These measures would be breakwaters or groins placed on the bay facing coastline in the eroded area to reduce erosion of the shoreline and entrap sediment to build a larger beach.
11. **Debris Clean-up**- The presence of the inlet jetty features causes a wave shadow effect on the southern shoreline, and wave energy and currents are decreased along this section of the beach. As a result, large mats of straw and marsh grass debris accumulate on the beach. This makes this section of the beach unsuitable for recreation, shorebird habitat, and horseshoe crab habitat. This material would be removed and considered for beneficial use.

Table 12 summarizes the "Initial Measures Screening" process. Measures shown in green were considered viable and were retained for developing alternative plans. Measures in red were screened out for the reasons noted.

Measures that did not pass the initial screening against the study area's problems are:

- Number 3 - Beach Nourishment with Beneficial Reuse of Dredged Material
- Number 7 - Inlet Jetty Repairs
- Number 9 - Training Dikes on the River Side.

Beach replenishment using dredged material from the Delaware Main Channel Deepening could be used for beach nourishment but would be cost prohibitive due to the distance the sand would need to be pumped. Additionally, while a small amount of sand is dredged from Mispillion Inlet, the small government dredges used to maintain Mispillion Inlet already place sand as close to shore as possible. It would be cost prohibitive to use dredges needed to pump the material to shore. Inlet jetty repairs are necessary but would have little to no effect on the problems outlined at the beginning of the study. Training dikes on the riverside would require extensive hydraulic modeling, and may not contribute to solving problems identified, or achieving the objectives for restoration.

Management measures carried forward for further analysis include:

- Number 2- Beach Nourishment with an Offshore Borrow Source
- Number 4- Beach Nourishment with Truck Fill
- Number 5- Beach Nourishment with Periodic Nourishment
- Number 6- Northern Dike Extension
- Number 8- Inlet Sediment Bypass
- Number 10- Erosion Control Features
- Number 11- Debris Clean-up.

These measures were combined iteratively into alternatives in Table 13.

Table 12. Summary of Screening against problem statements

Mispillion Inlet Section 111 - Initial Measures Screening						
Measure	Increased shoreline erosion of adjacent shoreline due to FNP	Habitat loss for federally-listed species	Breached impacts to tidal hydraulics and shoaling	Debris Accumulation on South Shoreline	Further Study and Analysis?	
1 No Action	Continued erosion	No habitat created	No effect	Continued debris accumulation, habitat covered	N	
2 Beach Nourishment (Offshore Borrow Source)	Possible in combination with an additional Living Shoreline feature to reduce erosion	Habitat created for horseshoe crab and red knot if stable	No effect	No effect	Y	
3 Beach Nourishment (Beneficial Re-use)	Likely not enough sediment for beach fill, also not likely to supply sand directly to the beach from Mispillion Inlet, but sources could be considered from Delaware Deepening	Limited due to small volumes and limits of dredge	Shoals would be removed as part of dredging, but likely No impacts to erosion areas	Shoals would be removed as part of dredging, but likely No impacts to erosion areas	N	
4 Beach Nourishment (Truck-haul/Bypass)	Possible in combination with an additional Living Shoreline feature to reduce erosion	Habitat created for horseshoe crab and red knot if stable	No effect	No effect	Y	
5 Beach Nourishment (Periodic Nourishment)	May not fit under Section 111 Limits to mitigate this problem	Beach habitat for plovers and horseshoe crabs	No effect	No effect	Y	
6 Northern Dike Extension	Mitigate erosion and prevent flanking	Preventing flanking would protect hydraulic flow and stability of shoreline and habitat	Preserve existing channel and flow by preventing Northern flanking	No effect	Y	
7 Inlet Jetty Repairs	No effect	Short term impacts to habitat	May reduce shoaling if velocities increase in channel, but repairs would likely exceed Section 111 Limits	Would increase wave shadow possibly increasing debris accumulation	N	
8 Inlet Sediment Bypass	Sediment availability on southern fillet is in question	Limited habitat due to limited sediments	Might reduce sediment seeping into channel from jetty in malfunctioning sections	No effect	Y/N	
9 Training Dikes on River Side	May require costly modeling, already built by NFS	May reduce interior flanking potential and habitat loss	May reduce flanking potential	No effect	N	
10 Erosion Control Feature (Near Shore Breakwaters)	Could reduce erosion at Northern beach	Would create habitat	No effect	No effect	Y	
11 Debris Clean-up	No effect	May increase use of intertidal area by T&E	No effect	Raking will likely be one time solution, O&M will likely be needed for continuously clean beaches	Y	

Table 13. Measures of the Alternative Arrays

Alternative	Measures from Table 12	Description	Complete Provide and account for all necessary investments	Effective Contribute to achieving the planning objectives	Efficient Cost-effective means of solving the problem and achieving the objectives	Acceptable Acceptance by the state and local entities and the public and compatibility with existing laws, regulations and public policies	Screening
A	No Action Plan	No federal project or repair, area to see continued erosion, potential flanking of the dyke and potential loss of launch services	N	N	N	N	Carried forward to the final array per USACE guidance
B	Beach Nourishment, Dike Extension, Erosion Control Feature, Debris Cleanup	Beach nourishment (30,200CY), Breakwater/sill for Erosion Control Feature, (2,500' LF) Dike Extension (300 LF to NW), Debris Cleanup (3,000 LF)	Y	Y	N	Y	Dike extension costly
C	Beach Nourishment, Dike Extension, Debris Cleanup	Beach nourishment (80,500CY) Dike Extension (300 LF to NW), Debris Cleanup (3,000 LF)	Y	Y	N	Y	Dike extension costly
D	Beach Nourishment, Erosion Control Feature, Debris Cleanup	Beach nourishment (80,500 CY), Breakwater/sill for Erosion Control Feature (2,500' LF), Debris Cleanup (3,000 LF)	Y	Y	Y	Y	Meets most objective in cost effective way, acceptable
E	Beach Nourishment, Dike Extension	Beach nourishment (80,500CY) Dike Extension (300 LF to NW)	Y	Y	Y	Y	May not be able to maintain beach w/o erosion control
F	Beach Nourishment, Erosion Control Feature	Beach nourishment (30,200 CY) + Breakwater/sill for Erosion Control Feature (2,500' LF)	Y	N	Y	Y	Excludes clean-up, but like Alternative D
G	Beach Nourishment Only	Beach nourishment (80,500CY)	Y	N	Y	Y	Meets objective in cost effective way, acceptable
H	Erosion Control Feature only	Breakwater/sill for Erosion Control Feature (2,500' LF)	N	N	N	N	Not enough sediment in the system to stabilize the beach
I	Dike Extension Only	Dike Extension (300 LF to NW)	Y	Y	N	N	Ignores other Objective to mitigate shoreline erosion
J	Debris Cleanup Only	Cleanup debris along 3,000 LF of shoreline with backhoe, loaders, dump trucks	N	N	N	N	Does not meet main study objectives to mitigate shoreline erosion

3.3 Arrays of Alternatives

The management measures retained following the initial screening process were combined in various configurations to develop a comprehensive array of alternatives. These alternatives represent distinct and scalable approaches to addressing the identified problems and opportunities within the study area. The mandatory No Action Plan is also included, which serves as the baseline against which all other alternatives are compared. The initial array of alternatives included Alternatives A-J representing the initial array that were formulated from the remaining management measures 1 through 11 in Table 12.

- **Alternative A.** No Action Plan: Assumes no project is implemented. Shoreline erosion would continue at historical rates, leading to further habitat loss and an increased risk of breaching. (Measure 1)
- **Alternative B:** A comprehensive plan combining beach nourishment, a dike extension, an erosion control feature, and debris cleanup. (Measure 4, 6, 10, 11)
- **Alternative C:** Combines beach nourishment, a dike extension, and debris cleanup. (Measures 4, 6, 11)
- **Alternative D:** Combines beach nourishment, an erosion control features, and debris cleanup. (Measures 4, 10, 11),
- **Alternative E:** Combines beach nourishment and a dike extension. (Measures 4, 6)
- **Alternative F:** Combines beach nourishment with an erosion control feature. (Measure 4, 10)
- **Alternative G:** A single-measure plan consisting only of beach nourishment(one-time beach nourishment). (Measure 4)
- **Alternative H:** A single-measure plan consisting only of an erosion control feature. (Measure 10)
- **Alternative I:** A single-measure plan consisting only of a dike extension. (Measure 6)
- **Alternative J:** A single-measure plan consisting only of debris cleanup on the south shoreline. (Measure 11)

Table 13 details the alternative formulated for evaluation. Each alternative is evaluated on meeting the four formulation and evaluation criteria: completeness, effectiveness, efficiency, and acceptability (ER 1105-2-103).

The alternative plans were screened to eliminate those that are not technically feasible, were excessively costly, or did not effectively meet the core study objectives, using the four key planning criteria: effectiveness, efficiency, acceptability, completeness.

Effectiveness is the extent to which the alternative plans contribute to achieving the planning objectives. Benefit metrics reflect the effectiveness of each alternative. Effectiveness does not mean that all planning objectives need to be addressed or fully realized. The degree of effectiveness will be used to illustrate the trade-offs between plans when compared.

Efficiency is the extent to which an alternative plan is a cost-effective means of solving the problem and achieving the objectives. Efficiency is determined through a comparison of the costs and benefits of each alternative.

Acceptability is the workability and viability of the alternative plan with respect to acceptance by state and local entities and the public and compatibility with existing laws, regulations, and public policies. Acceptability has two dimensions – implement ability and satisfaction. Implementing ability means the extent to which the alternative is feasible from a technical, financial, and legal perspective. Satisfaction is the extent to which the plan is welcomed from a political or preferential perspective.

Completeness regards the extent to which the alternative plans provide and account for all necessary investments or other actions to ensure the realization of the planning objectives, including actions by other federal and non-federal entities. Completeness must consider the sustainability and long-term aspects of the plans and whether all resource requirements are included. Completeness does not mean that all planning objectives are fully realized, only that the required resources and actions are included to achieve the estimated benefits.

The formulated alternatives range from comprehensive, multi-component solutions to single-measure approaches:

3.4 Evaluation of Alternative Plans

The goal of the evaluation process is to provide a complete and comprehensive accounting of the benefits, costs, impacts, and risks expected from each alternative. Comprehensive accounting would illustrate whether and how economic, social, and environmental conditions are impacted relative to the no-action baseline. The alternative plans were evaluated based on their ability to meet the study objectives, their adherence to constraints, and the four key Principles & Guidelines(P&G) criteria (Completeness, Effectiveness, Efficiency, and Acceptability).

3.4.1.1 Contribution to Objectives:

Beach nourishment with a structural component (i.e., Alternatives B, C, D, E, F) were judged to be most effective at meeting the primary objective of mitigating long-term shoreline erosion.

Beach nourishment (Plan G) components directly address the habitat restoration objective by providing immediate new beach habitat for horseshoe crabs and shorebirds.

Debris cleanup (including Plans B, C and D) addresses the secondary objective of improving conditions on the south beaches, but plans may be in place for other agencies to deal with this problem.

Single-measure Alternatives (H, I, J) were found to be incomplete, as they only addressed one facet of the overall problem. Alternative H, which focuses solely on erosion control, is insufficient to meet project objectives independently because it fails to introduce new sediment into the sediment-starved system. Similar to Alternatives I and J. These were excluded from further comparison and screening.

3.4.1.2 P&G Criteria Evaluation:

Completeness: Alternatives H, I and J were screened out for being incomplete solutions. A dike extension or breakwater alone does not solve the sediment deficit, and debris cleanup does not stop erosion.

Effectiveness: Alternatives lacking an erosion control or structural component (like Alternative G) were initially considered less effective over the long term, as the placed sand would erode without a feature to help retain it. However, a sufficiently large one-time placement could still provide significant short- to medium-term benefits.

Efficiency: The high cost of dike extensions (included in Alternatives B, C, E, I) made these alternatives less efficient compared to plans that relied on beach nourishment and smaller erosion control features. This led to the screening of Plans B and C.

Acceptability: All retained plans were considered generally acceptable to the sponsor and public, as they align with the goal of shoreline protection and habitat restoration.

This evaluation resulted in a final array of the most viable Alternatives (A, D, E, F, G) to be carried forward for detailed comparison and cost analysis to identify TSP. Alternatives H, I and J were screened out from further analysis.

3.5 Risk and Uncertainty

All coastal engineering projects carry inherent risks and uncertainties that must be considered during plan formulation and selection. For this study, key risks include:

Technical Risk: The actual performance of beach nourishment may differ from model predictions. The long-term rate of erosion and the effectiveness of retention structures are subject to the intensity and frequency of future storms, which cannot be predicted with certainty.

Sea Level Change: While the analysis incorporates USACE guidance on sea-level change, accelerated rates beyond the "high" scenario could reduce the project's lifespan and effectiveness.

Cost and Schedule Risk: Construction costs, particularly the cost of sand from a quarry or offshore borrow site, are volatile. Environmental windows for construction (e.g., to avoid impacts on nesting shorebirds or spawning horseshoe crabs) can constrain the schedule and increase the risk of weather-related delays.

Environmental Risk: The project is designed to be environmentally beneficial, but there is always a risk of temporary impacts during construction, such as increased turbidity. Unforeseen changes to sediment transport patterns could also occur.

Real Estate Risk: A significant real estate risk pertains to the potential for concurrent, competing projects conducted by the non-federal sponsor within the immediate project area. This introduces the possibility of conflicting claims on the designated construction staging area, which is slated for restoration following the completion of our project.

In the event that this staging area is unavailable, the project team would be required to identify and secure an alternative location. This would likely increase project costs and extend timelines due to the logistical challenges and transportation expenses associated with a more distant staging area.

4.0 Plan Comparison

This section presents the comparison of the final array of alternative plans developed to prevent damage to the Mispillion River Federal Navigation Project from shoreline erosion. In accordance with the Section 111 authority, the objective of this evaluation is to identify the least-cost plan that is engineeringly feasible and environmentally acceptable. The plans were evaluated based on their ability to meet the project objectives and their associated costs. The section concludes with the selection of the TSP.

The final array includes Alternatives A, D, E, F, and G. The No Action Plan serves as the baseline for comparison. Alternative D consists of beach nourishment, an erosion control feature and debris clean-up, Alternative E consists of a beachfill with a dike extension, Alternative F combines beach nourishment with an erosion control feature, and Alternative G consists of a single beach nourishment.

Each alternative was evaluated to determine the most cost-effective means of addressing the erosion-related project needs.

Alternative A. No Action

The No Action plan would see continued erosion of the northern shoreline caused by the Federal navigation feature, the potential breaching of the inlet complex from continued erosion, the destabilization of the inlet and impacts to the associated local launch services to offshore vessels, and the loss of valuable environmental habitat.

Alternative D. Beach Nourishment, Erosion Control Features and Debris clean-up

The Beach Nourishment for Alternative D extends over 1,700 feet of shoreline plus a 300-foot taper. The beach berm consists of a 30-foot-wide design berm, extending approximately 30 feet landward of the survey and construction baseline, for a total design beach width of approximately 60 feet. Alternative D is estimated to need 30,200 cubic yards for initial construction and to have longevity of 5 years. The Erosion Control Feature includes five rubble mound breakwaters to reduce wave energy, sediment transport, and increase the longevity of the nourishment project. Each breakwater is 200 feet long with an opening gap of 100-feet from the adjacent breakwater. Each breakwater consists of a 4-foot layer of Armor Stone (W50=1360 lb.) and a core stone layer consisting of R-4 riprap. The crest of the breakwater is 6-foot wide with a top elevation of +6 feet. The side slopes extend at 2H:1V to a 4-foot bench at elevation +4 feet. The breakwater foundation layer is a 12-inch-thick marine mattress that extends 5 feet beyond the stone on each side to prevent scour and undermining of the breakwater. The existing seafloor elevations where the mats would be placed are approximately +2 feet. See Figure 15 for the plan view of the beach nourishment and breakwaters and Figure 14 (Detail 2) for a typical section of the breakwaters. The Debris Clean-up would consist of 3,000 linear feet of debris removal located northwest of the dike extension.

Alternative E. Beach Nourishment and Dike Extension

The Beach Nourishment would consist of a 1,700-foot-long berm from Station 25+00 to Station 45+00, with a 300' taper beginning at Station 42+00. The berm will be constructed with a width of 150 feet and a crest elevation of +5 feet, based on the North American Vertical Datum of 1988 (NAVD88). See Figure 13 for plan view and Figure 14(Detail 1) for a cross-section view for a typical beach nourishment section. The Debris Clean-up would consist of 3,000 linear feet of debris removal located northwest of the dike extension. See Figure 14 (Detail 3) for the cross-section view of the dike extension and Figure 16 for the plan view of the dike extension.

Alternative F. Beach Nourishment and Erosion Control Feature

Alternative F is similar to Alternative D but does include the Debris Clean-up. The Beach Nourishment for Alternative F extends over 1,700 feet of shoreline plus a 300-foot taper. The beach berm consists of a 30-foot-wide design berm, extending approximately 30 feet landward of the survey and construction baseline, for a total design beach width of approximately 60 feet. Alternative D is estimated to need 30,200 cubic yards for initial construction and to have longevity of 5 years. See Figure 15 for the plan view of the beach nourishment. The Erosion Control Feature includes five rubble mound breakwaters to reduce wave energy, sediment transport, and increase the longevity of the nourishment project. Each breakwater is 200 feet long with an opening gap of 100-feet from the adjacent breakwater. Each breakwater consists of a 4-foot layer of Armor Stone (W50=1360 lb.) and a core stone layer consisting of R-4 riprap. The crest of the breakwater is 6-feet wide with a top elevation of +6 feet. The side slopes extend at 2H:1V to a 4-foot bench at elevation +4 feet. The breakwater foundation layer is a 12-inch-thick marine mattress that extends 5 feet beyond the stone on each side to prevent scour and undermining of the breakwater. The existing seafloor elevations where the mats would be placed are approximately +2 feet. See Figure 15 for the plan view and Figure 14 (Detail 2) for a typical section.

Alternative G: Beach Nourishment Only

The Beach Nourishment for Alternative G begins at the dog leg portion of the existing stone dike at Station 25+00 and extends for 1,700 feet to Station 45+00, with a 300' taper beginning at Station 42+00. A 1,700-foot-long berm will be constructed with a width of 150 feet and a crest elevation of +5 feet, based on the North American Vertical Datum of 1988 (NAVD88). See Figure 13 for plan view and Figure 14 (Detail 1) for a cross-section view for a typical beach nourishment section. Alternative G is estimated to need 80,500 cubic yards for initial construction and to have longevity of 10 years. Longevity is defined here as the number of years before the beach conditions will have eroded back to the pre-project conditions and where a subsequent periodic nourishment operation would typically be required.

Shoreline Erosion Rate: Based on post-construction historical data, the analysis assumes a continued average shoreline erosion rate of approximately 10 to 14 feet per year along the beach north of the inlet for the future without-project condition. **Sea Level Change (SLC):** The analysis incorporates the three official USACE sea level change scenarios (Low, Intermediate, and High), based on the historic rate of SLC at the Lewes, DE tidal gauge. **Sediment Availability and Compatibility:** It is assumed that a sufficient quantity of compatible sand is commercially available

from a local quarry for mechanical (truck-haul) placement or can be sourced from a suitable offshore borrow site for hydraulic placement.

Project Performance: It is assumed that the one-time placement of sand will restore the beach profile as designed and will provide a predictable period of storm damage mitigation and habitat availability, extending the functional lifespan of the shoreline by approximately 10 years before it returns to pre-project conditions. Implementing the beach nourishment project will yield long-term residual benefits by mitigating the baseline erosion rate at Conch Bar. By placing sediment now, we establish a protective buffer that slows the overall rate of coastal degradation. Consequently, even after the placed material eventually dissipates, the shoreline will have experienced significantly less land loss compared to a 'no action' scenario.

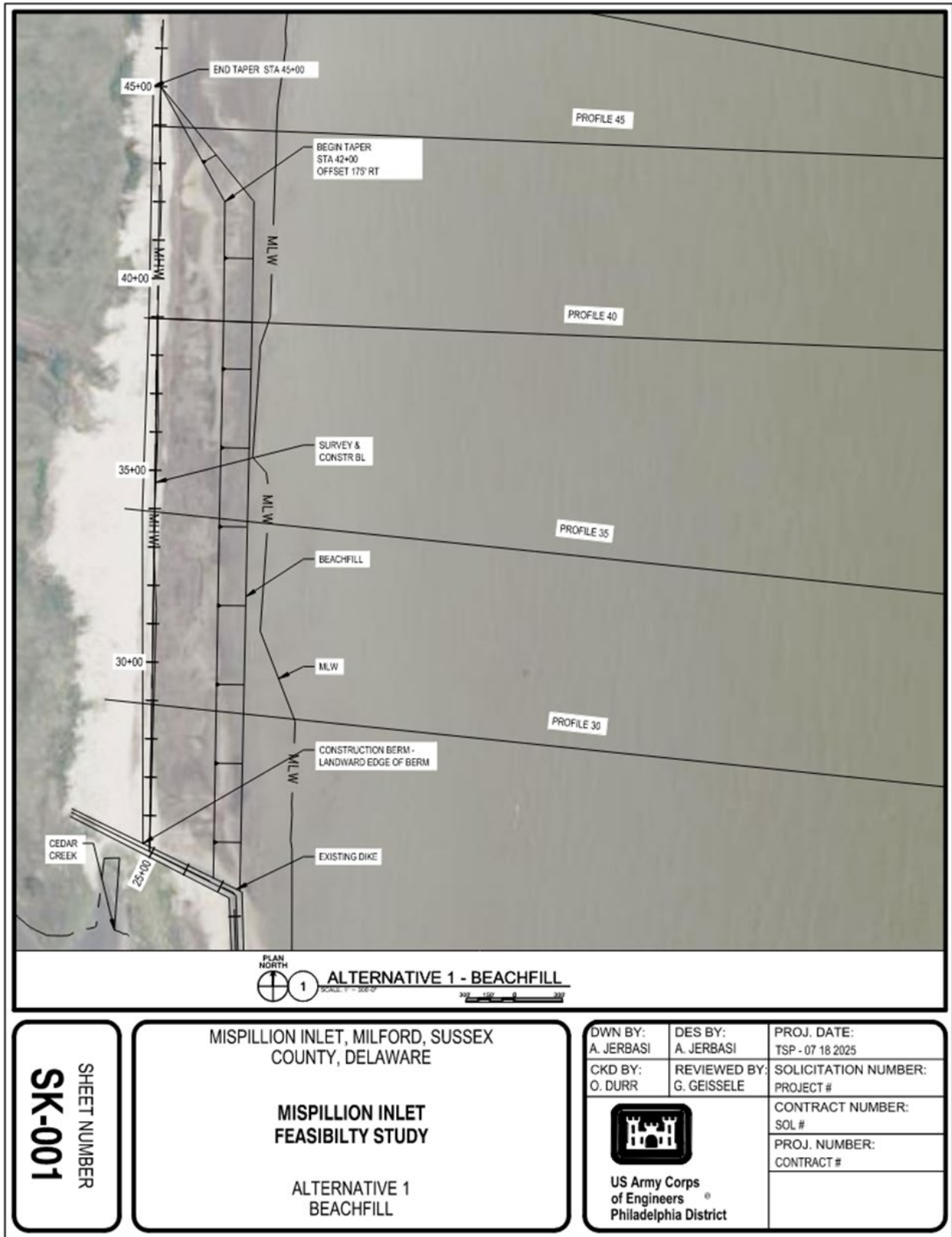


Figure 13. Plan View of Beach Nourishment for Alternatives D, E, F, and G

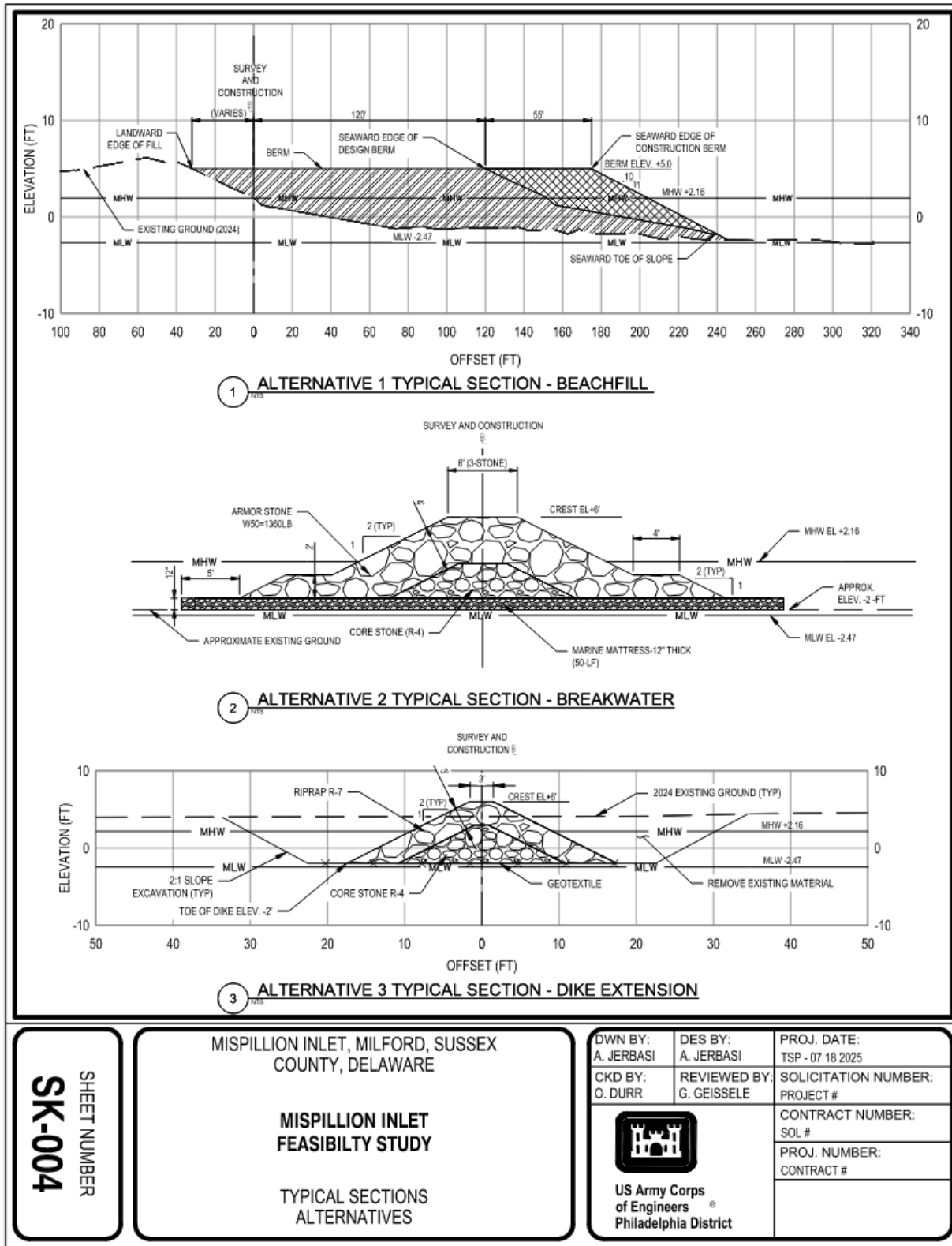

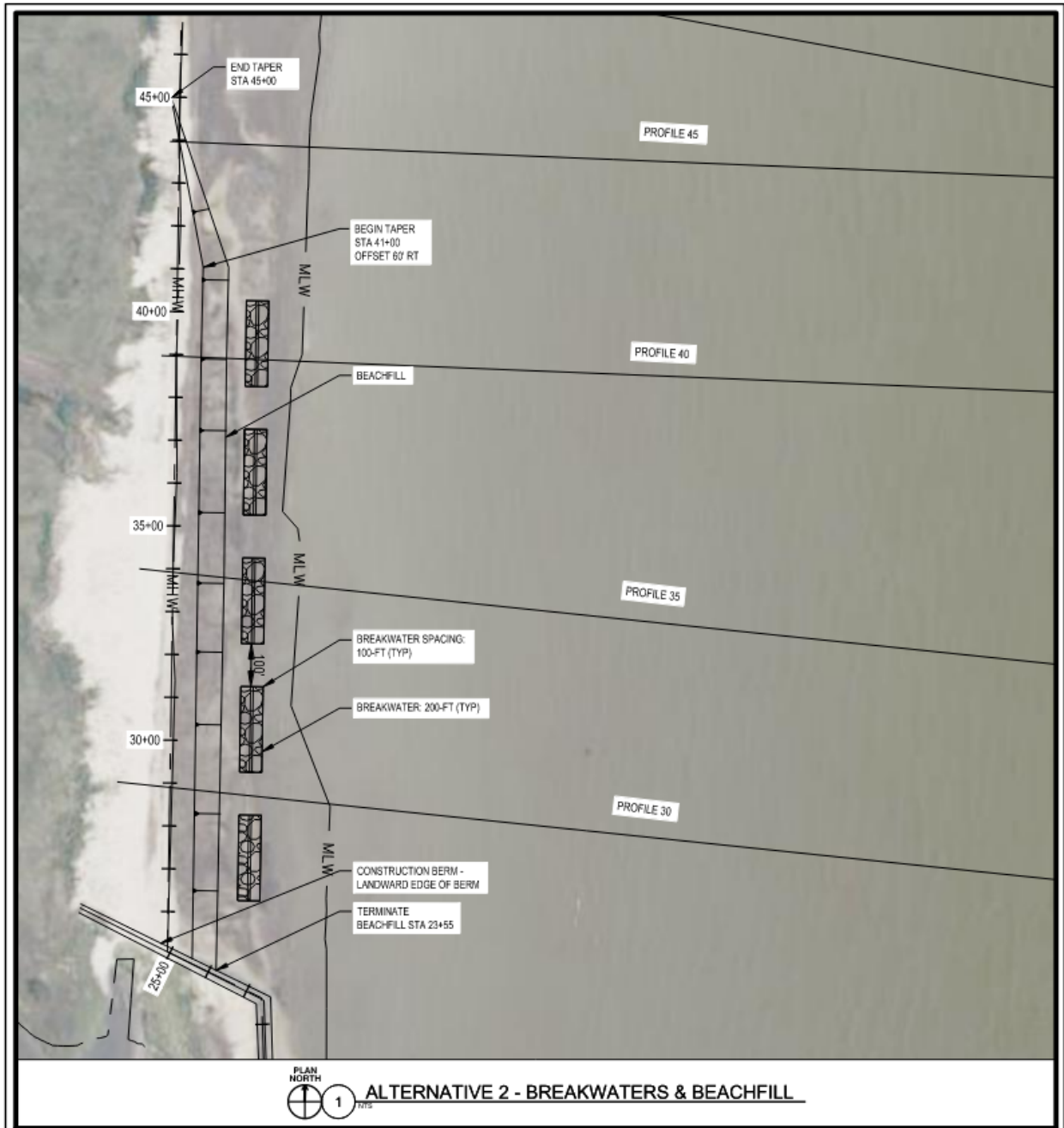


Figure 14. Cross Section Views of Beach Nourishment (Detail 1, Alternatives D, E, F, and G), Breakwater (Detail 2, Alternatives D and F), and DiKE Extension (Detail 3, Alternative E)

SHEET NUMBER SK-004	MISPELLION INLET, MILFORD, SUSSEX COUNTY, DELAWARE	DWN BY: A. JERBASI	DES BY: A. JERBASI	PROJ. DATE: TSP - 07 18 2025
	MISPELLION INLET FEASIBILITY STUDY	CKD BY: O. DURR	REVIEWED BY: G. GEISSELE	SOLICITATION NUMBER: PROJECT #
	TYPICAL SECTIONS ALTERNATIVES	 US Army Corps of Engineers Philadelphia District		CONTRACT NUMBER: SOL #
				PROJ. NUMBER: CONTRACT #



SK-002
SHEET NUMBER

MISPILLION INLET, MILFORD, SUSSEX
COUNTY, DELAWARE

**MISPILLION INLET
FEASIBILITY STUDY**

ALTERNATIVE 2
BEACHFILL & BREAKWATERS


DWN BY: A. JERBASI	DES BY: A. JERBASI	PROJ. DATE: TSP - 07 18 2025
CKD BY: O. DURR	REVIEWED BY: G. GEISSELE	SOLICITATION NUMBER: PROJECT #
 US Army Corps of Engineers Philadelphia District		CONTRACT NUMBER: SOL #
		PROJ. NUMBER: CONTRACT #

Figure 15. Plan View of Plans D and F (Beach Nourishment and Erosion Control Feature)

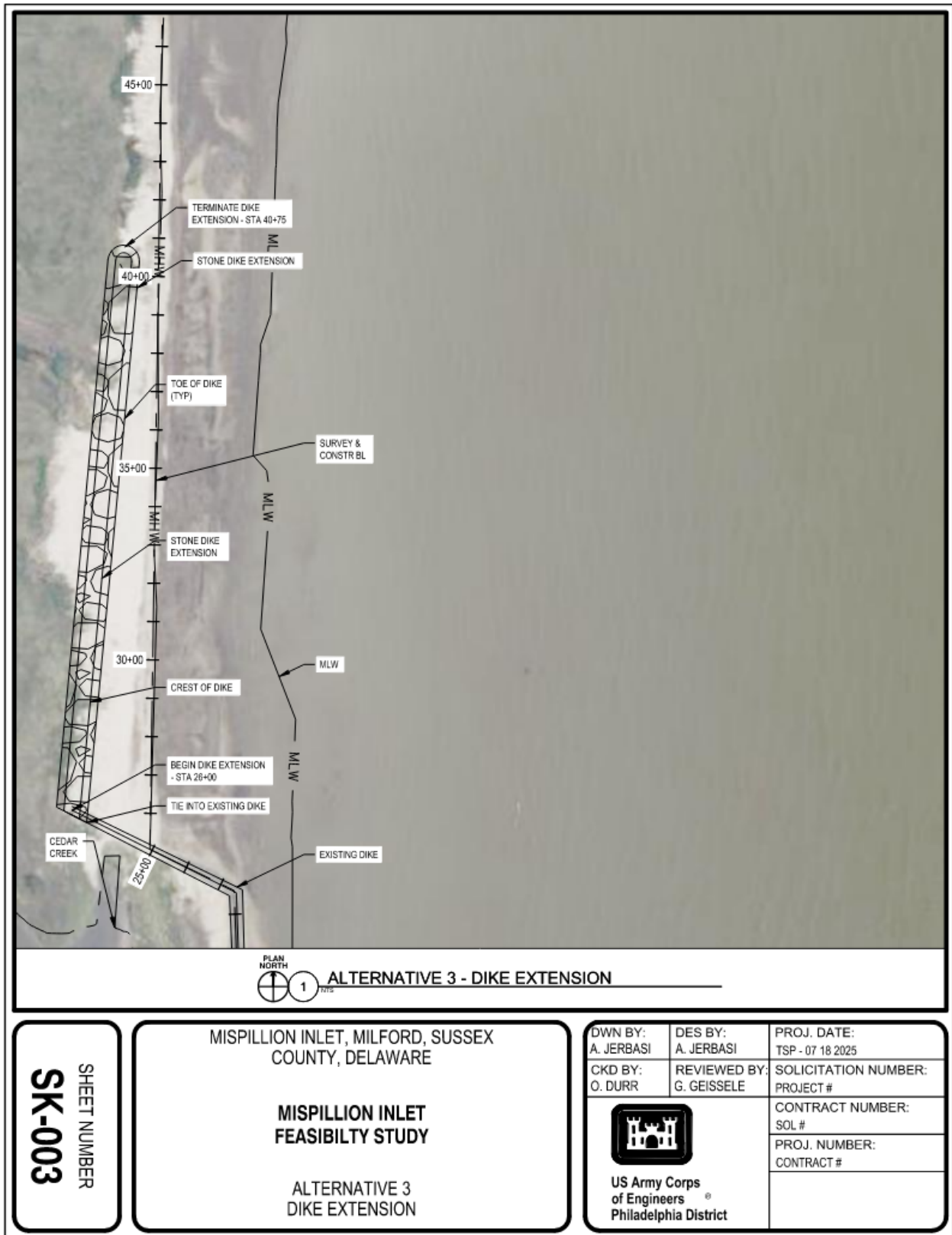


Figure 16. Plan View of Plan E (Dike Extension)

4.1 Trade Off Discussion

The trade-offs – monetary, quantitative, and/or qualitative among and within economic, environmental, and social metrics must be explicitly identified across alternative plans. Trade-offs are compared from the perspective of the specific circumstances of each study, including the study area, resources, environmental impacts, impacted populations, and study authority. They form the basis for deciding which plan best addresses the Federal Objectives and Guiding Principles. The trade-off comparison shows that both action alternatives provide a viable solution to the shoreline erosion problem, but their costs differ significantly. Plan F provides a higher level of protection due to the inclusion of the breakwater, but at a substantially higher cost. Therefore, reduces some technical risk identified above, but is not necessarily the least cost alternative to meet planning objectives and may introduce Implementation Risk due to Federal CAP limit of \$15 Million. Plan G is beach nourishment only and represents the least cost alternative (Table 14). Both Plan F and Plan G are preferable to the No Action alternative. Under No Action, erosion would continue unabated, potentially leading to inlet complex breaching and the loss of both habitat and critical launch and recovery services at Mispillion Inlet. While placing hardened structures (Plan F) on the bay shoreline could be effective, it would require ongoing sand nourishment to prevent erosion around it. This approach is not feasible for a Section 111 study, as the authority only permits a one-time placement of material. Therefore, in a system that is naturally lacking sediment, adding sand is likely the best solution for the adjacent shorelines.

Table 14. Alternative Array Project First Cost

Alternative	Project First Cost	Longevity	Beachfill Quantity (CY)
No Action	\$0	0	0
Alternative F Beach Nourishment + Breakwaters 60-foot-wide berm	\$14,828,000	10 years	30,200 (+17,000 Tons Stone)
Alternative G Beach Nourishment 60-foot-wide berm	\$7,145,000	5 years	30,200
Alternative G Optimized Beach Nourishment 150-foot-wide berm	\$12,318,000	10 years	80,500

4.2 Identification of the Justified Level of Work

The purpose of a Section 111 project is to identify and recommend a justified level of work for the prevention or mitigation of damages attributed to Federal navigation works (EP 1105-2-58). Alternative G (Beach Nourishment Only) provides the necessary level of mitigation to effectively prevent further damage to the existing navigation project. Based on the analysis summarized in the table above, Alternative G is identified as the Justified Level of Work, with a total first cost of \$13,655,000. This alternative represents the optimal engineered solution for addressing the identified issues at the Mispillion Inlet under the Section 111 Authority. Plan Selection after a comparison of the alternatives, Alternative G (Beach Nourishment Only) is selected as the TSP.

The selection of Alternative G is based on the following:

- It is the justified level of work that meets the primary objective of the Section 111 authority.
- This is a practical and effective engineering solution for shoreline erosion. It is environmentally acceptable and has the support of the non-federal sponsor, DNREC.
- It represents a justified level of work for the prevention or mitigation of damages attributed to a Federal navigation works since it is within the Section 111 cost limits and restores the shoreline damage attributable to a Federal Navigation works.

5.0 The Tentatively Selected Plan

The TSP for the Mispillion Inlet Section 111 project is Alternative G: Beach Nourishment (Figure 17). This plan was selected as the most cost-effective and environmentally acceptable means of preventing and mitigating shoreline erosion caused by the Mispillion River Federal Navigation Project. A plan view and cross-sectional view of the Beach Nourishment can be seen in Figure 13 and Figure 14.



Figure 17. The Tentatively Selected Plan - Beach Nourishment

As the least-cost alternative that meets the project's purpose and need, the Beach Nourishment plan directly addresses the authority of Section 111. It provides a necessary level of protection to the federal channel, supporting its continued viability and safe use. The plan is supported by the non-federal sponsor, DNREC and is considered the most prudent and feasible solution.

5.1 Plan Accomplishments

The implementation of the TSP will achieve the following key accomplishments:

- **Protects Critical Infrastructure:** By constructing a durable sand berm, the plan prevents a potential breach north the existing dike and protects the integrity of the Mispillion River Federal Navigation Project.
- **Prevents Habitat Loss:** The plan halts shoreline erosion into the adjacent marsh, preserving this valuable ecosystem from being lost to open water and preventing shoaling of the channel.
- **Ensures Long-Term Reliability:** The beach nourishment is designed to protect the shoreline for a 10-year project life span.
- **Maintains Economic Use of the River:** By securing the integrity of the federal channel and preventing erosion-related damages, the plan supports the continued cost-effective maintenance of Mispillion Inlet via decreasing risk of increased shoaling and access of the Ports in Cedar Creek, which supports a significant commercial fishing fleet and other maritime activities.

5.2 Plan Components

The TSP consists of the following primary components:

- **Sand Source:** A sufficient quantity of suitable sand will be sourced from a local, approved quarry by the NFS. It is assumed that at least two approved quarries would be available within 30 miles of the project area. The material will be transported via truck to the staging area on Cedar Creek. There are two methods that could be used to transport sand from the staging area to Conch Bar, hydraulic pumping and barging (mechanical). With pumping, the material would be loaded into a hopper, mixed into a slurry, and then pumped to the beach. It is assumed that the slurry would be composed of 1-part solids and 1.5 parts liquids and require a pump capable of pumping 1,490 gallons per minute.
- **Beach Nourishment Placement:** Approximately 80,500 cubic yards of sand will be placed along 1,700 feet of shoreline on Conch Bar, north of the rock dike. The sand will be graded to create a 150-foot-wide berm with a crest elevation of +5 feet NAVD88.
- **Construction and Staging:** All construction activities, including truck hauling routes, material stockpiling, and equipment staging, will be performed in a manner that minimizes disruption to public access and impacts to the local environment.

5.3 Lands, Easements, Rights-of-Way, Relocations, and Disposal

DNREC, as the non-federal sponsor, provides or acquires all Land, Easements, Right-of-Way, Relocations, and Disposal Areas (LERRDs) at no cost to the Federal government. Parcel impacts are expected to be low to moderate and predominantly on state-owned lands managed by DNREC, minimizing private involvement.

5.4 Project Risks

This section outlines the potential risks associated with the Mispillion River Project beach nourishment. The analysis considers various factors, including funding, contracting, logistics, and environmental variables. Where applicable, mitigating factors and assumptions are noted.

5.4.1 Funding Risks

The project's funding is uncertain. As a 100% federally funded initiative under the Continuing Authorities Program (CAP), its Design and Implementation phase is contingent on the availability of federal funds. The project also faces risks related to the contracting and bidding process.

Contracting Plan: The contracting plan is not yet established. The project development team (PDT) and cost estimate assume a design-bid-build, unrestricted contract awarded to a large business prime contractor. A shift to a small business set-aside is possible and could lead to increased project costs.

Bid Competition: The project's remote site, with no land access, is anticipated to limit bid competition. The difficulty of mobilizing construction equipment to the beach may result in low competition and a wide range of bid costs compared to typical beach nourishment projects.

5.4.2 Logistical and Construction Risks

The chosen construction methodology, involving multiple handling steps for the sand, presents several challenges:

Material Transport: The large quantity of sediment required will necessitate a substantial number of truck trips from the quarry to the staging area. This could create logistical challenges and impact communities and infrastructure along the haul route. The cost of potential road repairs may need to be added to the project budget.

There is no road access to the beach nourishment site. Barge or boat would be needed to transport laborers to the site. Pumping or barging would need to be used to transport 80,500 CY of sand to the beachfill site.

Construction Method: The use of bypass pumping is a specialized method, and not all contractors possess the necessary experience or equipment. While the cost estimate accounts for potential inefficiencies and pipeline blockages, the lack of widespread expertise in this method could introduce unforeseen challenges.

Material Handling: Sand will be trucked to a staging area, loaded into a hopper, mixed into a slurry, and then pumped to the beach. This multi-step process has inherent inefficiencies, although a 90% productivity rate and material loss have been factored into the cost estimate.

5.4.3 Cost and Schedule Risks

Material Pricing: While a sand quote is still considered valid, there is concern about potential price fluctuations due to market conditions. Unanticipated inflation of fuel and/or sand prices would have a moderate impact on the project's budget.

Schedule: A detailed bid schedule has not been developed. The project schedule will need to account for potential delays due to adverse weather, which is a likely occurrence.

5.4.4 Environmental and Design Risks

Beach Erosion: Additional erosion between now and the construction start date could increase the required amount of sediment. While the design includes advanced fill quantities based on recent survey data, the possibility of losing an additional 10 feet of beach (an increase of 5,000 cubic yards per year) exists.

Permitting: Although the project has local support, there is a possibility of challenges or delays in obtaining the necessary permits from regulatory agencies. Required coordination, consultations, and permits include CBRA, ESA, EFH, Delaware State Historic Preservation Office (DESHPO), and tribal consultation, Coastal Zone Management Act (CZMA) consistency determination concurrence, and CWA Section 401 water quality certificate.

5.4.5 Risk Mitigating Factors

Several factors help to mitigate the identified risks:

- **Scope and Design:** The project has minimal possibility for scope growth, and the beach nourishment design is expected to accomplish its intent over its 10-year design life.
- **Cost Estimate:** The cost estimate has incorporated several contingencies. It accounts for inefficiencies in the bypass pumping method, material loss during handling, and potential for pipeline blockages. The cost engineer is confident in the estimated crew and equipment needs based on historical data.
- **Delivery Method:** The project is unlikely to use more oversight-intensive delivery methods like Multiple Award Task Order Contract (MATOC) or design-build, simplifying the management process.

5.5 Cost Sharing

Under the authority of Section 111 of the River and Harbor Act of 1968, the USACE is empowered to undertake projects to prevent or mitigate shoreline erosion caused by federal navigation projects. This component of CAP allows the USACE to partner with non-federal sponsors to address adverse impacts on both public and private shores resulting from the construction or maintenance of federal navigation channels and structures. Projects under this authority are initiated after a DRP study confirms the engineering viability, environmental soundness, and economic justification of the proposed mitigation work.

For this specific project, the construction costs are funded entirely by the federal government up to the program's statutory limit of \$15 million per project. This 100% federal cost share is permissible under the program's rules, which stipulate that mitigation costs are shared in the same proportion as the original navigation project that caused the damage. Consequently, DNREC, as the non-federal sponsor, has a 0% cost-share obligation for the project's construction, though it remains responsible for providing any necessary lands, easements, rights-of-way, and relocations (LERRs). The partnership between the USACE and a non-federal sponsor like DNREC is critical for the successful implementation and long-term performance of the project. While the USACE manages the design and construction phases, DNREC will assume responsibility for the operation

and maintenance of the completed project to ensure its continued effectiveness. This collaborative approach ensures that local resources and expertise are integrated into the project, addressing the specific coastal challenges and protecting valuable shoreline resources from ongoing erosion.

5.6 Environmental Commitments

Examples of measures USACE would implement to avoid and minimize impacts during construction to protect natural resources include:

- To avoid impacts, vessel mooring, pipeline, and heavy equipment would avoid areas of natural, stable/uneroded habitat in the salt marsh, dune, upper beach, and berm to the maximum extent possible. Additional measures can be taken to reduce impacts to these habitats, such as using marsh mats and cribbing.
- USACE would work with resource agencies to develop best management practices, to minimize the impact of construction and avoid areas of natural habitat (upper beach and berm) that have not been affected by erosion.
- Onshore habitat impacted during construction would be restored.
- Work would not be conducted from April 15 to August 30 to avoid impacts on horseshoe crabs, eggs, and larvae.
- To avoid impacts on anadromous species, in-water work would not take place from March 15 to May 31.
- To avoid impacts on American eels, in-stream work would not take place from March 1 to May 15.
- Seasonal restrictions (likely from mid-March to mid-September) would help to reduce entrainment of listed species from the intake to fluidize the quarry sand.
- While it is assumed that most mobile species such as sturgeon and sea turtles would be able to avoid the temporary sea water intake, it would be appropriately screened to avoid entrainment of larger species such as sturgeon or sea turtles.
- To avoid adverse impacts to the red knots activity during a critical stage of their migration, no work would occur from April 15 to June 7.
- Seasonal restriction from March 15 to September 15 for construction activities would help to avoid adverse impacts to the American oystercatchers.
- Although there is no current legislation for the protection of diamondback terrapin nesting habitat, the following BMPs would be considered to ensure the protection and continuation of the species:
 - Sandy areas above the high tide line would be avoided to the maximum extent possible.
 - If possible, proposed construction would avoid nesting season (between mid-May to mid-July), if nesting season cannot be avoided, the following measures could be implemented to minimize impacts: 1) place secure opaque fencing around the work area to exclude nesting females or alternatively 2) have a biologist on site throughout the project to deter nesting terrapins from using the work area.
 - If any work occurs when hatchlings typically emerge from nests in late summer (early-August to mid-September) or when those that over-wintered in the nest are

likely to emerge (mid-March to end of May), a biologist could be on site during spoil placement to guide emerging hatchlings out of the work area.

- While the material placement would change the size and slope of the berm, it is meant to mimic and restore natural conditions, to the maximum extent practicable, in an area that was eroded due to the Federal navigation project. Additionally, truck-hauled quarry sand will be compatible with existing sand. Details of the slope and grain size will be developed during the design phase.

5.7 Views of the Non-Federal Sponsor

The non-federal sponsor, DNREC, has affirmed its full support for and is committed to the Mispillion Navigation Project CAP Section 111. DNREC specifically endorses the TSP, which is limited to beach nourishment only for the Mispillion area as outlined in the project proposal. This commitment from the sponsor is a critical component for the successful implementation and future maintenance of the project.

6.0 Environmental Consequences

6.1 Natural Environment

6.1.1 Terrestrial Habitat

The No Action Alternative would have adverse effects on habitat, by allowing beach erosion to continue. A Mispillion River breach would also result in a loss of salt marsh which also serves as important habitat (see Figure 8).

Under the TSP, constructing a beach nourishment, by placing large volumes of sand immediately north of the rock dike along Conch Bar and the southern end of Big Stone Beach would have temporary adverse effects and long-term beneficial effects on habitat at Mispillion Inlet.

Construction would result in the temporary disturbance of the existing eroded berm to the mean low water (MLW). Sand would either be pumped using a sand bypass system or barged from a staging area to the north side of the inlet. The staging area will likely be a property on Cedar Creek or Mispillion River with a boat ramp. Heavy equipment would be used to move the sand on the staging area and on the north side of the inlet. Vessel mooring, pipeline, and heavy equipment would avoid areas of natural, stable/uneroded habitat. Seasonal restrictions would be used to avoid impacts on shorebirds, horseshoe crabs, and diamondback terrapins. See subsequent sections on rare, threatened, and endangered species for more information on seasonal restrictions.

The TSP would have temporary effects on aquatic habitat with the intake of water, and a temporary increase in turbidity from beach nourishment placement. There is the potential that a pipe would be used to transport sand from the staging area to the beach. If so, water would be added to the sand to form a slurry; therefore, temporary water intake in Cedar Creek or Mispillion River would be required. It is estimated that a total of 120,000 CY or 24,240,000 gallons of water would need to be added to 80,500 CY of sand for a total of 40,400,000 gallons of slurry would be needed. Seasonal restrictions for migratory fish would help to avoid entrainment early life stages of these migratory fish.

The effects of turbidity caused by the TSP will be insignificant due to the temporary and localized nature. Many factors affect turbidity associated with a beach nourishment, including weather and grain size. The purpose of the project is to stabilize the shoreline and maintain sand on the beach. Sand would be placed above the swash zone, any sand entering the water would settle out quickly. Finer solids would filter through the sand, which would also help to improve clarity. The work area would return to natural conditions once the work is completed.

The beach nourishment will restore and improve beach habitat for shorebirds, horseshoe crabs, and diamondback terrapins. Sand would be placed along a gradually sloping profile that would be resilient to storms, promote shoaling and beach nourishment. While the material placement would change the size and slope of the berm, it is meant to mimic and restore natural conditions in an area that was eroded due to the Federal navigation project. Using compatible material would encourage benthic community recolonization. Berm construction will improve habitat for shorebirds, horseshoe crabs and other wildlife in the nourishment. Additionally, it would help to prevent a breach of the Mispillion River, in turn preventing loss of the salt marsh between the river and the beach.

6.1.2 Vegetation

The No Action Alternative would have adverse effects on vegetation, with continued shoreline erosion, eventually resulting in dune and dune vegetation losses. Additionally, if the Mispillion River breaches by 2050, as predicted, a large span of salt marsh would be lost (Figure 8).

Constructing a beach nourishment under the TSP would have temporary adverse effects on vegetation at Mispillion Inlet. Most of the construction would avoid vegetation. However, the pipeline used to pump sand and the heavy equipment used to move the sand could result in temporary adverse effects outside of the target area. Vegetation temporarily impacted would include beachgrass/panicgrass, dune grasslands, north Atlantic salt marsh, overwash dune grassland, and reed tidal marsh.

To avoid impacts, vessel mooring, pipeline, and heavy equipment would avoid areas of natural, stable/uneroded habitat in the salt marsh, dune, upper beach, and berm to the maximum extent possible. Additional measures can be taken to reduce impacts to these habitats, such as using marsh mats and cribbing. USACE would work with resource agencies to develop best management practices, to minimize the impact of construction and avoid areas of natural habitat (upper beach and berm) that have not been affected by erosion. Onshore habitat impacted during construction would be restored.

Over the long-term, the beach nourishment would improve shoreline habitat, protecting the dune and salt marsh vegetation behind it.

6.1.3 Wildlife

The No Action Alternative would have adverse effects on habitat, by allowing beach erosion to continue. A Mispillion River breach would also result in a loss of dune and salt marsh which also serves as important wildlife habitat.

Under the TSP, a beach nourishment would result in temporary impacts and long-term beneficial effects on terrestrial animals such as shorebirds, ghost crabs, and diamondback terrapins, that use the upper beach, the intertidal zone, or adjacent areas. Construction activities could disturb and disrupt nesting, nursing, or breeding. Most larger animals such as shorebirds and crabs would avoid the impact for foraging or breeding. However, construction activities might result in shorebirds abandoning nests or bird or terrapin eggs or hatchlings being trampled. These impacts would be avoided by implementing seasonal restrictions, as described in rare, threatened, and endangered species.

The beach nourishment will restore beach habitat and improve habitat for shorebirds, horseshoe crabs, and diamondback terrapins. Sand would be placed along gradually sloping profile that would be resilient to storms, promote shoaling and beach nourishment. Berm construction will improve habitat for shorebirds, horseshoe crabs and other wildlife in the nourishment. Additionally, some sand may move beyond the area and replenish beaches to the north.

In the long term, a beach nourishment project would improve eroded beach habitat for nesting, nursing, or breeding.

Impacts on nesting and hatching diamondback terrapins are described further in rare, threatened, and endangered species.

6.1.4 Aquatic Habitat

Under the No Action Alternative, there is the potential for the Mispillion River to breach above the rock dike, which would result in salt marsh loss.

The TSP would have temporary effects on aquatic habitat with the intake of water, and a temporary increase in turbidity from beach nourishment placement. There is the potential that a pipe would be used to transport sand from the staging area to the beach. If so, water would be added to the sand to form a slurry; therefore, temporary water intake in Cedar Creek or Mispillion River would be required. It is estimated that a total of 120,000 CY or 24,240,000 gallons of water would need to be added to 80,500 CY of sand for a total of 40,400,000 gallons of slurry would be needed. Seasonal restrictions for anadromous fish and eels would help to avoid entrainment early life stages of these anadromous fish.

The effects of turbidity caused by the TSP will be insignificant due to the temporary and localized nature. Many factors affect turbidity associated with a beach nourishment, including weather and grain size. The purpose of the project is to stabilize the shoreline and maintain sand on the beach. Sand would be placed above the swash zone, and any sand entering the water would settle out quickly. Finer suspended solids in the water would be filtered through the sand, which would also help to improve clarity. The work area would return to natural conditions once the work is completed.

6.1.5 Aquatic Species

The No Action Alternative would have minimal impact on fish, but if shoreline erosion is allowed to continue, it would have long-term negative effects on horseshoe crab spawning habitat.

Beach nourishment under the TSP would have temporary adverse effects and long-term beneficial effects on aquatic species at Mispillion Inlet. Construction would result in temporary disturbance of the existing eroded berm in the intertidal zone. This could result in turbidity in nearshore waters and the burial and smothering of benthic organisms in the intertidal area. The nearshore intertidal zone is highly dynamic and is characterized by variations in abiotic factors. The nearshore community is resilient and expected to recover within one or two seasons because the sediment used in the beach nourishment would be compatible with existing sand.

If a pump is used to transport sand from the staging area to the beach, the potential for entraining smaller fish, larvae, and exists. Seasonal restrictions would be used to avoid working in the spring, which would avoid effects on fish eggs and larvae that were spawned in the spring and summer. The intake would be appropriately screened to avoid the intake of larger aquatic species. It is assumed that most mobile species would be able to avoid this sea water intake.

The project site is a well-known high-density spawning area for horseshoe crabs. Material placement may result in the loss of horseshoe crabs, and their eggs and larvae. Work would not be conducted from April 15 to August 30 to avoid impacts on this species. While the material placement would change the size and slope of the berm, it is meant to mimic and restore natural conditions, to the maximum extent practicable, in an area that was eroded due to the Federal navigation project. Additionally, while the sand will be truck-hauled, the material will be compatible with existing sand. Details of the slope and grain size will be developed during the design phase. In their scoping letter, NMFS (2024) indicated that beach restoration at Mispillion Inlet has the potential to restore spawning habitat for horseshoe crabs (Loveland and Botton, 2015).

Beach nourishment activities could disturb anadromous fish including river herring (blueback herring and alewife) and white perch during their spawning migration or American eel during the upstream migration of elvers (young eels). Additionally, a temporary intake could entrain the early life stages of these species. To avoid impacts on anadromous species, in-water work would not take place from March 15 to May 31. To avoid impacts on American eels, in-stream work would not take place from March 1 to May 15.

6.1.6 Rare, Threatened, and Endangered Species

The No Action Alternative would have adverse effects on rare, threatened, and endangered species habitat, by allowing beach erosion to continue. A Mispillion River breach would also result in a loss of salt marsh which also serves as important habitat for threatened and endangered species.

Constructing a beach nourishment under the TSP would have temporary adverse impacts and long-term beneficial impacts on rare, threatened and endangered species. Construction noise and activity would cause a temporary disturbance to these species, which would be avoided with seasonal restrictions. Beach nourishment would have long-term beneficial impacts on these species by providing suitable habitat.

Sea Turtles and Sturgeon. The No Action Alternative would have no effects on sea turtles and sturgeon.

The TSP would have insignificant effects on sea turtles and sturgeon. Effects of turbidity caused by this action will be insignificant due to the temporary and localized nature. Many factors affect turbidity associated with beach nourishment, including weather and grain size. The purpose of the project is to stabilize the shoreline and maintain sand on the beach. Sand would be placed in the intertidal zone, mostly on dry land, and any sand entering the intertidal waters would settle out quickly. Finer solids water would filter through the sand, improving the clarity. The work area would return to natural conditions once the work is completed. Seasonal restrictions (likely from mid-March to mid-September) would help to avoid impacts on listed species. In the unlikely event that an ESA listed species is in the project area, they would have a wide zone of passage to avoid the sediment plume.

There is the potential that a pump will be used to transport sand from the staging area to the beach via a pipeline. If so, water would be needed to create a slurry from the truck-hauled sand and a temporary water intake in Cedar Creek or Mispillion River would be required. Seasonal restrictions (likely from mid-March to mid-September) would help to reduce entrainment of listed species. While it is assumed that most mobile species such as sturgeon and sea turtles would be able to avoid the temporary sea water intake, it would be screened (with 4-inch by 4-inch screen or smaller) to avoid entrainment of larger species such as sturgeon or sea turtles.

Red Knot. The No Action Alternative would have adverse effects on critically important red knot habitat, by allowing beach erosion to continue, resulting in a loss of red knot foraging and resting habitat. It would also impact red knot foraging with impacts to horseshoe crab spawning or spawning habitat.

Construction activities associated with the beach nourishment under the TSP have the potential to disturb red knot resting and foraging. To avoid adverse impacts to the red knots activity during a critical stage of their migration, no work would occur from April 15 to June 7.

Beach nourishment would provide long-term beneficial impacts to the red knot by restoring habitat for horseshoe crab spawning, which are a primary prey source for the red knot. A stable berm would improve habitat for roosting by reducing the impact of large storm events on foraging areas.

American Oystercatcher. The No Action Alternative has the potential to allow continued erosion of oystercatcher breeding habitat.

The TSP has the potential to disturb and disrupt oystercatchers breeding and nesting. Seasonal restriction from March 15 to September 15 for construction activities would help to avoid adverse impacts to the American oystercatchers. Beach nourishment would provide long-term beneficial impacts to this species by improving nesting habitat and enhancing foraging.

State-listed Migratory Birds. Black skimmer, saltmarsh sparrow, and least terns are state-listed migratory birds addressed in Section 6.1.8.

Diamondback Terrapin. The No Action Alternative has the potential to allow continued erosion of diamondback terrapin habitat.

Long-term adverse impacts to the diamondback terrapin are not anticipated as a result of the TSP. Beach nourishment would restore diamondback terrapin nesting habitat.

Short term, adverse impacts during construction such as crushing or injuring nesting females, impeding nesting, destroying nests, crushing eggs and hatchlings, and preventing hatchlings from emerging from nests. Some of these impacts would be avoided by using BMPs during construction, including seasonal restrictions. Although there is no current legislation for the protection of diamondback terrapin nesting habitat, the following BMPs would be considered to ensure the protection and continuation of the species:

- Sandy areas above the high tide line would be avoided to the maximum extent possible.
- If possible, the beach nourishment would avoid nesting season (between mid-May to mid-July), if nesting season cannot be avoided, the following measures could be implemented to minimize impacts: 1) place secure opaque fencing around the work area to exclude nesting females or alternatively 2) have a biologist on site throughout the project to deter nesting terrapins from using the work area.
- If the work occurs when hatchlings typically emerge from nests in late summer (early-August to mid-September) or when those that over-wintered in the nest are likely to emerge (mid-March to end of May), a biologist could be on site during sand placement to guide emerging hatchlings out of the work area.

6.1.7 Essential Fish Habitat

The No Action alternative would have no effect on EFH.

Constructing a beach nourishment under the TSP would have localized, temporary adverse impacts and beneficial long-term impacts on essential fish habitat. An EFH Assessment is provided in Appendix C.

Construction would result in temporary disturbance of the existing eroded berm in the intertidal zone. This could result in turbidity in nearshore waters and the burial and smothering of benthic organisms in the intertidal area. The nearshore intertidal zone is highly dynamic and is characterized by variations in abiotic factors. The nearshore community is resilient and expected to recover within one or two seasons because the sediment used in the beach nourishment would be compatible with existing. Placing material during periods of low tide would help to reduce impacts such as turbidity.

The effects of turbidity caused by the TSP will be insignificant due to the temporary and localized nature. Many factors affect turbidity associated with beach nourishment, including weather and grain size. The purpose of the project is to stabilize the shoreline and maintain sand on the beach. Sand would be placed above the swash zone, any sand entering the water would settle out quickly. Finer suspended solids would filter through the sand, which would also help to improve clarity. The work area would return to natural conditions once the work is completed.

If a pump was used to transport sand from the staging area to the beach, the potential for entraining smaller fish, larvae, and exists. This effect would be temporary and seasonal restrictions in the spring and summer would be used to avoid working in the spring, which would avoid effects on butterflyfish larvae, which are the only vulnerable species and life stage with EFH designated in the project area. The intake would be screened to avoid the intake of larger aquatic species. It is assumed that most mobile species would be able to avoid this sea water intake.

Beach nourishment would provide long-term benefits on EFH by stabilizing shorelines, enhancing habitat, and protecting nearshore environments. Adding sediment to the beach can also support the growth of seagrasses and other aquatic plants that are important for fish nursery habitats. The intertidal zone is a critical area for many fish species, such as the summer flounder. Beach nourishment can expand the intertidal zone and provide feeding and shelter areas for fish species. Additionally, beach nourishment activities prevent habitat fragmentation that might occur from increased shoreline erosion.

6.1.8 Migratory Bird Act and the Bald and Golden Eagle Protection Act

The No Action Alternative would have adverse effects on migratory shore bird habitat, by allowing beach erosion to continue. A Mississippi River breach would also result in a loss of salt marsh which also serves as important migratory bird habitat.

Construction would have temporary adverse impacts and long-term beneficial impacts on migratory shorebirds that use the study area for nesting or for resting and foraging during their migration. Seasonal restrictions would help to avoid disturbing migratory birds associated with construction noise and activity, which would cause a temporary disturbance to these shorebirds.

Beach nourishment would have long-term beneficial impacts on these species by providing suitable habitat.

6.2 Physical Environment

6.2.1 Climate and Weather

Under the No Action Alternative, sea level change would exacerbate erosion and the potential for a Mispillion River breach.

Constructing a beach nourishment under the TSP would not result in adverse effects on the climate or weather and is not expected to result in weather-related changes. The project would make the habitat and the federal navigation project more resilient to sea level and weather-related changes.

6.2.2 Water Resources

The No Action Alternative would have no effect on water quality.

6.2.2.1 Water Quality

The TSP would result in temporary, minor effects on turbidity. Many factors affect turbidity associated with beach nourishment, including weather and grain size. The purpose of the project is to stabilize the shoreline and maintain sand on the beach. Sand would be placed above the swash zone, any sand entering the water would settle out quickly. Finer suspended solids water would filter through the sand, which would also help to improve clarity. The work area would return to natural conditions once the work is completed. USACE will obtain a DNREC 401 Water Quality Certification for the TSP.

6.2.2.2 Waters of the U.S.

An evaluation of compliance with Clean Water Action (CWA) Section 404(b)(1) is provided in Appendix C. The activity would not violate State water quality standards. Sand would come from a clean and approved site and turbidity associated with the beach nourishment would be temporary and minor. A CWA 401 water quality certificate would be obtained prior to construction. Measures would be incorporated in the TSP to avoid and minimize effects on water quality, the ecosystem, and threatened and endangered species. One of the objectives of the TSP is to conserve and protect tidal saltmarsh which provide habitat to migratory birds, rare, threatened and endangered species, and a host of other terrestrial and aquatic animals. The TSP would comply with CWA Section 404(b)(1) guidelines.

6.2.2.3 Floodplains

This project has been reviewed in accordance and complies with Executive Order 11988 Floodplain Management. None of the proposed work will result in an increase of flood risk, nor will it result in a loss of floodplain surface area, connectivity, or function. The proposed action will be implemented in compliance with minimization plans and flood insurance requirements. The following is the 8-step process required by USACE (ER 1165-2-26) to comply with Executive Order 11988.

1. Determine if the proposed action is in the base floodplain.

The project is in the base floodplain.

2. If the action is in the base floodplain, identify and evaluate practicable alternatives to the action or to location of the action in the base floodplain as outlined in paragraph 7 above.

The purpose of the project is to mitigate shoreline damage; therefore, there are no practicable alternatives to the action that would locate it outside of the base floodplain.

3. If the action must be in the floodplain, advise the general public in the affected area and obtain their views and comments.

This project is being completed at the request of the State of Delaware (the non-federal sponsor) and has the support of the public. The draft EA will be available for public review and comment.

4. Identify beneficial and adverse impacts due to the action and any expected losses of natural and beneficial floodplain values. Where actions proposed to be located outside the base floodplain will affect the base floodplain, impacts resulting from these actions should also be identified.

Impacts of the action are outlined throughout Section 6 of this draft Environmental Assessment (EA). The effects of the project will be beneficial to floodplain values.

5. If the action is likely to induce development in the base floodplain, determine if a practicable non-floodplain alternative for the development exists, as outlined in paragraph 7, above.

The action is not likely to induce development in the base floodplain.

6. As part of the planning process under the Principles and Guidelines, determine viable methods to minimize any adverse impacts of the action including any likely induced development for which there are natural and beneficial floodplain values. This should include reevaluation of the "no action" alternative.

The action will not have adverse impacts and is not likely to induce development.

7. If the final determination is made that no practicable alternative exists to locating the action in the floodplain, advise the general public in the affected area of the findings.

There are no practicable alternatives outside of the base floodplain that meet the purpose and need of this project.

8. Recommend the plan most responsive to the planning objectives established by the study and consistent with the requirements of the Executive Order stated in paragraph 6 above.

The TSP is designed to avoid, as much as possible, any negative long- and short-term impacts that could result from using or altering the base floodplain. Furthermore, the plan avoids supporting any new development in the floodplain whenever a practical alternative exists.

6.2.3 Geology

The No Action Alternative would have adverse effects on local geology, as the beach continues to erode. The impact would be larger with a Mispillion River breach.

6.2.3.1 Shoreline Change

The TSP would reduce shoreline erosion. Material placement would change the size and slope of the berm; however, it is meant to mimic and restore natural conditions in an area that was eroded due to the Federal navigation project. The beach nourishment is designed to protect the shoreline for a 10-year project life span.

6.2.3.2 Soils

The TSP would have minor adverse effects on soils. Beach nourishment sand will come from a permitted quarry and the sediment placed will be compatible with the existing sand. While the material placement would change the size and slope of the berm, it is meant to mimic and restore natural conditions in an area that was eroded due to the Federal navigation project.

6.2.4 Land Use

Under the No Action Alternative, there would be no change to land use, but the beach would continue to erode and a Mispillion River breach would erode the salt marsh. These effects would result in changes to land cover.

There would be no change to land use under the TSP.

6.2.5 Coastal Zone

As described throughout Section 6 of this EA, the TSP is expected to have temporary minor impacts and long-term beneficial effects on the resources of the Delaware coastal zone. The TSP has been reviewed for consistency with the Delaware Coastal Management Program, as required under 15 CFR 930 Subpart C. USACE has determined that the TSP is consistent, to the maximum extent practicable, with the enforceable policies of the Delaware Coastal Management Program.

6.2.6 Coastal Barrier Resources

The No Action Alternative would have no effect on the Broadkill Beach CBRS Unit (HOO) or the Broadkill Beach Otherwise Protected Area (HOOP).

The TSP is consistent with the CBRA general exception that allows for stabilization projects for fish and wildlife resources and habitats (16 U.S.C. 3501(b)) and nonstructural projects for shoreline stabilization that are designed to mimic, enhance, or restore a natural stabilization system (16 U.S.C. 3505(a)(6)(G)). USACE has initiated CBRA consultation to confirm that the TSP is consistent with the exception(s) under CBRA.

CBRA at 16 U.S.C. § 3505(a)(6) provides exceptions to the limitation on federal expenditures within the System, which include nonstructural projects for shoreline stabilization that are designed to mimic, enhance or restore a natural stabilization system.

Delaware Bay beach/shoreline habitat is nationally significant for horseshoe crabs and shorebirds. These habitats supported a variety of fish and wildlife, including spawning horseshoe crabs, foraging migratory shorebirds, beach nesting birds, and nesting diamondback terrapins.

The federal navigation project at Mispillion Inlet has reduced the naturally dynamic conditions responsible for sustaining habitat quality, resulting in beach erosion and the reduction of shoaling. This has resulted in the sand beach habitat being replaced by peat or clay dominated banks. The breaches that have occurred since the late 1970s have resulted in converting several hundred acres of degraded salt marsh into open water. The northern extension of the rock dike completed in 2017 reduced the threat of a future breach, but the potential still exists because of the inland migration/erosion of the Conch Bar shoreline (USFWS, 2024).

Sand in the estuarine system may protect the marsh in localized areas; however, significant portions of the marsh platform and vegetation have been affected by mosquito ditching and the Grecos Canal, making the marsh less resilient to tidal and wave energies and less effective at trapping and accreting sediments. Beach erosion and salt marsh degradation will continue in the future without the project. Additionally, sea level change may aggravate beach erosion and marsh degradation. In the future without the project, the shoreline could erode past the landward tip of the dike and significantly increase the risk of a breach. This would result in the loss of beach, dune, and salt marsh habitat north of the inlet (see Figure 8).

Material placement would change the size and slope of the berm; however, it is meant to mimic and restore natural conditions in an area that was eroded due to the Federal navigation project. Additionally, while the sand will be truck-hauled material, it will be compatible with the existing sand. The beach nourishment proposed by USACE and DNREC is designed to protect the shoreline for a 10-year project life by constructing a durable sand berm. The plan would prevent a potential breach north of the existing dike and protect the integrity of the Mispillion River Federal Navigation Project. The plan reduces shoreline erosion into the adjacent marsh, preserving this valuable ecosystem from being lost to open water and preventing shoaling of the channel. While the beach nourishment is designed to protect the shoreline for a 10-year project life span.

6.2.7 Air Quality

Under the No Action Alternative there would be no change to air quality or the SIP.

Under the TSP, approximately 4,900 truck trips will be required for delivery of 80,500 CY of sand from a local quarry to the staging area. Two quarries have been identified within approximately 30 miles of the staging area. There are two methods of transporting the sand from the staging area to Conch Bar, hydraulic pumping and barging. These components of the proposed action were considered for an emissions estimate (Appendix C)

The emissions estimate was completed to determine the Nitrogen Oxides (NO_x), Volatile Organic Carbon (VOC) emissions (precursors to ozone formation), and PM_{2.5} associated with the beach nourishment project. The total estimated emissions that will result from hydraulic pumping are 23.54 tons of NO_x, 0.47 tons of VOC, and 0.40 tons of PM_{2.5}. The total estimated emissions that will result from barging are 79.31 tons of NO_x, 1.59 tons of VOC, and 1.34 tons of PM_{2.5} (see Appendix C). Construction of this project will be completed in less than one year. These estimated emissions are below *de minimis* levels established by the EPA of 100 tons of NO_x and PM_{2.5} and 50 tons of VOC per year. Therefore, General Conformity is not required for either method because the total direct and indirect emissions from the project are below the *de minimis* level set forth at 40 CFR 93.153 (b) for ozone (NO_x and VOC) in a Marginal Nonattainment Area (100 tons and

50 tons of each pollutant per year) and PM2.5 in a maintenance area. The project is not considered regionally significant under 40 CFR 93.153 (i).

6.2.8 Hazardous, Toxic, and Radioactive Waste

No excavation, dredging, or sediment disposal would occur as a result of the project. Sand used for the beach nourishment would come from an approved quarry. If it is determined that excavation is needed during design and implementation, a more intensive investigation would be conducted and any HTRW would be disposed of appropriately.

6.3 Built Environment

There would be no changes to the built environment under the No Action Alternative.

Under the TSP, approximately 4,900 truck trips will be required for delivery of sand from a local quarry approximately 30 miles from the project. Truck traffic could result in the deterioration of local roads. The contractor would be required to obtain any applicable road permits. Any road affected by the proposed action would be restored.

6.4 Cultural Resources

There would be no potential to impact historic properties under the No Action Alternative.

Under the TSP, the USACE has determined that the project will have No Effect on historic properties eligible for or listed on the NRHP.

6.5 Economic Environment

Under the No Action Alternative, a Mispillion River breach north of the dike could result in shoaling of Cedar Creek and Mispillion Inlet. This would potentially impede the operations of Delaware Launch Services, which provides safe transport of personnel and supplies to tanker vessels anchored in Delaware Bay and the nearby Atlantic Ocean. Disruptions to Delaware Launch Service's operations would have a negative impact on the regional economy.

The TSP would reduce the risk of a breach and shoaling of Cedar Creek, which would allow Delaware Launch Service to maintain their service. Additionally, constructing a beach nourishment would result in a short-term increase in regional employment.

7.0 Environmental Compliance

Environmental review and compliance for the TSP is currently in progress, as summarized in Table 14 for applicable Federal Statutes, Executive Orders, and Executive Memoranda. The proposed beach nourishment is authorized under Section 111 of the CAP program. The project complies with and will be conducted in a manner consistent with Delaware's requirements with regards to Section 401 of the Clean Water Act and the CZMA. Water Quality Certification and concurrence with a Federal Coastal Zone Consistency Determination are being requested from DNREC, with the circulation of this draft EA.

The TSP is being coordinated with the U.S. Fish & Wildlife Service (USFWS) and the National Marine Fisheries Service (NMFS) pursuant to the Fish and Wildlife Coordination Act, the Endangered Species Act, and the Magnuson Stevens Fishery Conservation and Management Act.

The TSP is not expected to have significant changes in air quality impacts and complies with Section 176(c)(1) of the Clean Air Act amendments of 1990.

Table 14. Compliance with environmental quality protection statutes and other environmental review requirements.

FEDERAL STATUTES	COMPLIANCE STATUS
Bald and Golden Eagle Protection Act	Full
Clean Air Act, as amended	Partial
Clean Water Act of 1977	Partial
Coastal Barrier Resources Act	Partial
Coastal Zone Management Act of 1972, as Amended	Partial
Endangered Species Act of 1973, as amended	Partial
Federal Water Project Recreation Act, as amended	Full
Fish and Wildlife Coordination Act	Partial
Magnuson-Stevens Fishery Conservation and Management Act	Partial
Migratory Bird Treaty Act	Full
National Historic Preservation Act of 1966, as Amended	Partial
National Environmental Policy Act, as amended	Partial
Rivers and Harbors Act	Partial
Resource Conservation and Recovery Act, as amended, 43 U.S. C. 6901, et seq.	Full
Wild and Scenic River Act	N/A
EO 11990, Protection of Wetlands	Full
EO 11988 Floodplain Management	Full
EO 12114, Environmental Effects of Major Federal Actions	Full
EO 13045, Protection of Children from Environmental Health Risks and Safety Risks	Full
EO 13175, Consultation and Coordination with Indian Tribal Governments	Partial
County Land Use Plan	Full

Notes:

Full Compliance - Requirements of the statute, EO, or other environmental requirements are met for the current stage of review.

Partial Compliance - Some requirements and permits of the statute, E.O., or other policy and related regulations remain to be met and coordination is ongoing.

Noncompliance - None of the requirements of the statute, E.O., or other policy and related regulations have been met.

N/A - Statute, E.O. or other policy and related regulations are not applicable.

The following paragraphs describe pertinent public laws applicable to the project.

National Environmental Policy Act of 1970, As Amended, 42 U.S.C. 4321, *et seq.* NEPA requires that all federal agencies use a systematic, interdisciplinary approach to protect the human environment. NEPA requires the preparation of an EIS for any major federal action that could have a significant impact on quality of the human environment and the preparation of an EA for those federal actions that do not cause a significant impact but do not qualify for a categorical exclusion. Section 102 of the Act authorized and directed that, to the fullest extent possible, the policies, regulations and public law of the United States shall be interpreted and administered in accordance with the policies of the Act. This EA was prepared as a full-disclosure document in accordance with NEPA and a Public Notice was issued for public review. Comments will be provided.

Clean Air Act, as amended, 42 U.S.C. 7401, *et seq.* The Clean Air Act regulates air emissions from stationary and mobile sources. The law authorizes USEPA to establish NAAQS to protect public health and public welfare and to regulate emissions of hazardous air pollutants. Based on ambient levels of a pollutant compared with the established national standards for that pollutant, regions are designated as either being in attainment or non-attainment. Sussex County is in marginal nonattainment for the 2008 8-hour ozone Standard (primary and secondary). Kent and Sussex Counties are in attainment for all other priority pollutants. The draft EA was forwarded to the USEPA and DNREC for their review to confirm compliance with Section 309 of the Clean Air Act.

Clean Water Act, 33 U.S.C. 1251, *et seq.* A 404(b)(1) Evaluation has been completed to ensure the TSP is in compliance with the Clean Water Act of 1977 and subsequent amendments. A Section 401 Water Quality Certification is required for the project and is being requested from DNREC, with the circulation of this EA. Implementation of the TSP would not result in permanent negative changes in water quality. Following construction activities, intertidal habitat in the placement area is expected to be more resilient in the face of sea level change. All state water quality standards will be met.

Coastal Zone Management Act of 1972. The proposed project is within the coastal zone, which is managed under the DNREC Coastal Zone Management Program (CZMP). Although truck-hauled sand will temporarily impact shallow water habitat, which is protected under the Coastal Zone program, beneficial effects from the proposed action are consistent with other goals of the CZMP. The CZMP includes goals to protect coastal land and water habitat. A Federal consistency determination in accordance with 15 CFR 930 Subpart C has been made stating that the TSP is consistent with the enforceable policies of Delaware's federally approved coastal management program.

Endangered Species Act of 1973. The TSP has been determined to be in compliance with the Endangered Species Act of 1973 (ESA) after completion of consultation with the natural resource regulatory agencies. The TSP is not anticipated to adversely affect threatened or endangered species and is expected to provide a positive impact through the development of additional valuable habitat used by threatened and endangered species.

Fish and Wildlife Coordination Act. The Fish and Wildlife Coordination Act (FWCA) requires Federal agencies to consult with the USFWS, NMFS, and the fish and wildlife agencies of States where the "waters of any stream or other body of water are proposed or authorized, permitted or licensed to be impounded, diverted or otherwise controlled or modified" by any agency under a Federal permit or license. Consultation is to be undertaken for the purpose of "preventing loss of and damage to wildlife resources." The intent is to give fish and wildlife conservation equal consideration with other purposes of water resources development projects. This draft EA has been provided to USFWS and NMFS for their review, pursuant to the Fish and Wildlife Coordination Act in fulfillment of Section 2(b) of the FWCA (48 Stat.401, as amended, 16 U.S.C. 661 *et seq.*). Additionally, the NMFS also received an independent EFH Assessment report pursuant to both the Magnuson Stevens Fishery Conservation and Management Act and the FWCA. Coordination with USFWS and NMFS will be ongoing through the completion of the EA and construction.

Magnuson-Stevens Fishery Conservation and Management Act. The Magnuson-Stevens Fishery Conservation & Management Act (MSA) is the primary law governing marine fisheries management in U.S. federal waters. Pursuant to Section 305 (b)(2) of this act, the USACE is required to prepare an Essential Fish Habitat (EFH) Assessment. The draft EA and an EFH Assessment were submitted to NMFS for their review. Coordination with NMFS for EFH is ongoing.

Migratory Bird Treaty Act, 16 U.S.C. 715-715s and Executive Order 13186 Responsibilities of Federal Agencies to Protect Migratory Birds. The Migratory Bird Treaty Act (MBTA) prohibits the taking or harming of any migratory bird, its eggs, nests, or young without an appropriate federal permit. Almost all native birds, including any bird listed in wildlife treaties between the United States and several other countries are covered by this Act. A "migratory bird" includes the living bird, any parts of the bird, its nest, or eggs. The take of migratory birds is governed by the MBTA's regulation of taking migratory birds for educational, scientific, and recreation purposes and requiring harvest to be limited to levels that prevent over-utilization. Section 704 of the MBTA states that the Secretary of the Interior is authorized and directed to determine if, and by what means, the take of migratory birds should be allowed and to adopt suitable regulations permitting and governing take. Disturbance of the nest of a migratory bird requires a permit issued by the USFWS pursuant to Title 50 of the CFR. Seasonal restrictions will be used to avoid taking of migratory birds or their nests and eggs during beach nourishment construction. The TSP is expected to mitigate shoreline erosion and benefit migratory shorebirds, including the red knot. The TSP is in compliance with the MBTA and Executive Order 13186.

Section 106 of the National Historic Preservation Act of 1966. The National Historic Preservation Act (NHPA) of 1966, as amended (54 U.S.C. § 306108) and its implementing regulations, 36 CFR § 800 requires federal agencies to consider the effects of its actions on historic properties by identifying historic properties, assessing effects and resolving those adverse effects. Full compliance will be achieved upon review and concurrence of a "no effect" determination by the DESHPO.

Resource Conservation and Recovery Act, as amended, 43 U.S. C. 6901, *et seq.* The Resource Conservation and Recovery Act (RCRA) controls the management and disposal of hazardous waste. “Hazardous and/or toxic wastes,” classified by RCRA, are materials that may pose a potential hazard to human health or the environment due to quantity, concentration, chemical characteristics, or physical characteristics. This applies to discarded or spent materials that are listed in 40 CFR 261.31-.34 and/or that exhibit one of the following characteristics: ignitable, corrosive, reactive, or toxic. Radioactive wastes are materials contaminated with radioactive isotopes from anthropogenic sources (*e.g.*, generated by fission reactions) or naturally occurring radioactive materials (*e.g.*, radon gas, uranium ore). There are no hazardous material concerns associated with the TSP. The TSP is in compliance with the RCRA.

Executive Order 11990, Protection of Wetlands. This Executive Order directs federal agencies to avoid undertaking or assisting in new construction located in wetlands unless no practicable alternative is available. The preferred TSP is in compliance with Executive Order 11990. The beach nourishment would improve shoreline habitat and protect the salt marsh behind it. The project is in compliance with the E.O.

Executive Order 11988, Floodplain Management. Executive Order 11988 directs federal agencies to evaluate the potential effects of proposed actions on floodplains. Such actions should not be undertaken that directly or indirectly induce growth in the floodplain unless there is no practicable alternative. The TSP is in compliance with Executive Order 11988 and would have no effect on development within floodplains.

Executive Order 13045, Protection of Children from Environmental and Safety Risks. This Executive Order requires federal agencies to make it a high priority to identify and assess environmental health and safety risks that may disproportionately affect children and to ensure that policies, programs, activities, and standards address these risks. No risks to children are expected from the TSP.

Executive Order 13175, Consultation and Coordination with Indian Tribal Governments. This Executive Order requires federal agencies to engage in regular and meaningful consultation and collaboration with tribal officials in the development of federal policies that have tribal implications, to strengthen the United States government-to-government relationship with the tribes.

7.1 Coordination and Public Involvement

This EA was developed in accordance with the applicable regulations, policies, and procedures, including DOD’s 20 June 2025 NEPA implementing regulations and appropriate USACE Civil Works planning requirements. The project was developed by USACE in partnership with DNREC. Initial scoping was conducted in April 2024. The draft EA is available for public review. A Public Notice of the availability of the EA is advertised on the USACE website.

Consultation was conducted in accordance with all applicable requirements. An interagency meeting was conducted on 16 November 2024. The draft EA will be provided to the U.S. Environmental Protection Agency (EPA) Region III, the U.S. Fish and Wildlife Service (USFWS),

the National Marine Fisheries Service (NMFS), DNREC, and all other known interested parties for review and comment. Pertinent correspondences are provided in Appendix C.

The TSP and the USACE No Effect determination will be coordinated with the DESHPO, the Federally Recognized Tribes and other consulting parties.

7.2 Public Comments Received and Responses

Views of the public, stakeholders, and tribes will be provided in the final report. Responses received to comments provided during public review will be provided in Appendix C.

8.0 District Engineer Recommendation

The content for this section will be inserted upon final review and compilation of the report.

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10.0 Acronym Definition

AEP	Annual Exceedance Probabilities
APEs	Areas of Potential Effect
ARPA	Archaeological Resources Protection Act
ATR	Agency Technical Review
ATTAINS	Assessment, Total Maximum Daily Load (TMDL) Tracking and Implementation System
BGEPA	Bald and Golden Eagle Protection Act
BMPs	Best Management Practices
CAP	Continuing Authorities Program
CBRA	Coastal Barrier Resources Act
CBRS	Coastal Barrier Resources System
CHS	Coastal Hazards System
CSRM	Coastal Storm Risk Management
CSTORM-MS	Coastal Storm Modeling System
CWA	Clean Water Act
CY	Cubic Yards
CZMA	Coastal Zone Management Act
DE DFW	Delaware Division of Fish and Wildlife
DESHPO	Delaware State Historic Preservation Office
DGS	Delaware Geological Survey
DNREC	Delaware Department of Natural Resources and Environmental Control
DSP	Delaware Shorebird Project
DQC	District Quality Control
EA	Environmental Assessment
EFH	Essential Fish Habitat
EPA	U.S. Environmental Protection Agency
ESA	Endangered Species Act
FEMA	Federal Emergency Management Agency
FID	Federal Interest Determination

FNP	Federal Navigation Project
FR/EA	Feasibility Report and Environmental Assessment
FWCA	Fish and Wildlife Coordination Act
HAPC	Habitat Area of Particular Concern
IFR/EA	Integrated Feasibility Report/Environmental Assessment
IPaC	Information for Planning and Conservation
LERRDs	Land, Easements, Right-of-Way, Relocations, and Disposal Areas
LST	Longshore Sediment Transport
MAFMC	Mid-Atlantic Fishery Management Council
MATOC	Multiple Award Task Order Contract
MBTA	Migratory Bird Treaty Act
MHHW	Mean Higher High Water
MHW	Mean High Water
MLLW	Mean Lower Low Water
MLW	Mean Low Water
MSA	Magnuson-Stevens Fishery Conservation & Management Act
MSL	Mean Sea Level
NAAQS	National Ambient Air Quality Standards
NACCS	North Atlantic Coast Comprehensive Study
NAD	North Atlantic Division
NAGPRA	Native American Graves Protection and Repatriation Act
NAVD88	North American Vertical Datum of 1988
NDBC	National Data Buoy Center
NED	National Economic Development
NEFMC	New England Fishery Management Council
NEPA	National Environmental Policy Act
NER	National Ecosystem Restoration
NMFS	National Marine Fisheries Service
NOx	Nitrogen Oxides
NRC	National Research Council
NRHP	National Register of Historic Places
NSRS	National Spatial Reference System
NTDE	National Tidal Datum Epoch
NWLON	National Water Level Observation Network
O&M	Operations & Maintenance
P&G	Principles & Guidelines
PDT	Project Development Team
PED	Preconstruction Engineering and Design
PMP	Project Management Plan
POOCs	Problems, Opportunities, Objectives and Constraints
RCRA	Resource Conservation and Recovery Act
RHA	River and Harbor Act
RSLC	Relative Sea Level Change
SAFMC	South Atlantic Fishery Management Council
SAV	Submerged Aquatic Vegetation

SIP	State Implementation Plan
SLC	Sea Level Change
SPT	Standard Penetration Test
TMDL	Total Maximum Daily Load
TSP	Tentatively Selected Plan
USACE	U.S. Army Corps of Engineers
USCG	U.S. Coast Guard
USEPA	U.S. Environmental Protection Agency
USFWS	U.S. Fish and Wildlife Service
VOCs	Volatile Organic Compounds
WRDA	Water Resources Development Act

11.0 List of Preparers

Table 15 provides a list of USACE personnel who prepared this draft EA.

Table 15. USACE Personnel who Prepared this Draft EA

Name	Title
Nicholas Cosenza	Project Manager/Planner
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Brian Bogel	Plan Formulator
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Robert Hampson	Hydraulic Engineer
Earl Fisher	Geotechnical Engineer
Anthony Jerbasi	Civil Engineer
Kimani Mcrae	Real Estate

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