US Army Corps

of Engineers

Baltimore District

DRAFT SUPPLEMENTAL ENVIRONMENTAL ASSESSMENT

DORCHESTER COUNTY, MARYLAND

MID-CHESAPEAKE BAY ISLANDS ECOSYSTEM RESTORATION PROJECT: BARREN ISLAND

DECEMBER 2021

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EXECUTIVE SUMMARY

The U.S. Army Corps of Engineers, Baltimore District, (USACE) in partnership with the Maryland Department of Transportation Maryland Port Administration (MDOT MPA), the non-federal sponsor, has prepared this draft supplemental Environmental Assessment (sEA) in compliance with the National Environmental Policy Act (NEPA) of 1969, as amended, for the Mid-Chesapeake Bay Island Ecosystem Restoration Project (Mid-Bay Island Project) at Barren Island. The Mid-Bay Island Project recommends remote island restoration at two locations, James Island and Barren Island, both on the Eastern Shore of Maryland and in Dorchester County, Maryland, through the beneficial use of dredged material. Section 7002 of the Water Resources Reform and Development Act of 2014 authorized the Mid-Bay Island Project, as described in the Chief's Report dated August 24, 2009 and the *Mid-Chesapeake Bay Island Ecosystem Restoration Integrated Feasibility Report and Environmental Impact Statement (EIS)*, dated June 2009. The record of decision was signed in July 2019 initiating the next phase of the project, Preconstruction Engineering and Design (PED). This sEA serves to update NEPA compliance during the PED Phase prior to construction of the Barren Island portion of the project. The sEA evaluates impacts and benefits associated with the 35% design, identifying any changes since 2009. A separate NEPA compliance document will be prepared prior to construction of the James Island Project component. The purpose of the Mid-Bay Island Project is to: restore and protect wetland, aquatic, and terrestrial island habitat for fish, reptiles, amphibians, birds, and mammals; protect existing island ecosystems to prevent further loss of island and aquatic habitat; provide dredged material placement capacity for Federal navigation channels; increase wetlands acreage in the Chesapeake Bay watershed; decrease local erosion and turbidity; promote conditions to establish and enhance submerged aquatic vegetation (SAV); and promote conditions that support oyster recolonization.

The Barren Island restoration project is in Dorchester County and will be the smaller portion of the Mid Bay Project. Currently, Barren Island is approximately 138 acres (ac) in size, and portions of it is protected by 4,850 linear feet (lf) of stone sill.

This draft sEA evaluated a No Action alternative and eight (8) alternatives for protective measures and habitat restoration at Barren Island. The preferred alternative for the restoration project will include the construction of new and modified stone sills, segmented breakwaters to provide increased protection to the eroding Barren Island and to the extensive SAV habitat to the east of Barren Island, installation of two bird islands (approximately 8.5 ac total), and restoration of approximately 83 ac of wetlands.

Once the confining sills are constructed, and dredged material is available, the project's habitat components will be constructed. Authorized maintenance material dredged from small local federal navigation channels will be placed behind the confining stone sills up to the Mean High Water (MHW) elevation. Because several dredging cycles will be required to meet the material capacity of the proposed restored wetland acreage, this is considered a long-term restoration project. Placed dredged material will be used for the restoration of approximately 83 ac of wetlands/mudflats. Wetlands will include low and high marsh plantings as well as some intertidal mudflats. The 2009 Feasibility Report included a 50/50 low marsh to high marsh ratio for the wetlands restored at Barren Island. Given the increased understanding of climate change and sea level rise since the completion of the feasibility report, the expectation is that the proportion of high marsh would be increased to enable high marsh to migrate to low marsh with sea level rise versus conversion of low marsh to open shallow water. During final wetland development planning, current conditions will be evaluated with respect to sea level rise projections and sustainable marsh elevations will be determined to identify high to low marsh ratios. Tidal exchange will be established through use of open tidal guts or outfall structures after the material is stabilized. The design will aim to take advantage of any freshwater flow from the island to augment tidal gut flow. To the extent practicable, wetlands will be designed to allow for estuarine connectivity via gaps and tidal creeks to maximize value to fisheries resources.

Unsuitable foundation material will be dredged from the northeast Barren Island stone sill location to an approximate depth of 7 feet (ft). The dredged material will be placed hydraulically or mechanically within the confined area found behind the constructed sills at Barren Island. Suitable/approved fill material will be placed in the void created by removal of the unsuitable material to create a solid structurally sound base for the northeast sill. While it is anticipated that sand material will be used to backfill the void created by removal of the unsuitable material, stone materials from a local quarry may also be used. Identification of a clean sand borrow area for use in foundation replacement, construction of interior dikes for wetlands restoration, and bird island restoration is in progress. This sEA covers all project components except the possible borrow area for clean sand. The borrow area will be covered by a future NEPA document once identified.

This project is an ecosystem restoration project that will provide a myriad of environmental benefits including but not limited to; shoreline protection for remote island habitat as well as the neighboring mainland, protection of over 1,000 ac of existing and potential SAV beds, improvement of water quality, and wetland/habitat restoration (approximately 83 ac of wetland and 8.5 ac of bird island habitat).

Impacts associated with implementing the restoration project include short-term impacts from construction. These include temporary impacts to 1.4 ac of existing wetlands; increased turbidity and noise; temporary impacts to aesthetics, recreation, and fishing; and the temporary displacement of wildlife from the area. There would be a long-term conversion of approximately 119.5 ac of shallow water subtidal estuarine habitat to 81.4 ac of wetlands (high and low marsh and mudflats), 8.5 ac of nesting bird islands, and approximately 29.6 ac of sills and breakwaters. A small portion of that area is currently a sill on the northwest of the island. There is the potential to impact SAV habitat that has encroached into areas planned for wetland restoration since the feasibility phase was completed in 2009. The northeast sill would impact portions of the Great Bay (Maryland Historic Oyster Bar) bar within Tar Bay. There may also be increased water velocities produced by storms driven by northerly winds associated with the northeast sill that could affect adjacent SAV habitat. Modeling of the no action alternative demonstrated that water velocities within SAV habitat during these storms are currently elevated above the targeted velocity of 100 cm/s for SAV habitat, but the addition of the northeast sill is projected to increase water velocities further. The increased velocities are believed to occur as waves rebound off the sills. It is expected that as designs are refined, the northeast sill would be shortened. Shortening the northeast sill would decrease the area affected by these storm energies around the northeast sill. As a result, the area affected by wave energy rebounding off the sills and increased velocities would be reduced and the footprint requiring foundation removal would also be reduced. Although the affected area would be reduced with a shortened sill, water velocities could still affect SAV habitat immediately adjacent to the terminal of the northeast sill. Based on modeling, this area currently is exposed periodically to water velocities at the higher range of SAV tolerance, and therefore the degree of change is not expected to be significant. Overall, modeling demonstrated that the preferred alternative provided for conditions in Tar Bay that support SAV habitat. Through the NEPA process as well as the PED Phase, every effort will be made to maximize environmental and ecosystem benefits while minimizing impacts. Extensive natural resource agency coordination has been undertaken and will continue through the final design process and development of an adaptive management plan. Input provided by resource agencies throughout the design phase has been utilized to develop the project presented in this sEA. Guidance provided by USFWS in a Planning Aid Report (Appendix F3) has been incorporated to enhance value of the project for wildlife and document impacts. Environmental compliance coordination is ongoing with responsible resource agencies as documented in the sEA.

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ACRONYMS

ac	Acres
ACS	American Community Survey
ACJV	Atlantic Coast Joint Venture
ADCIRC	Advanced Circulation model
APHIS	Animal and Plant Health Inspection Service
ARI	Annual reccurence interval
CDC	Centers for Disease Control
CBRA	Coastal Barrier Resources Act
CMS	Coastal Modeling System
CMS-Wave	Coastal Modeling System Wave model
CSTORM	Coastal Storm Modeling System
CZMP	Coastal Zone Management Program
cy	Cubic yards
DLQ	Diurnal low water inequality
DHQ	Diurnal high water inequality
E2EM	Estuarine, intertidal, emergent wetland
E2FO	Estuarine, intertidal, forested wetland
E2SS	Estuarine, intertidal, scrub-shrub wetland
EIS	Environmental Impact Statement
ERDC	Engineering Research and Development Center
ESA	Endangered Species Act
EUS	Estuarine, unconsolidated shore
ft	Feet
FY	Fiscal Year
GT	Great diurnal range
HAPC	Habitat Areas of Particular Concern
IPaC	Information for Planning and Consultation
lf	Linear feet
LIDAR	Light Detection and Ranging
LOD	Limit of disturbance
m	Meter
MBTA	Migratory Bird Treaty Act
MCY	Million cubic yards
MDE	Maryland Department of the Environment
MDOT MPA	Maryland Department of Transportation Maryland Port Administration
MDNR	Maryland Department of Natural Resources
MDTL	Mean diurnal tide level
MHW	Mean high water
MLLW	Mean lower low water
MHT	Maryland Historic Trust
MN	Mean range of tide
MTL	Mean tide level

NAAQS	National Ambient Air Quality Standards
NACCS	North Atlantic Coastal Comprehensive Study
NAVD88	North Atlantic Vertical Data 1988
NCDC	NOAA National Climatic Data Center
NEPA	National Environmental Policy Act
OPA	Otherwise Protected Area (Coastal Barriers Resources Act)
PAR	Planning Aid Report
PED	Preconstruction, Engineering, and Design
PEM	Palustrine emergent wetland
SAV	Submerged aquatic vegetation
sEA	Supplemental Environmental Assessment
SHARP	Saltmarsh Habitat and Avian Research Program
STWAVE	Steady State Wave Model
T&E	Threatened and endangered
TOY	Time of Year
USACE	U.S. Army Corps of Engineers
USDA	U.S. Department of Agriculture
USEPA	U.S. Environmental Protection Agency
USFWS	U.S. Fish and Wildlife Service
VIMS	Virginia Institute of Marine Science
WMA	Wildlife Management Area

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1 INTRODUCTION

The U.S. Army Corps of Engineers, Baltimore District, (USACE) in partnership with the Maryland Department of Transportation Maryland Port Administration (MDOT MPA), the non-federal sponsor, has prepared this draft supplemental Environmental Assessment (sEA) in compliance with the National Environmental Policy Act (NEPA) of 1969, as amended, for the Mid-Chesapeake Bay Island Ecosystem Restoration Project (Mid-Bay Island Project) at Barren Island. The Mid-Bay Island Project recommends remote island restoration at James Island and Barren Island, both on the Eastern Shore of Maryland and in Dorchester County, Maryland, through the beneficial use of dredged material. This sEA serves to update NEPA compliance during the Preconstruction Engineering and Design (PED) Phase prior to construction of the project. The sEA evaluates impacts and benefits associated with the design for the Barren Island portion of the project. The James Island component of the project will be addressed in a future supplemental NEPA document.

1.1 Study Authority

The Mid-Bay Island Project is authorized to restore remote island habitat at James Island and Barren Island, in Dorchester County on the Eastern Shore of Maryland, through the beneficial use of dredged material. Section 7002 of the Water Resources Reform and Development Act of 2014 authorized the Mid-Bay Island Project, as described in the Chief's Report (USACE, August 2009) dated August 24, 2009 and the *Mid-Chesapeake Bay Island Ecosystem Restoration Integrated Feasibility Report and Environmental Impact Statement (EIS)*, hereafter, Mid-Bay Feasibility Report, dated April 2009 (USACE, April 2009). The record of decision was signed in July 2019 initiating the PED phase of the study. The project is being completed in partnership with a nonfederal sponsor, MDOT MPA.

1.2 Project Location and Setting

The Mid-Bay Island Project is located at James and Barren Islands in Dorchester County, Maryland along the eastern shore of the Chesapeake Bay (Figure 1). James Island is situated north of Taylor Island. Barren Island is a small island located approximately 1 mile east of Hoopers Island. Originally attached to the Delmarva Peninsula, Barren Island has now eroded into two smaller, separate land masses.

The island was acquired in 1993 by the United States Fish and Wildlife Service (USFWS) and is managed as a satellite refuge of the Chesapeake Marshlands National Wildlife Refuge Complex. A small portion of the island on the northwest was created by USACE-Baltimore District Operations and Navigation Division in 2003 using dredge material taken from the realignment of the adjacent Honga River channel. The Tar Bay Wildlife Management Area (WMA), a small section of Barren Island, is owned by Maryland's Department of Natural Resources (MDNR) and managed by the Wildlife and Heritage Service to conserve and enhance wildlife and their habitats and provide recreational use of the wildlife resources (MDNR Tar Bay WMA 2020). Tar Bay WMA was created in the 1980s by placement of dredged material from the Honga River channel, and at the time was a separate island from Barren Island.


Baltimore
Dover
Annapolis
Delaware
Washington
Maryland
Approximate Study Area
301
50
Crossroads
Blackwater
Robbins
Andrews
Honga
Beech Ground Swamp
Barren Island
Fishing Creek
Wroton Island
Crapo
Toddville
Middle Hooper Island
Wingate
Duck Cove
Hoopersville
Thorofare Cove
Legend
Study Area
Tar Bay Wildlife Management Area
Federal Navigation Channels
Honga River/Tar Bay/Tyler Cove
Duck Point Cove
Muddy Hook
Back Creek
0
10,000
20,000
Feet
N

The Mid-Bay Island Project is an environmental restoration/beneficial dredge material use project proposed for the Chesapeake Bay. Dredged material from the Upper Chesapeake Bay Approach Channels that service the Port of Baltimore will be beneficially used to restore wetland and upland habitat at James Island. Dredged material from local federally maintained navigation channels will serve as the material to stabilize Barren Island, restore wetlands, and thereby, provide for the conditions for submerged aquatic vegetation (SAV) habitat east of Barren Island.

The Mid-Bay Island Project is focused on restoring and expanding island habitat to provide hundreds of acres of wetland and terrestrial habitat for fish, shellfish, reptiles, amphibians, birds, and mammals through the beneficial use of dredged material. Given the time that has elapsed since the Feasibility Report was completed, USACE is preparing this sEA to update the NEPA documentation for the Barren Island component of the project. A similar NEPA action will be undertaken at a future time for the James Island component. This Barren Island sEA will serve as an update and compliment of the June 2009 Mid-Bay EIS. Similar data, results, and methods used in 2002, 2003, and 2004 for the Mid-Bay Feasibility Report will be referenced for existing affected environment conditions. However, new studies have been performed within the last two fiscal years (FYs) and new findings have occurred since original surveys were performed in the early to mid-2000s. These updated findings will be detailed and included in this sEA.

1.3 Scope of Action

The scope of action for this sEA is restoration actions at Barren Island. These actions include the rehabilitation of an existing stone sill, the construction of new sills and breakwaters, restoration of wetlands habitat, and creation of bird islands.

The Mid-Bay Island Project is an environmental restoration/beneficial dredge use project proposed for the Chesapeake Bay. Dredged material from the Upper Chesapeake Bay Approach Channels that service the Port of Baltimore will be beneficially used to restore wetland and upland habitat. The Mid-Bay Island Project will be developed through the cooperative efforts of Federal and State agencies.

The Mid-Bay Island Project will restore remote island habitat, a scarce and rapidly vanishing ecosystem component within the Chesapeake Bay region. Loss of remote island habitat within the middle eastern Chesapeake Bay has been estimated at approximately 10,500 acres (ac) in the last 150 years, a trend that will continue because of erosive forces and sea level rise. Remote islands in the Chesapeake Bay serve as an important stop-over point for migratory avian species, providing forage and protected resting habitat during spring and fall migration along the Atlantic Flyway. Additionally, the remote island habitat restored at James and Barren Islands will provide valuable wetlands and a vital connection between open-water and mainland terrestrial habitats within the region as well as valuable nesting habitat for a variety of colonial nesting and wading bird species.

The Mid-Bay Island Project is an integral component of the Federal Dredged Material Management Plan (*DMMP*), which is the long-term regional plan for managing sediments from the Chesapeake Bay Federal navigation channels. The significance of the fish and wildlife resources of the Chesapeake Bay is widely recognized by resource agencies, the public, and academic institutions. For more than 20 years, extensive efforts have been expended to support natural resources management and restoration plans in the Chesapeake Bay region. The restoration projects at James and Barren Island will contribute to the goals of the Chesapeake Bay Program watershed partnership through its habitat and ecosystem recovery and preservation efforts. Both James and Barren Islands will contribute to the Chesapeake 2000 Agreement goal to restore 25,000 ac of tidal and non-tidal wetlands. In addition, the protection of 1,325 ac of SAV habitat adjacent to Barren Island will contribute to the Chesapeake 2000 Agreement goal to protect and restore 114,000 ac of SAV and to develop strategies to address water clarity in areas of critical importance for SAV. Both the James and Barren Island projects will improve water clarity by the protection of SAV and the reduction in shoreline erosion. The Feasibility Phase for the Mid-Bay Island Project started in 2002. The feasibility report culminated in the recommendations for large-island restoration at James Island as well as island restoration actions to conserve and restore Barren Island. The study's Chief's Report (USACE, August 2009) and the Mid-Bay EIS were completed in 2009. The record of decision was signed in July 2019 initiating the current phase of the study, PED.

As determined by the June 2009 Mid-Bay Feasibility Report, the Barren Island Project component was formulated to provide minor dredged material placement capacity, protect the existing island resources, reduce erosion of the existing shoreline at Barren, create wetlands, and protect areas of SAV from high wave energy. The feasibility design provided for three protective measures as listed below, plus consideration of a breakwater element south of the island in PED:

- a western sill alignment of approximately 13,550 linear feet (lf),
- a northern sill alignment of approximately 3,840 lf, and
- a southern sill alignment of approximately 1,300 lf.

Each alignment was laterally located just offshore in relatively shallow water (3-4 feet (ft) of depth at mean lower low water (MLLW)). The northern portion of the western protection included a modification to the existing sill (4,900 lf of 13,550 lf) and consisted of adding one layer of armor stone to the existing project to raise the top of the structure from the existing elevation of +2 ft MLLW to +4 ft MLLW. The new and revised sills were planned to be built to an elevation of +4 MLLW. The PED phase was to determine the need for and if needed, the extent of a southern breakwater following the historic shoreline to protect the SAV habitat to the south and southeast of Barren Island. This breakwater was proposed to be at a maximum 8,200 lf in length and built to an elevation of +6 ft MLLW. The recommended plan within the Feasibility Report included backfilling between the created structures and the existing island to create approximately 72 ac of wetlands along the shoreline of the island.

One additional feature included in the Feasibility Report recommended plan was the consideration during PED of habitat enhancements. As part of the evaluation for the southern breakwater, a consideration was to be made for incorporating bird nesting habitat into the design. An addition of one or more islands isolated from the main Barren Island formation would provide high quality nesting habitat for birds. Nesting habitat for birds free of predators is becoming scarce in the Chesapeake Bay. This habitat would support nesting for common tern

(*Sterna hirundo*), royal tern (*Thalasseus maximus*), black skimmers (*Rynchops niger*), and saltmarsh sparrows (*Ammodramus caudacutus*).

This sEA updates the NEPA process for the Barren Island portion of the project and includes the evaluation of whether to include a southern breakwater, possible southern breakwater alignment variations, as well as other habitat enhancements.

1.4 Relevant Federal Actions Near the Project Area

1.4.1. Creation of Tar Bay Wildlife Management Area

Prior to the Mid-Bay Feasibility Report in the early 2000s, there had been restoration efforts undertaken by USACE at Barren Island to restore wetlands and nesting bird habitat. In the fall of 1981, USACE dredged the Federal channel leading from the Chesapeake Bay to the Honga River, accumulating over 176,500 cubic yards (cy) of fine-grained material to deposit nearby. For economic purposes, the site needed to be within 2 miles (3.2 kilometers (km)) of the dredging area. The decision was made to deposit the material in a shallow water area off of the northeast corner of Barren Island. This cove area had a moderate erosion rate ranging from 3.4 to 7.9 ft (1.2 to 2.4 meters (m)) per year; north of this area was an accretion area dominated by smooth cordgrass (*Spartina alterniflora)*, south of the cove and into the interior of the island was dominated by loblolly pine (*Pinus taeda*). Seeding of the site with *S. alterniflora* following dredge material placement was completed in spring 1982, and saltmarsh hay (*Spartina patens)* was transplanted at the uppermost tidal elevations (Earhart and Garbish 1983). A ditch (9.8 ft, 1,200 ft long, and -1 ft MLW) was developed using high pressure water along the western end of the placement site. This was done to encourage tidal flushing to a pond area, to improve access for fish and to discourage access to the placement site by predators, ideally to maintain it as a predator-free least tern (*Sterna antillarium*) nesting site. Shell was deposited at this location to create a 0.25 ac (1,000 m^2) area to encourage nesting by shorebirds (Earhart and Garbisch 1983). This site was subsequently used by least terns in the summer of 1982, and USACE estimated a minimum of 462 least terns in the area, 30 black skimmers, 5 common terns, herring gulls (*Larus argentatus*), and killdeer (*Charadrius vociferous*). To further enhance the nesting area, an additional 0.11 ac (460 m^2) of oyster shell was placed in the winter of 1982 and then raked to create documented nesting preferences of the aforementioned species.

In 1984, USACE dredged approximately 150,000 cy of material from the Honga River channel. USACE deposited approximately 49,700 cy of material on the northeast edge of the original wildlife habitat island that was established in 1981. North of the habitat island, over 99,000 cy of material was deposited. This created a 11.6 ac (4.7-hectare (ha)) island to provide additional protection of Barren Island. Habitat was developed in this area by controlled elevation of dredged material and post-placement landscaping. Following dredged material placement, *Spartina alterniflora* was planted in some areas, and sand and shell deposited in others to provide nesting substrate for the terns and skimmers that had historically been present (Earhart and Garbisch 1986).

1.4.2. Prior Barren Island Restoration Efforts

A small portion of the island on the northwest was created by USACE-Baltimore District Operations and Navigation Division using dredge material taken from the realignment of the adjacent Honga River channel. In 1994, a contract was awarded to allow filling and placing of geotextile tubes along the western side of Barren Island using dredged material from the Honga River. Approximately 1,800 ft of geotextile tubes were filled and placed along the northwest shoreline of Barren Island by USACE- Baltimore District to reduce erosion, and capture material to restore wetlands habitat. The geotextile tubes were unable to perform as planned in the exposed environment. As a result, in 2003, the geotextile tubes were incorporated into stone sills. Following sill construction, 138,000 cy of dredged material was placed leeward of the 1,800 lf of sills and planted with marsh grasses to restore 5 acres of wetland habitat.

1.4.3. Maintenance Dredging of Federal Navigation Projects

Federal navigation projects require periodic maintenance dredging and could potentially use Barren Island as a placement site, the Duck Point Cove, Honga River/Tar Bay/Tyler Cove, Back Creek, and Muddy Hook Federal navigation projects are located in the vicinity of Barren Island and would be the projects most likely to use the site (Figure 1). Dredged material placement sites for these projects are developed on a case-by-case basis due to the limited funding available to dredge these projects and the infrequent dredging requirements of the projects. Dredged material from the Honga River and Tar Bay, Muddy Hook, and Tyler Cove projects has been used beneficially in the past to create island and wetland habitat nearby and along the shoreline of Barren Island. Because the Barren Island Project is in the vicinity of these channels, costs for providing the necessary containment structures, wetland planting, etc. will be funded under the existing Barren Island Project and cost-shared between the Federal Government (65 percent) and the MDOT MPA (35 percent), the use of the Barren Island site will be considered comparable to the Federal standard or base plan for the channels. Therefore, the Barren Island Project would not fund any additional dredging costs for these projects to use the Barren Island site.

1.4.4. Beneficial Use of Dredged Material

1.4.4.1 Paul S. Sarbanes Ecosystem Restoration Project at Poplar Island

The Paul S. Sarbanes Ecosystem Restoration at Poplar Island (Poplar Island) is an ecosystem restoration project located in the Chesapeake Bay, Talbot County, MD; 39 miles (34 nautical miles) south-southeast of the Port of Baltimore, and two miles northwest of Tilghman Island. Poplar Island is approximately 30 miles north of Barren Island. Dredged material from the Upper Chesapeake Bay Approach Channels that service the Port of Baltimore is being beneficially used to restore 1,140 ac of wetland and upland habitat using approximately 40 million cubic yards (MCY) of dredged material. The island restoration will resemble the approximate 1847 footprint, which, as of 1996, had eroded to three separate islands with an area of less than 3 ac.

1.4.4.2 Poplar Island Expansion

USACE guidance specifies that the expansion of existing sites should be considered for placement capacity before new placement sites are proposed. The General Reevaluation Report and Supplemental Environmental Impact Statement for Poplar Island investigated the opportunities for expanding Poplar Island. The study was completed in September 2005 and recommended the construction of a northern lateral expansion of approximately 575 ac, consisting of 29% wetland, 47% upland, and 24% open water embayment habitat, as well as vertical expansion of five feet for two existing upland cells. The final study was publicly released in September 2005. The Chief's report was signed on 31 March 2006. The Poplar Island project authorization was modified to include the expansion by Section 3087 of WRDA 2007. The construction of the containment dikes and spillway structures for the expansion was completed in January 2021 and dredge material started being placed in the new expansion cells in April 2021. Between Poplar Island and the Expansion, 382 acres of tidal wetlands and 110 acres of open embayment habitat have been restored, and approximately 37.1 million cubic yards (MCY) of dredged material has been placed at the site through 2020. It is estimated that the Expansion will provide an additional 28 MCY of dredged material placement capacity. Poplar Island, including the Expansion are projected to reach capacity in 2030.

1.4.5. Ecosystem Restoration Projects in Dorchester County

Wetland restoration in Dorchester County, MD is one of the seven alternatives recommended for additional study by the Federal DMMP (USACE, 2005a). Blackwater National Wildlife Refuge (Blackwater NWR) is a 28,000-ac complex, consisting of 1/3 wetland, 1/3 forest, and 1/3 open water. More than 7,000 ac of tidal marsh in Blackwater NWR have drowned in place or have been lost to erosion since 1940 as a result of sea level rise, hydrologic changes, wildlife damage, and vegetation management practices (USACE, 2002a). The importance of Blackwater NWR has been recognized nationally and internationally. Blackwater NWR wetlands are designated as wetlands of international importance and is one of six priority wetland areas identified by the North American Waterfowl Management Plan. Further, The Nature Conservancy has named Blackwater NWR one of the 'Last Great Places'. In 2001, USACE, USFWS, and MDNR began investigations under Section 206 Aquatic Ecosystem Restoration of the Continuing Authorities Program to assess the feasibility of restoring several hundred acres of brackish marsh in the Blackwater NWR. MDNR, the study sponsor of that effort, has been involved in further Blackwater restoration studies under the auspices of the Maryland Marsh Restoration and Nutria Control Project.

As part of the Section 206 feasibility assessment (2001), USACE-Baltimore District conducted a demonstration project using thin-layer dredged material spraying and conventional dredged material placement techniques on approximately 15 to 20 ac of degraded marsh at Blackwater NWR. Dredged material was used to increase the surface elevation in areas where the marsh was failing or had recently failed. The raised areas were then planted with wetland flora (USACE, 2002a and 2004). Monitoring studies indicated that the marsh plants performed well during their first summer of growth (USACE, 2004). The demonstration area has persisted and continues to be well vegetated. An additional thin layer project was completed in 2016 at Blackwater NWR.

Future ecosystem restoration efforts at Blackwater NWR are necessary and important for several reasons: the Blackwater marsh system is of great regional ecological significance; tidal marsh losses have been extensive and are likely to have regional ecologically detrimental consequences; human activities have contributed to marsh losses; and the tidal marshes will not recover without human intervention. The project proposed in the Federal DMMP consists of placement of approximately 2 ft of dredged material (totaling approximately six MCY) over approximately 2,000 ac of degraded wetlands in Dorchester County. The dredged material would be hydraulically pumped into temporary containment (earthen berms) in the areas proposed for restoration.

2 PURPOSE, NEED, AND OBJECTIVES

2.1 Purpose

The Mid-Bay Island Study built upon the Federal and State's DMMP planning efforts to identify beneficial use sites to meet dredged material capacity needs and habitat restoration goals. The prior study determined the technical, economic, and environmental feasibility of protecting, restoring, and creating aquatic, intertidal wetland, and upland habitat for fish and wildlife within the Mid-Bay Island Project study area using clean dredged material from the Upper Chesapeake Bay Approach Channels. The purpose of the Barren Island project is to beneficially use dredged material to restore remote Chesapeake Bay Island habitat. This sEA updates the NEPA documentation focused on the Barren Island component of the Mid-Bay Island Project.

2.2 Need

The need for the Barren Island portion of the project is the preservation and restoration of remote Chesapeake Bay island habitat that is quickly being lost due to climate change (sea level rise, storm surge, etc.). This sEA will include updated natural resource information as well as a discussion of alternative designs for the construction of the Barren Island portion of the Mid-Bay Island Project. Barren Island provides critically needed remote island habitat in the Chesapeake Bay and is one of the last remaining uninhabited islands in the Chesapeake Bay, but is being lost to erosion at a rate of 3 to 4 ft per year. The project is needed to stabilize the island remnants, restore habitat that has been lost, add resiliency to address sea level rise and coastal storm risk, and maintain suitable conditions for SAV in the waters east of the island.

In the nearly 20 years since the studies for the feasibility phase was conducted, Barren Island has lost approximately 42 acres. Barren Island has continued to experience shoreline erosion while facing increased risks from coastal storms and sea level rise. Erosion has been greatest along the northern shore of the Tar Bay WMA centrally between what is now the north and south remnant, and along the western shoreline of the southern remnant.

2.3 Objectives

The objective of the Mid-Bay Island Project is to restore and protect valuable but threatened Chesapeake Bay remote island ecosystems through the beneficial use of dredged material. The goals of this project are to identify a final design for the Barren Island component of the Mid-Bay Island Project that incorporates resilience to climate change and coastal storms. The final design will provide for habitat protection and restoration that contributes to multiple Baywide restoration goals. The objectives of the Mid-Bay Island Project (as outlined in the 2009 Feasibility Report) are listed below. Those italicized are applicable to the Barren Island component.

- *Restore and protect wetland, aquatic, and terrestrial island habitat for fish, reptiles, amphibians, birds, and mammals;*

- *Protect existing island ecosystems, including sheltered embayments, to prevent further loss of island and aquatic habitat;*
- Provide dredged material placement capacity (3.2 MCY/yr) for Federal navigation channels;
- *Increase wetlands acreage in the Chesapeake Bay watershed to assist in meeting the Chesapeake 2000 (2014) Agreement goals;*
- *Decrease local erosion and turbidity;*
- *Promote conditions to establish and enhance submerged aquatic vegetation; and*
- *Promote conditions that support oyster recolonization.*

3 ALTERNATIVES

Alternative development started with the recommended plan identified by the 2009 Feasibility Report (Figure 2). The 2009 Feasibility Report determined that the inclusion of the southern breakwater and its configuration, as well as habitat enhancements, would be evaluated in PED. Alternatives were developed to incorporate current conditions into the design and consider options for the southern breakwater and habitat enhancements.

3.1 Alternatives Considered

The 'No Action' alternative and five additional alternatives were initially formulated for evaluation within this sEA:

- Alternative 1 is the 'No Action' or base condition that represents existing conditions without any future USACE actions.
- Alternative 2 is protective structures (sills) around Barren Island only, without inclusion of a southern breakwater.
- Alternative 3 is Barren Island protection with the full breakwater proposed in the 2009 Feasibility Report.
- Alternative 4 is Barren Island protection plus a shortened southern breakwater.
- Alternative 5 is Barren Island protection plus a shortened southern breakwater and two remote bird islands south of the southern breakwater terminus.
- Alternative 6 is Barren Island protection plus a shortened southern breakwater and a segmented breakwater system at the southern end of the breakwater terminus.

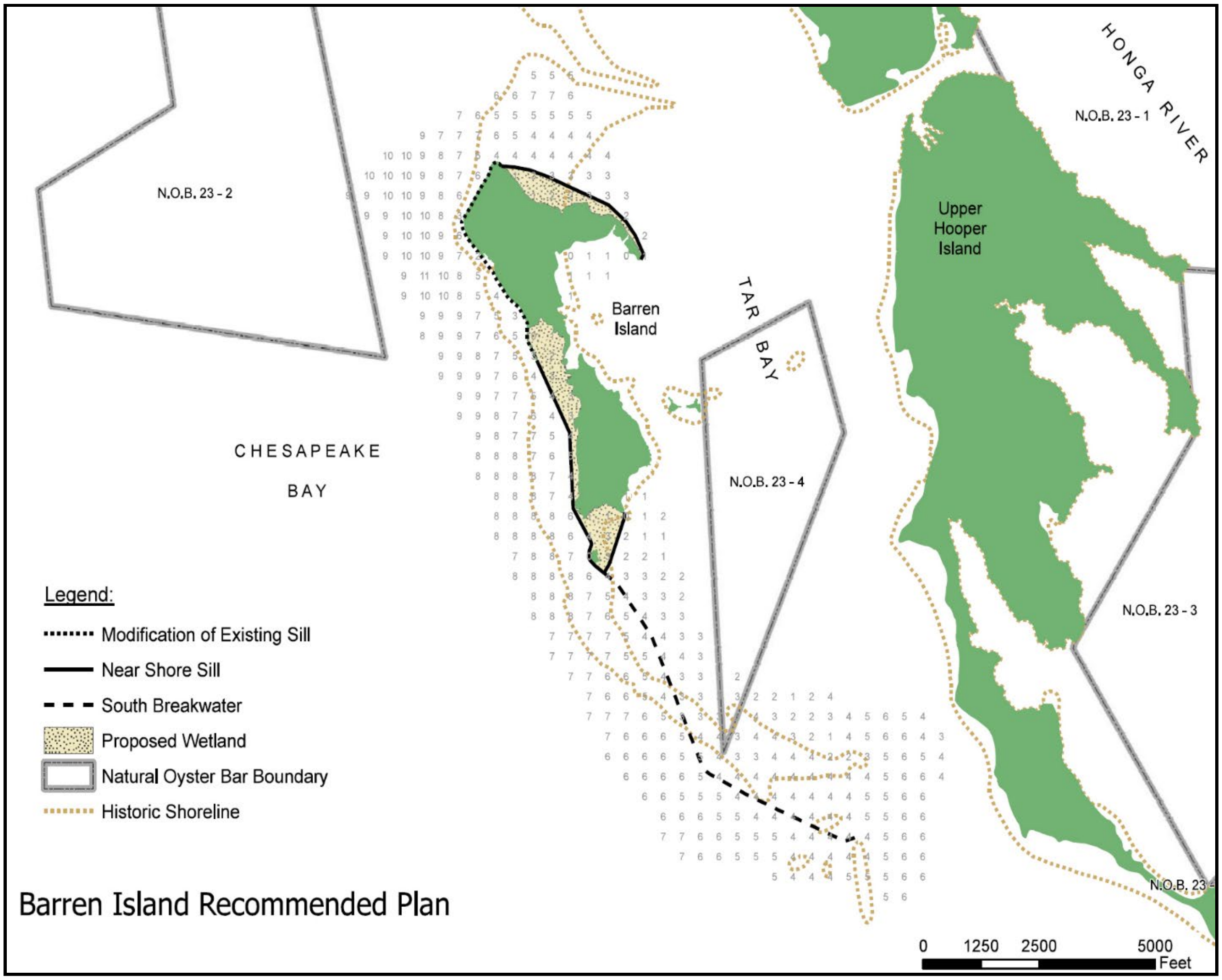

Figure 2. Barren Island Recommended Plan from Feasibility Report (2009)

- Alternative 7 was developed through an iterative process and secondary analyses of Alternatives 5 and 6. This alternative includes three bird islands and optimizes the benefits of Alternatives 5 and 6 and minimizes the negative effects of an induced increase in velocity on SAV habitat.

- Alternative 8, the Preferred Alternative, has most of the components of Alternative 7; however, the bird islands have been reduced from three to two islands. This reduction allows the two bird islands to have greater separation from one another and the main Barren Island. This configuration will provide additional predator free, remote island habitat specifically for shorebirds. Also, the wetland cell located at the southern tip of the southern remnant included in Alternatives 2 through 7 has been removed from Alternative 8. This is because foundation materials on the bay bottom in this area are not suitable for the construction of the sills necessary to contain the dredged material.

3.1.1. Alternative 1

The No Action Alternative would involve no further USACE actions at Barren Island.

3.1.2. Alternative 2

Alternative 2 (Figure 3) includes protective structures (sills) around Barren Island with no southern breakwater and includes restoration of 104 ac of wetlands.

3.1.3. Alternative 3

Alternative 3 (Figure 4) involves sills around Barren Island and the full southern breakwater along the alignment outlined in the 2009 Feasibility Report. The breakwater would be the maximum 8,200 ft in length and built to an elevation of +6 ft MLLW. Alternative 3 includes restoration of 104 ac of wetlands.

3.1.4. Alternative 4

Alternative 4 (Figure 5) includes sills around Barren Island with a short southern breakwater of 5,350 ft and restoration of 104 ac of wetlands.

3.1.5. Alternative 5

Alternative 5 (Figure 6) includes sills around Barren Island, a short southern breakwater, restoration of 104 ac of wetlands, and two independent bird islands at the southern end of the breakwater. Each island is 590 ft in length and 350 ft wide.

3.1.6. Alternative 6

Alternative 6 (Figure 7) includes sills around Barren Island, a short southern breakwater, a segmented breakwater system at the southern end of the breakwater, and restoration of 104 ac of wetlands. The southernmost row of breakwaters is set in the same footprint as the full breakwater modeled in Alternative 3. Each breakwater is 360 ft in length.

3.1.7. Alternative 7

Alternative 7 (Figure 8) was developed by refining and merging Alternatives 5 and 6. The alignment was moved west to provide a position over historic island bottom to avoid the need for foundation replacement. An additional bird island was added to simulate a segmented breakwater. Alternative 7 includes sills around Barren Island, a shortened breakwater, and three distinct bird islands. A 480 ft long breakwater was added to the southern portion of the sill. Resource agency feedback was incorporated to establish distances to minimize the possibility of predator interactions. It was proposed that a 330 ft gap between the breakwater with bird islands and the southern breakwater would be sufficient to prevent predators from accessing the bird islands. The gap between the breakwater and the northernmost island is approximately 350 ft, and the islands range from roughly 480 to 710 ft in length along their western shorelines and are approximately 230 to 300 ft in width. This alternative minimizes impacts associated with the footprint of the breakwater, avoids foundation replacement associated with the breakwater and prior island alignments, provides conditions suitable for SAV in Tar Bay, and includes bird islands

Figure 3. Alternative 2

Figure 4. Alternative 3

Figure 5. Alternative 4

Figure 6. Alternative 5

Figure 7. Alternative 6

Figure 8. Alternative 7

for nesting habitat. Additionally, Alternative 7 provides for restoration of approximately 104 ac of wetlands habitat.

3.1.8. Alternative 8 – Preferred Alternative

Following presentation of the alternatives evaluation and Alternative 7 to resource agencies, a number of revisions were made resulting in Alternative 8, the Preferred Alternative. Additional historical data on bird nesting on islands in the Barren Island vicinity was provided by the resource agencies. This information suggested that a greater distance was needed to make the habitat of value to nesting birds. At the request of the resource agencies, an evaluation was conducted to determine how to add distance between the bird islands and position the islands over the historic small islands that had provided nesting habitat prior to the 2000s. This resulted in the removal of the central island and shifting of the most southern bird island to the south. Additional modeling will be conducted on this selected alignment as the final design is completed, but it is expected that the preferred alternative will perform similarly to Alternatives 6 and 7 with respect to protection of SAV habitat. Alternative 8 (Figure 9) includes sills around Barren Island, a short southern breakwater, restoration of approximately 83 ac (82.8 ac) of wetlands, and two independent bird islands (approximately 8.5 ac total) at the mid-point and southern end of the shortened breakwater.

3.2 Factors Used for the Evaluation of Alternatives

Five factors were considered to evaluate the alternatives:

1. hydrologic and hydraulic (H&H) modeling
2. historic island footprint,
3. suitable foundation and need to perform foundation replacement,
4. ecosystem resources: oysters and SAV, and
5. ability to incorporate remote island bird habitat.

The following sections provides a discussion of each factor.

3.2.1. H&H Modeling

Model setups developed as part of the North Atlantic Coastal Comprehensive Study (NACCS) were leveraged and refined specifically in the Barren Island region. Out of the 1,050 synthetic tropical storms developed for the NACCS, 100 storms were selected for use for modeling H&H conditions at Barren Island based on the proximity of their storm track to the region. Those 100 storms were then narrowed down to a set of 25 storms that were determined to influence the localized area the most and were used as screening storms on all the with- and without project scenarios. These storms represent a variety of storm tracks, wind and pressure conditions, and water level annual recurrence intervals (ARIs) so that the impacts of a wide range of different storm conditions were captured.

With the selected 25 storms, USACE's Engineering Research and Development Center (ERDC) conducted H&H modeling using the Coastal Storm Modeling System (CSTORM) for the selected

Figure 9. Alternative 8

25 simulated storms to investigate water levels, wave heights, and velocities for the five alternatives. The surge, currents, and nearshore wave modeling was performed using CSTORM-MS (Massey et al. 2011, Massey et al. 2015), which is composed of the two-way coupled Advanced Circulation (ADCIRC) model and a Steady State Wave (STWAVE) model. The initial five proposed with-project designs as well as a refined alternative (developed based on initial results) were modeled; these alternatives represent a variety of different sill, breakwater, and island configurations being considered for the final Barren Island project design (See Sections 3.2 and 3.3). Wave diffraction modeling was also conducted using the Coastal Modeling System wave model (CMS-Wave) to determine the impact of various gap design widths between breakwaters/islands. The preferred alternative alignment (35% design outcome) will be modeled and will be incorporated into the 65% design submission. Further details about the model development and setup, storm selection process, simulation results, and the conclusions drawn from this study are presented in *Storm Surge, Currents and Wave Modeling for the Mid-Chesapeake Bay Islands Ecosystem Restoration Project: Barren Island* (Massey et al, 2021) available in Appendix B (Note that the alternatives are numbered differently in Massey et al. 2021 due to the inclusion of the No Action Alternative as Alternative 1 in this sEA). The modeling was completed without tides but did incorporate wind forcing and river flows. CSTORM outputs were generated at select locations known as save points to facilitate comparisons between alternatives and the no action alternative. Model outputs computed for each alternative were maximum significant wave heights, storm surge (maximum water surface elevation), existing condition velocity during spring tides (high flow conditions) and summer tides (low flow conditions), maximum water velocity, and 24-hour and 48-hour peak velocities. The effect of adjusting the Manning's roughness coefficient in the model to represent bottom conditions provided by SAV beds was also evaluated.

The modeling identified a number of patterns. Significant wave heights are consistently reduced behind the structures for all alternatives. With respect to storm surge, maximum water surface elevations were minimally affected. The change was typically $\pm$ 0.1 ft. The southern breakwater would have minor effects on water levels and wave heights within SAV habitat. As a result, velocity was the primary metric used to evaluate the effects of the southern breakwater alternatives.

Existing conditions were characterized with the modeling. During spring tides, average velocities range from 0 to 26.9 cm/s and maximum velocities range from 0 to 46.8 cm/s. During summer tides, average velocities range from 0 to 27.2 cm/s, and maximum velocities range from 0 to 44 cm/s. Base storm conditions produce modeled maximum velocities between 33.6 and 129.3 cm/s. The modeling results of the alternatives were compared with the existing condition velocity regime to determine whether the alternative could maintain or provide for reduced velocities in SAV habitat.

To maintain the natural habitat in this area, it is important that construction of new protective features do not have significant adverse impacts to the SAV by any changes in hydrodynamics during major storm events. Although it is estimated that SAV can withstand water velocities of up to 180 cm/s, the upper velocity threshold that SAV in this region routinely survive without being damaged or otherwise adversely affected is approximately 100 cm/s (Koch 2001 and CBP

2000). Thus, water velocities in Tar Bay during storm events should ideally remain below 100 cm/s after the Barren Island Project is completed.

3.2.2. Historic Island Footprint

The Barren Island Project is situated over bottom that was once island habitat to comply with Maryland state law. Additionally, bottom that was once island habitat is typically the most structurally capable of supporting the weight of restoration materials. Often substrate in areas that were never island are soft muds and silts that would require the foundation to be excavated and replaced with material that can support restoration materials (stone).

3.2.3. Suitable Foundation

Borings of the Bay bottom throughout the project area were collected to characterize the composition of the sediments and to understand the ability of the sediments to support placement of stone for sill and breakwater construction. Foundation materials (bottom sediments) unsuitable for placement of stone require excavation and replacement with suitable materials.

3.2.4. Ecosystem resources: SAV and oysters

A primary objective of the Barren Island Project component is to stabilize Barren Island to maintain conditions suitable for SAV in the waters between Barren Island and the Eastern Shore (Hoopers Island). SAV have had a relatively consistent presence in the waters east of Barren Island prior to 2019. The ability of the southern breakwater to provide suitable habitat conditions for SAV was a primary evaluation criterion. Velocity was selected as a habitat metric responsive to in-water structural changes. Alternatives were modeled to understand their ability to replicate or improve (reduce velocity) the current conditions that promote SAV habitat. Through a review of scientific literature (Koch 2001 and CBP 2000), it was determined that intermediate currents (5 to 100 cm/s) are needed to support SAV growth and distribution. The maximum velocities tolerated are 50 to 180 cm/s. The primary SAV species in the Barren Island vicinity is widgeon grass (*Ruppia maritima*). Horned pondweed (*Zannichellia palustris*) and widgeon grass, canopy forming SAV species, are wave limited and prefer velocities on the lower end of the range. Eelgrass (*Zostera marina*), a meadow forming species, can tolerate velocities at the higher end of the tolerable range. Wave tolerance for widgeon grass is low, 0 to 1 m, whereas meadow formers can tolerate waves up to 2 m. Natural oyster beds also exist in the waters surrounding Barren Island. Project impacts such as potential habitat conversions and loss were considered for oysters as well as SAV.

3.2.5. Inclusion of bird habitat (habitat enhancements)

The ability of an alternative to incorporate isolated islands for waterbird nesting was considered in the evaluation.

3.3 Alternative Evaluation and Comparison

3.3.1. Alternative 1: No Action

It can be expected that under this scenario Barren Island would continue to erode and lose acreage, eventually succumbing to the Bay. The existing sill on the northwest would continue to degrade and provide less protection over time. Barren Island is projected to be fully eroded by the middle part of this century (2050 – 2055). The loss of Barren Island would represent a loss to the USFWS Federal Refuge system. The No Action alternative would also lead to the eventual loss of MDNR's Tar Bay WMA. Sedimentation would continue to be high in the waters surrounding Barren Island as sediment is introduced to the water column from island erosion. Oyster resources in Tar Bay would be further impaired by the continue sedimentation. As Barren Island is lost, Tar Bay would become a more energetic environment and it would be expected that the SAV habitat between Barren Island and Hoopers Island would gradually diminish and eventually be lost. The storm risk protection provided by Barren Island to the residents of Hoopers Island would also eventually be lost. The No Action alternative would not meet the purpose and need, nor any of the Mid-Bay Island Project objectives.

3.3.2. Alternative 2: Barren Island Protection Only

Although much of the value to SAV habitat east of Barren Island can be accomplished with Alternative 2, the SAV habitat south/southeast of Barren Island would remain exposed. Alternative 2 does not reduce maximum and peak velocities in the SAV habitat south/southeast of Barren Island to the extent that the alternatives with a southern breakwater (Alternatives 3 – 6) are capable of providing.

3.3.3. Alternative 3: Barren Island Protection with Full Southern Breakwater

Comparing the results of Alternative 1 (No Action) and the 5 other alternatives, identified that Alternative 3 (full breakwater) is not justified. The geotechnical investigations identified poor foundation in the southern half of the alignment for Alternative 3 that would necessitate foundation replacement. This excavation and replacement of poor foundation material would create the need for additional sand borrow and further impacts to Bay bottom associated with the dredging of a borrow area. This would be in addition to the foundation replacement needed for the northeast sill. Further, although Alternative 3 (full breakwater) reduced maximum velocities throughout much of the project area to the greatest degree, Alternatives 4, 5, and 6 also achieved velocities suitable to SAV with less structure, and therefore less cost. Finally, modeling identified increased velocities in the vicinity of the southern end of the full breakwater that could be deleterious to SAV.

3.3.4. Alternative 4: Barren Island Protection with Short Southern Breakwater

Modeling of Alternative 4 (short breakwater) demonstrated that the shorter southern breakwater can provide for existing or reduced velocity conditions throughout the SAV habitat. Alternative 4 avoids poor foundation materials and the need for foundation replacement for the full southern breakwater but does not avoid foundation replacement for the northeast sill. This alternative also avoided the increased velocities associated with the end of the full southern breakwater.

3.3.5. Alternative 5: Barren Island Protection, Short Southern Breakwater, and Two Independent Bird Islands at Southern End of Breakwater

Model results for Alternative 5 provide for existing or reduced velocity conditions throughout the SAV habitat and provides for inclusion of bird islands. However, the bird islands are located over poor foundation that would require foundation replacement and associated impacts.

3.3.6. Alternative 6: Barren Island Protection, Short Southern Breakwater, and Segmented Breakwater

Alternative 6 provides for existing or reduced velocity conditions throughout the SAV habitat and demonstrates that a continuous breakwater is not necessary. The segmented breakwaters are located over poor foundation that would require foundation replacement and associated impacts.

3.3.7. Alternative 7: Barren Island Protection, Short Southern Breakwater, Wetland Cell at the Southern Tip of the Southern Remnant, and Three Bird Islands

Alternative 7 minimizes impacts associated with the footprint of the breakwater, avoids foundation replacement associated with the breakwater and prior island alignments, provides conditions suitable for SAV in Tar Bay, and includes bird islands for nesting habitat. Additionally, Alternative 7 provides for restoration of approximately 104 ac of wetlands.

3.3.8. Alternative 8 (Preferred Alternative): Barren Island Protection, Short Southern Breakwater, and Two Bird Islands

Similar to Alternative 7, this alternative will provide and maintain oyster and SAV habitats, restore approximately 83 ac of wetlands, and includes two bird island habitats as recommended by the resource agencies. Additional considerations will be undertaken to determine if the northeast sill can be shortened as a way to decrease wave energy and velocities in an effort to protect existing SAV habitat and reduce the amount of foundation removal along the north east section of the northern remnant. For NEPA purposes, the full extent of the northeast sill is evaluated for impacts.

3.3.9. Ecosystem Benefits and Impacts Considerations

Alternative 1 (No Action) would not provide any additional ecosystem benefits but would also not have any impacts associated with construction activities.

For Alternatives 2 through 8, impacts will occur to shallow water estuarine habitat within the footprint of all sill and breakwater alignments. Impacts to shallow water habitat would vary based on the length of sill and breakwater in each alternative. Alternatives 3 and 6 would have the greatest impacts to shallow water habitat based on the proposed length of the sills and breakwaters.

There would also be impacts to Great Bay Bar, a Maryland Historic Oyster Bar, and Tar Bay WMA associated with implementation of the northeast sill for each of the action alternatives. The sill in this section would require foundation replacement. Refinements are taking place on the design of the northeast sill to address and minimize the need to replace the unsuitable foundation materials on the bay bottom. Also, modeling results suggest that the northeast sill may cause negative impacts to SAV related to increased current velocities in Tar Bay by certain storms. Storms modeled with a principal northerly wind direction at max wind speed demonstrated increased water velocities in adjacent SAV habitat. Modeling of the no action alternative demonstrated that water velocities during these storms are currently elevated above the targeted velocity of 100 cm/s for SAV habitat, but the addition of the northeast sill is believed to increase water velocities further. The increased velocities are believed to occur as waves rebound off the sills. Further considerations to shorten the northeast sill would reduce the area affected by increased water velocities.

All alternatives except Alternative 1 (No Action), would provide for the restoration of wetland habitat, conserve the remaining habitat on Barren Island, and help to preserve the SAV habitat east of Barren Island. Alternatives 5, 7, and 8 also include remote bird islands for shorebird nesting habitat.

3.4 Alternative Refinement and Selection

The modeling results for all alternatives identified increased velocities associated with the proposed northeast sills in the Tar Bay area. Additionally, it was identified that the 2009 Feasibility Report alignment and subsequent variations were not within the historic footprint of the island. This was the reason for needing to undertake foundation replacement for the bird islands and segmented breakwaters of Alternatives 5, 6, and 7. The modeling results for Alternatives 4, 5, 6, 7, and 8 demonstrated that a shortened breakwater could provide the desired habitat conditions for SAV in Tar Bay while minimizing the ecosystem impacts associated with the long southern breakwater. Alternative 5 provides for remote bird islands for nesting habitat but requires foundation replacement. Alternatives 7 and 8 do not require foundation replacement for bird island construction.

Table 1 provides a summary of the evaluation conducted to compare the initial 6 (No Action plus 5 with-project) alternatives, Alternative 7 (the refined alternative), and Alternative 8, (the preferred alternative).

Alternative 7 was initially selected as the Preferred Alternative due to ecosystem benefits and impact considerations; and its ability to provide conditions suitable for SAV in Tar Bay and bird islands for nesting habitat. Additional geotechnical investigations identified that the southeast sill was positioned over poor material and would require foundation replacement. As a result, the alignment of the sill at the southern end of the existing Barren Island was pulled north to an east-west alignment along the current southern shoreline of Barren Island. Consequently, the wetland restoration cell behind the south sill was removed from the plan resulting in the reduction of wetland restoration to approximately 83 ac.

Table 1. Alternatives Comparison

	Alternatives							
Screening Criteria	No Action	Alternative 2	Alternative 3	Alternative 4	Alternative 5	Alternative 6	Alternative 7	Alternative 8/ Preferred Alternative
H&H modeling	NA	increased velocities from northeast (NE) sill	increased velocities from NE sill and southern end of breakwater	increased velocities from NE sill	increased velocities from NE sill	increased velocities from NE sill	increased velocities from NE sill	increased velocities from NE sill
Alignment within historic island footprint	NA	yes	not completely	yes	not completely	not completely	yes	yes - NE sill
Foundation replacement needed	no	yes - NE and southeast (SE) sills	yes - NE sill, SE sill, and southern half of south breakwater	yes - NE and SE sills	yes - NE sill, SE sill, and bird islands	yes - NE sill, SE sill, and segmented breakwaters	yes - NE and SE sills	yes - NE sill
Oysters	additional exposure and sedimentation	conditions provided by Barren Island maintained but impacted by NE sill	conditions provided by Barren Island maintained but impacted by NE sill	conditions provided by Barren Island maintained but impacted by NE sill	conditions provided by Barren Island maintained but impacted by NE sill	conditions provided by Barren Island maintained but impacted by NE sill	conditions provided by Barren Island maintained but impacted by NE sill	conditions provided by Barren Island maintained but impacted by NE sill
SAV habitat protected	no, additional exposure and sedimentation	south/southest not protected	yes	yes	yes	yes	yes	yes
Bird Islands restored	no	no	no	no	yes -2	possible addition	yes - 3	yes - 2
Wetlands restored	no	104 acres	104 acres	104 acres	104 acres	104 acres	104 acres	83 acres

To address the increased velocities in the Tar Bay area, the northeast sill will be shortened as designs are finalized. A shorter sill would still provide a measure of protection to the Tar Bay WMA but would minimize the potential for the sill to increase velocities during storm conditions. Submerged rock reefs are also proposed in the waters adjacent to the bird habitat coves to reduce energies and help maintain substrates within the bird islands. These reefs would also add value to fisheries resources and could serve as substrate for a three-dimensional oyster reef. The location and height of the reefs will be determined as design plans are finalized.

3.5 Preferred Alternative

The preferred alternative (Figure 9) includes the construction of approximately 13,046 lf of new and modified stone sills and 4,620 lf of segmented breakwater to immediately provide increased protection to the eroding Barren Island and to the extensive SAV beds to the east of Barren Island, and installation of two bird islands (approximately 8.5 ac total) and approximately 83 ac of wetlands. The stone sills will be constructed to an elevation of +6 ft NAVD88 and the breakwater to an elevation of +8.5 ft NAVD88.

The preferred alternative includes restoration of approximately 83 ac of wetlands and 8.5 ac of bird islands. Approximately 429,000 cy of authorized maintenance material dredged from small local federal navigation channels will be placed behind the confining stone sills up to the Mean High Water (MHW) elevation to restore wetlands habitat. Restoration of the full wetlands goal is expected to take multiple dredging cycles. Wetlands will include low and high marsh plantings as well as some intertidal mudflats. During final wetland development planning, current conditions will be evaluated with respect to sea level rise projections and determinations of sustainable marsh elevations to identify high to low marsh distributions.

At the southern end of the restoration Project, two small bird islands will be integrated into the breakwater. The bird islands will range from 3.5 – 5 ac for a total of approximately 8.5 ac. The bird island designs will incorporate natural resource agencies' input to allow for greater distance from the main Barren Island and between the two islands to avoid predation, while maintaining benefits to SAV bed habitat with the use of a segmented breakwater design. The bird islands will have a natural connection to Tar Bay for access to the water by chicks.

3.6 Implementation

The Project involves rehabilitation of existing sills and construction of new sills and breakwaters by placing stone in the shallow water around Barren Island. Wetlands will be restored in the area between the sills and mainland using dredged material from local federal navigation channels. To the greatest extent possible, this work will be completed from the water off barges or utilizing pontoon equipment.

Based on the analysis completed as part of this sEA, the Project includes the following (Figure 10):

- 13,023 linear ft of sill,
  - modification of 4,850 lf of current sill
  - creation of 8,173 lf of new sills
- 4,620 lf of breakwater,
- 2 bird islands (8.5 ac total), and
- Approximately 83 ac of wetland and intertidal mudflats.

The Project will be constructed in phases. The first phase of the Project will complete all the stone placement to modify the current sills and create the new sills and breakwater. The stone sills and breakwater will be constructed on top of geotextile fabric and composed of a small stone base topped with larger armor stone ranging from 2,100 to 4,100 pounds. The stone sills will be constructed to an elevation of +6 ft NAVD88 and the breakwater to an elevation of +8.5 ft NAVD88. The existing sills are at an elevation of 0 – 1 ft NAVD88. They will be brought up to the 6 ft elevation by placing stone over the pre-existing structure until the desired elevation is reached. The completion of the sills and breakwaters will provide immediate protection to the eroding Barren Island shoreline. Additionally, the structures will help to provide conditions for SAV beds directly to the east of the island and protect the mainland shoreline from erosion.

Resiliency to account for future sea level rise was built into the design of the breakwaters and sills. The design height for the breakwater was originally 6 ft MLLW (4.8 ft NAVD88), which was sufficient for the 50-year storm based on ERDC's life-cycle analysis that was completed during the feasibility phase. Following the USACE Value Engineering Study and the Agency Technical Review, the elevation of the stone sills and breakwater was raised to the current design to account for future SLR. It has been observed that the area has recently been following the high SLR curve rather than the intermediate SLR curve. The design accommodates sea level rise through 2072 using the USACE high SLR curve which corresponds to the 2125 intermediate SLR curve.

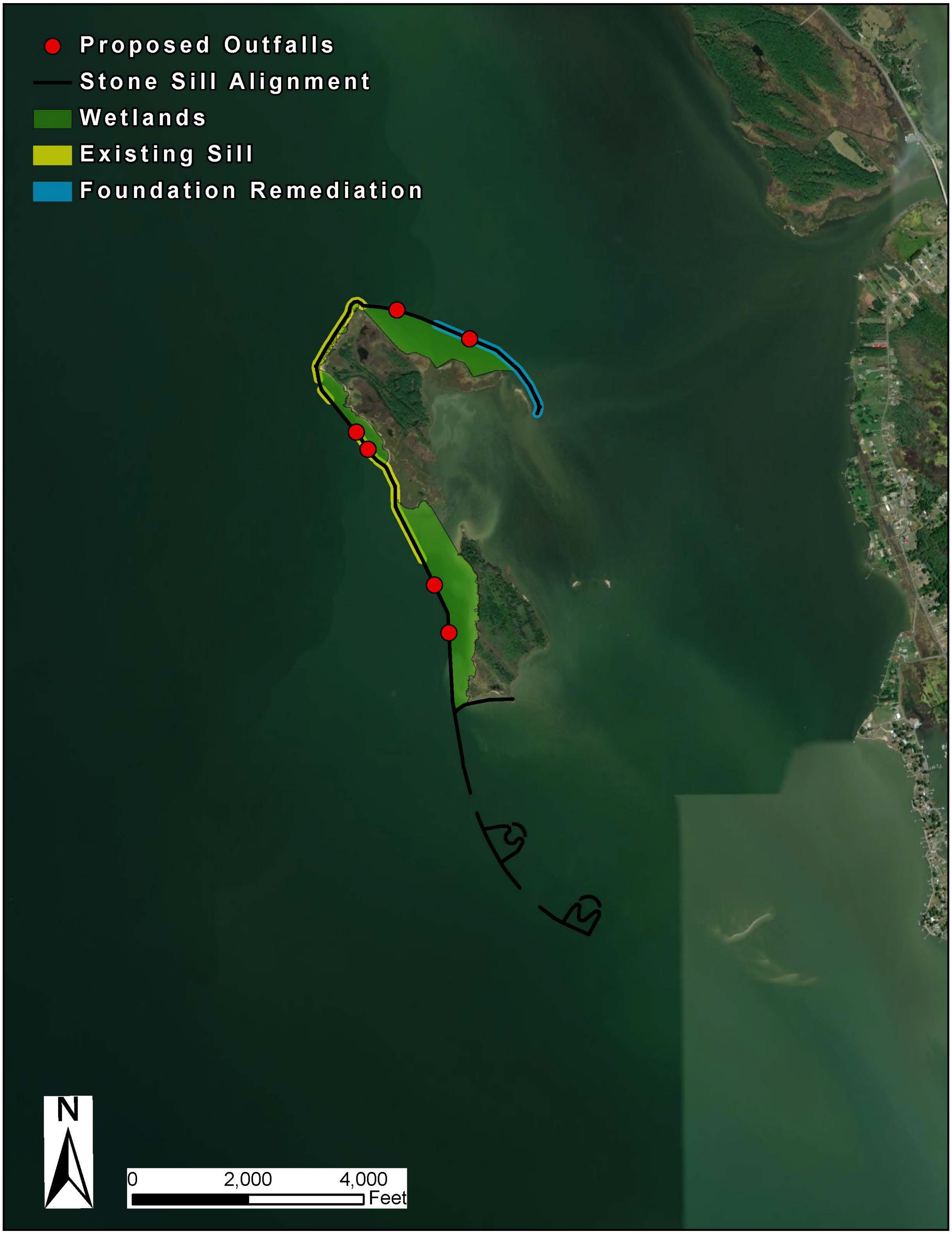

Figure 10. Barren Island Restoration Plan

Subsequent phases of the project will encompass dredging of sand for foundation replacement under the northeast sill, temporary dike construction for wetland restoration, and bird island habitat development. Unsuitable foundation material will be dredged from the northeast Barren Island stone sill location to an approximate depth of 7 ft. The amount of material to be removed will be determined as the project progresses to final design. The dredged material will be placed hydraulically or mechanically within the confined area behind the constructed sills at Barren Island. Approximately 63,000 cy of suitable/approved fill material will be placed in the void created by removal of the unsuitable material to create a structurally sound base for the northeast sill. While it is anticipated that sand material will be used to backfill the void created by removal of the unsuitable material at the northeast sill, stone materials from a local quarry may also be used. Identification of a clean sand borrow area for use in foundation replacement, construction of interior dikes for wetlands restoration, and bird island restoration is in progress. This sEA covers all project components except the borrow area. The borrow area will be covered by a future NEPA document once identified.

The final phase of the Project would include placement of dredged material for wetland restoration and development of wetland habitat. Once the confining sills are constructed, and dredged material is available, the Project's habitat components will be constructed. Approximately 429,000 cy of authorized maintenance material dredged from small local federal navigation channels will be placed behind the confining stone sills up to the MHW elevation. Because several dredging cycles would be required to meet the material capacity of the proposed restored wetland acreage, this is considered a long-term restoration project. Placed dredged material will be used for the restoration of approximately 83 ac of wetlands/mudflats. Wetlands will include low and high marsh plantings as well as some intertidal mudflats. During final wetland development planning, current conditions will be evaluated with respect to sea level rise projections and determinations of sustainable marsh elevations to identify high to low marsh distributions. It is anticipated that a higher proportion of high marsh would be designed to enable migration of low marsh with sea level rise versus conversion to open shallow water. Tidal exchange will be established through use of open tidal guts or outfall structures after the material is stabilized. The design will aim to take advantage of any freshwater flow from the island to augment tidal gut flow. To the extent practicable, wetlands will be designed to allow for estuarine connectivity via gaps and tidal creeks to maximize value to fisheries resources.

At the southern end of the restoration Project, two small bird islands will be integrated into the breakwater. The bird islands will range from 3.5 – 5 ac for a total of approximately 8.5 ac. The bird islands will be designed using tiered elevation control structures and stone sills to confine approximately 154,000 cy of sand that will be used to construct the bird islands. The sand for restoration of the bird islands would be acquired from the yet to be identified borrow area. Construction of the bird islands would utilize approximately 50% of the sand that would be dredged from the borrow area, with the remaining used for foundation replacement under the northeast sill and construction of interior dikes for wetlands restoration. The bird island designs will incorporate natural resource agencies' input to allow for greater distance from the main Barren Island and between the two islands to avoid predation, while maintaining benefits to SAV bed habitat with the use of a segmented breakwater design. The stone confining units to the west will be designed to withstand erosional forces based on H&H modeling, while the east side is designed to allow chicks to enter the tidal waters. Occasional wash over will assist with vegetation control.

4 AFFECTED ENVIRONMENT AND IMPACTS EVALUATION OF PROPOSED ACTION (PREFERRED ALTERNATIVE)

The 'No Action' Alternative and Alternatives 2-7 have been screened out from further analysis. The iterative process that developed out of the modeling results, additional geotechnical surveys, and continued discussions with regulatory agencies determined that Alternative 8 is the preferred alternative. Additional design efforts will refine the details of the components of the preferred alternative. The impact discussions for each of the resource topics below will focus on the impacts, negative and positive, associated with Alternative 8.

4.1 Physical Environment

4.1.1. Topography, Physiography, and Geology

The project area lies within the Atlantic Coastal Plain physiographic province. The Coastal Plain is underlain by unconsolidated sediments including gravel, sand, silt, and clay. Barren Island is comprised of Holocene Tidal Marsh Deposits and the Kent Island Formation, which primarily consist of silt and clay with thin beds of sand. Barren Island is situated within the U.S. Environmental Protection Agency (USEPA) Region III Middle Atlantic Coastal Plain – Chesapeake-Pamlico Lowlands and Tidal Marshes. This ecoregion is typically low in elevation and is representative of flat terrain, tidal marshes, wetlands, and low-gradient streams. Elevations range from 0 to 50 ft and relief is less than 35 ft (USEPA Ecoregions, 2021). Barren Island rests at a very low topographic elevation with a maximum elevation of 6 ft above mean high tide. Due to its low elevation, and vulnerability to wake caused by ship traffic, Barren Island has lost approximately 74 to 78% of its historical acreage, roughly 520 – 660 ac (USACE, April 2009).

Impacts: The areas within the footprint of sills and breakwaters would experience a direct and long-term impact. Sill elevations would be +6 ft NAVD88 and breakwater elevations would be +8.5 ft NAVD88. The areas planned for wetland restoration and bird island habitat would have a direct and long-term increase in elevation. These areas are currently submerged subtidal habitats with elevations ranging from – 1 ft MLLW to approximately – 11 ft MLLW. Resulting elevations for wetlands would be determined during final wetland design but would be set to provide high and low marsh and mudflats. Bird island elevations would be +8.5 ft NAVD88 and grade down to provide a connection to Bay waters on the east. No impacts to topography, physiography, and the larger geologic context of the study area are anticipated.

4.1.2. Climate

Barren Island exists within a temperate climate. Mild, windy winters and warm, muggy summers are characteristic of the weather in the Dorchester County region of Maryland. U.S. Climate Data shows that the average annual high temperature in Cambridge, Dorchester County, is 69 degrees Fahrenheit, while the average annual low temperature is 48 degrees Fahrenheit. Mean annual precipitation for Cambridge, Dorchester County is 46.06 inches, with August being the wettest month and February being the driest month (U.S. Climate Data, 2021).

Impacts: No impacts to climate are anticipated as a direct effect of the Project.

4.1.3. Substrate

Three separate subsurface investigations have been performed for the Project and its adjacent surroundings. The first investigation was performed in 2001 as part of a reconnaissance study that investigated the possibility of constructing a 1,000 – 2,000-acre island for dredged material placement and beneficial use. In 2004, a second investigation was performed as part of a similar study to 2001; this study was finalized in 2008. However, in 2008, the plan formulation changed and a much smaller ecosystem restoration project at Barren Island was formulated. The latest investigation was performed in 2020 and is part of the present study. The 2020 geotechnical investigation concluded in January 2021 and was developed to determine the engineering properties of the foundation materials along the proposed alignment in the 2008 Feasibility Report. Three stratums (Stratum 1, Stratum 2, and Stratum 3) were identified during the 2020 geotechnical investigation and they include silt, silty sand and clayey sand, and clay, respectively. Stratum 2 (silty sand and clayey sand) represents the primary stratum underlying the entire site. This stratum has a wide range of thickness and can be found interspersed with Stratum 1 (silt). Reference the *Barren 35% Geotechnical Design Documentation Report* in Appendix A for further details on the investigation.

Unsuitable foundation material will be dredged from the northeast Barren Island stone sill location to an approximate depth of 7 ft. The dredged material will be placed hydraulically or mechanically within the confined area found behind the constructed sills at Barren Island to restore wetlands. Suitable/approved fill material will be placed in the void created by removal of the unsuitable material to create a solid structurally sound base for the northeast sill. While it is anticipated that sand material will be used to backfill the void created by removal of the unsuitable material, stone materials from a local quarry may also be used. Identification of a clean sand borrow area for use in foundation replacement efforts as well as bird island restoration is in progress.

Impacts: The areas within the footprint of sills and breakwaters would experience a direct and permanent impact. These areas would now be covered with rock. The areas planned for wetland restoration and bird island habitat would have a direct and long-term increase in elevation and change in substrates. Substrates are typically silt and clay. Wetland substrates would be expected to be of similar composition as existing materials, with the addition of vegetation. Some areas would have sand added for temporary dike construction. Bird islands would have a sand and shell substrate.

4.1.4. Soils, Erosion, and Sedimentation

4.1.4.1 Soils

The USDA Natural Resources Conservation Service web soil survey (USDA, 2020) identifies six (6) soil complexes within the study area (Table 2). Elkton silt loam, Honga peat, and Sunken mucky silt loam are listed as hydric.

Table 2. Soils at Barren Island

Soil Name	Map Symbol	Drainage Class	Hydric Rating
Elkton Silt Loam, 0 to 2 percent slopes	EmA	Poorly Drained	Hydric
Honga peat, very frequently flooded, tidal	Ho	Very Poorly Drained	Hydric
Mattapex silt loam, 0 to 2 percent slopes, Northern Tidewater Area	MtdA	Moderately Well Drained	Predominantly Non-hydric
Mattapex silt loam, 2 to 5 percent slopes, Northern Tidewater Area	MtdB	Moderately Well Drained	Predominantly Non-hydric
Sunken mucky silt loam, 0 to 2 percent slopes, occasionally flooded, tidal	SuA	Very Poorly Drained	Hydric
Udorthents, loamy, 0 to 5 percent slopes	UzB	N/A	Not Hydric

4.1.4.2 Erosion

Kearney (1991) reported Barren Island to be approximately 700 ac in 1660. A State of Maryland study set the Island at 839 ac in 1848 (State of Maryland, 1949), while Wray et al. proposed that Barren Island was 754 ac during the same time (Wray, 1995). Given these discrepancies, Barren Island has lost between 74 and 78% of its historical acreage to erosion. At the time of the 2009 Feasibility Report, Barren Island consisted of three eroding island remnants totaling about 180 ac in size (MDOT MPA, 2005a) (197 ac including tidal flats). Based on 2020 surveys, only 138 ac of Barren Island remains. Barren Island experiences a long-term erosion rate of 14 ft per year (3 – 4 ft per year in recent years) or approximately 4.1 ac per year. At this rate, Barren Island could be completely lost by the early 2050s (2050-2055) without ongoing any future protection measures. Figure 11 depicts historic Barren Island shorelines from 1890 through 2020. Figure 11 also depicts the recommended plan alignment from the feasibility phase that was designed to

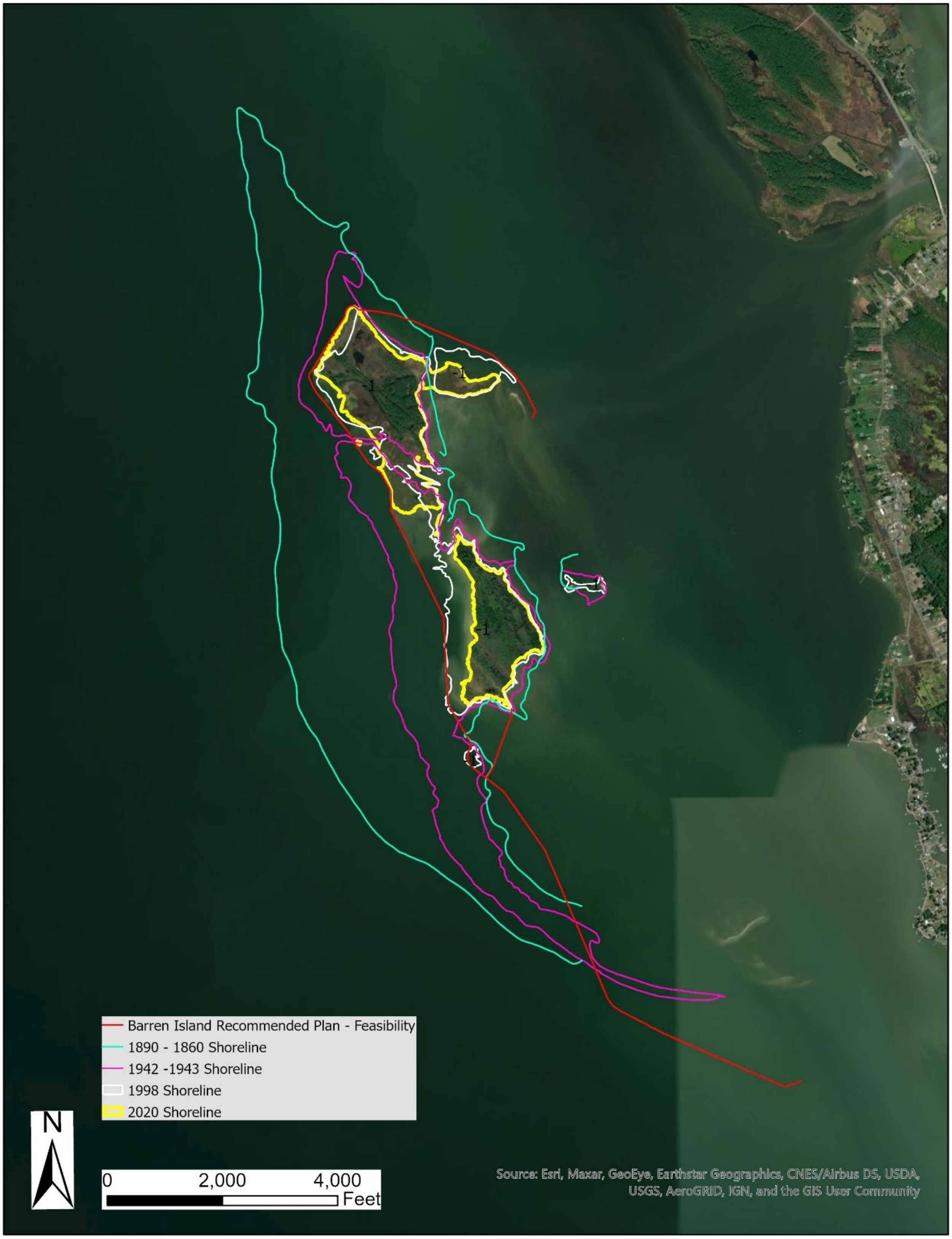

Figure 11. Barren Island Existing and Historic Shorelines

protect the shoreline at that time which is best represented by the 1998 shoreline. The current restoration plan sill alignment has not changed from feasibility except at the southern end of the island. The high degree of erosion that has occurred since feasibility is evident when comparing the Feasibility Recommended Plan with the current island shoreline.

4.1.4.3 Sedimentation

Waters around Barren Island are generally very shallow, contain an abundance of sediment from localized erosion of the island and runoff from adjacent land. Currently, no new sediment modeling has been performed for this study, but sampling was conducted during the feasibility study. Prior Feasibility phase modeling (Dinicola et al. 2006) has shown that storms are the primary force behind appreciable sediment movement in the project area. Calculated bottom elevation change was negligible under normal tide condition as compared to the storms. Normal tide conditions are associated with rather weak tidal currents. For the existing conditions, the modeling of storm conditions showed the highest sediment shoaling appeared at the north island tidal channel cut as a result of sediment being eroded from the existing island and carried by the current to the channel. The north island tidal channel was the channel between the Tar Bay WMA and Barren Island. Not surprisingly, this channel has shoaled closed since the prior modeling. The northeast waters in the Tar Bay WMA are a dynamic area that has been manipulated with anthropogenic sediment inputs periodically since the 1980s to create the Tar Bay WMA (Earhart and Garbsich 1983, 1986). Sediments dredged from the Honga River channel were placed unconfined and have moved over the years but have ultimately resulted in robust wetlands and SAV habitat. From the 2009 Feasibility Report modeling, sediment transport simulations generally showed "less sediment accretion or erosion along the Honga River Channel, especially between Taylors Island and Upper Hoopers Island. This trend is opposite to the future without-project condition, where the erosion becomes significant along the bay side shoreline and Honga River Channel because Barren Island does not exist to provide the protection to Taylors Island and Upper Hoopers Island."

Impacts: Implementation of the preferred alternative would have a direct and long-term positive impact on erosion of Barren Island. Erosion would be reduced and likely eliminated in areas protected by sills. The soils on Barren Island would remain in place. This would also reduce the sedimentation in the shallow waters adjacent to Barren Island. There would be a minor, temporary increase in turbidity during construction, but this would cease when construction is complete.

4.1.5. Bathymetry

On average, the Chesapeake Bay is approximately 21 ft deep. A few deep troughs run along most of the Bay's extent and are assumed to be remnants of the Susquehanna River. According to a study performed by Applied Coastal Research and Engineering in 2002, water depths around the Barren Island Project vicinity ranges from approximately - 1 ft MLLW along the east side of the island to more than - 9 ft MLLW along the west side of the island. The study concluded that the bathymetry around the east and south sides of the island are locally very shallow (USACE, 2009).

Impacts: Construction of sills, the breakwater, bird islands and wetlands would have a direct and long-term reduction to the depth of the waters immediately adjacent to Barren Island. Within the footprint of the sills, breakwaters, and bird islands, shallow water estuarine habitat would be converted to stone structures with heights above current water levels. Within the footprint for the sills, elevations would be changed to 6 ft MLLW. Elevations within the footprint for the breakwaters would be changed to 8.5 ft MLLW. Within the footprint for the bird islands elevations would be changed to 8.5 ft MMLW and grade to the water.

4.1.6. Water Levels and Sea Level Rise

According to the Mid-Bay Feasibility Report (USACE, April 2009), water levels at Barren Island are predominately driven by astronomical tides; however, other factors such as sustained wind (i.e., fetch), freshwater inflow, runoff, and strong tides driven by storms can also affect water levels. Due to Barren Island's variable shoreline, wake from ship traffic can temporarily alter water levels and can be one of the leading causes of erosion on the island's shorelines.

As part of USACE's Engineering Research and Development Center's (ERDC) H&H modeling, water depth was determined by using 2020 bathymetric data and the 100-year water surface elevation provided by ERDC. The ERDC modeling simulated water surface elevations under a suite of storm conditions focused on determining the existing and proposed sill and breakwater alignments. Under existing conditions, the average maximum water surface elevation in the Barren Island area was approximately 4 ft (1.2 m) relative to MSL on the western side (Bay side) of Barren Island and between 4.5 and 5 ft on the eastern side of the island in Tar Bay where the bathymetry is shallower than in the main bay. The surge levels away from the immediate proposed structures, in general undergo only small changes, on the order of a couple of inches, for the array of alternatives. With the northern portion of Barren Island enclosed on three sides by the 'with-Project' structures, the elevated floodwaters were able to enter from the non-enclosed side, where the wind piles the water up against the "backside" of the features by approximately 0.5 ft (Massey et al, 2021).

Investigations during the feasibility phase established tidal datums relative to NAVD88 that were updated to current conditions for PED (NOAA 2021). Interpretation of tidal datums revealed a tidal range of 1.22 ft present on Barren Island from Mean Higher High Water (MHHW) to MLLW. However, this data set would be irrelevant if not linked to the long-term station at Solomons Island that could show a progression of sea level trends for the life of the marsh surface. The daily and seasonal tidal signature at Solomons Island was extremely consistent with that of Barren Island and revealed similar tide stages and patterns. Solomons Island's long-term sea level trends from 1937 to 1999 exhibit a sea level rise of + 3.29 millimeters per year. Barren Island is expected to experience this same upward trend.

Impacts: Ambient water levels would not be affected by implementation of the project. However, implementation of the preferred alternative would affect water levels during storms. This impact would be temporary, intermittent, and direct. During storm conditions, the sills and breakwaters would have a direct and positive impact on water levels in the areas protected by the structures. Resiliency has been built into the sill design; the crest of the sill is 10.8 ft wide, which allows for increasing the height of the sill to accommodate future sea level rise without increasing the footprint of the stone structures. Wetland design will account for anticipated sea level rise and changing water levels.

4.1.7. Wind Conditions

Prevailing winds in the Mid-Bay region are predominantly from the northwest and can intensify over the Chesapeake Bay (USACE-Baltimore, 2001). Mean wind speed data is available from the NOAA National Climatic Data Center (NCDC) and for the Mid-Bay region; the Patuxent River Naval Air Station (NAS) wind monitoring system recorded a mean wind speed of 8.2 mph and an average maximum sustained wind speed of 15.8 mph for 2003. Wind speeds and directions during storm conditions were modeled by ERDC (Massey et al. 2021).

Impacts: No effect.

4.1.8. Currents

ERDC's H&H modeling investigated existing water currents in the project area to inform sill and breakwater design and understand how implementation of the Project would affect water currents, specifically within the SAV habitat in Tar Bay (Massey et al. 2021). Model outputs provided minimum, maximum, and average currents (cm/sec) under spring high tide and summer low tide conditions for points (save points) in Tar Bay. During spring high tides, maximum currents range from 0 – 46.8 cm/s with an average range from 0 – 26.9 cm/s. During summer low tides, maximum currents range from 0 – 44 cm/s and the average range is 0 – 27.2 cm/s.

Also modeled were existing current maximum velocities under 25 storm conditions, 24 hour and 48 hour mean peak velocities, and the effect that adjusting Manning's n coefficient to represent bottom roughness provided by existing SAV beds has on water currents (See Appendix B) (Massey, et al. 2021). Maximum velocities range from 33.6 – 129.3 cm/s with an average range from 16 – 95 cm/s.

Impacts: The Project is not expected to effect water currents in the mainstem of the Bay to the west of Barren Island. Implementation of the preferred alternative is expected to have direct and long-term, positive impacts on water currents within Tar Bay. By stabilizing Barren Island, the sills would enable Barren Island to continue to provide protection to the Tar Bay area from westerly winds and waves. The southern breakwater would provide the same protective benefit to SAV habitat in the southern portion of Tar Bay. As discussed in Section 4.3.3, water currents suitable to SAV habitat conditions were evaluated against modeling results to evaluate alternative performance and determine an alternative's ability to affect currents within a suitable range for SAV.

Although the preferred alternative is projected to largely reduce velocities in the waters protected by the project, the sills and breakwaters can produce increased velocities in waters close to the structures. These areas may experience a short-term, moderate increase in velocities during certain storm conditions. Increased velocities in the waters adjacent to the northeast sill could potentially affect SAV habitat. As designs are finalized, the extent of the northeast sill will be shortened to reduce the potential for impacts to SAV from increased velocities associated with the sill.

4.1.9. Wave Conditions

Storm surge and nearshore wave modeling for the project area was conducted as part of the H&H modeling effort. Overall, the mean changes over all storms for most of modeled locations (save points) shows a reduction in maximum significant wave heights for all with-Project conditions on the order of 3.0 to 6.0 inches. Alternatives that have longer breakwaters reduce significant wave heights in a larger area behind the structures than do the shorter structures.

Impacts: Ambient wave conditions would not be affected by implementation of the preferred alternative. Wave conditions during storms would be directly impacted over the long-term. Based on modeling results a mean reduction of less than 6 inches would be expected. Storm surge would be directly reduced during storm conditions in the areas leeward of the sill and breakwater structures.

4.2 Water Quality

Maryland Environmental Service (MES) performed surface water sampling at 11 locations around Barren Island in the summer (September) and fall (October) of 2020, and winter (March) and spring (May) of 2021. A full description of the methods and results of the samples taken at all sampling events is available in Appendix C1. A water quality meter was used to measure water temperature, salinity, dissolved oxygen (DO), turbidity, and pH. The measurements were recorded at the surface, mid-depth, and bottom (within 1 meter) of the water column at each location. All samples were carefully collected as not to disturb sediment and were placed in pre-labeled containers. In addition, water samples were analyzed for total dissolved nitrogen, total dissolved phosphorous, orthophosphate, particulate phosphorous, particulate carbon, dissolved organic carbon, total nitrogen, total phosphorous, chlorophyll *a*, Phaeophytin *a*, and total suspended solids. Sampling results from the summer, fall, winter, and spring monitoring events are provided within Appendix C1.

Lowest salinities typically occur in May, with mean monthly salinity of 11 ppt, and highest salinity occurs in October with mean monthly salinity of 16 ppt. Sampling conducted in 2002 to 2004 (MPA, 2005) found that salinity around Barren Island ranged from 9.0 to 18.7 ppt, whereas similar sampling in 2020 and 2021 recorded a salinity range of 11.3 to 16.3 ppt across depths surveyed (MPA 2021). Water temperature ranged from 6.2 to 25.2 °F, with an average of 65.5°F. Warmer water temperatures were generally recorded during the summer (ranging from 24.2°C to 25.3°C) and coolest water temperatures recorded during the winter (6.2°C to 8.3°C).

DO concentrations varied seasonally. DO concentrations tend to be lower in the summer compared to the winter because warm water has less ability to hold DO than cold water. The lowest DO levels were measured during the summer season (ranging from 6.9 to 7.3 milligrams per liter [mg/L]) and maximum DO levels were measured in the winter (11.7 to 12.9 mg/L). During all seasons, DO values were greater than 5.0 mg/L, which is considered healthy and allows the Chesapeake Bay's aquatic system to thrive.

Detectable nutrients resulted in low concentrations, and ammonium and orthophosphate were not detected in most surface water samples. Overall, there was little variability in nutrients between sampling location and season.

In compliance with the Clean Water Act and the State of Maryland permitting process, the MDOT Maryland Port Administration has applied for a Water Quality Certificate and Tidal Wetlands License (application number 21-WL-0640) for the project. A public notice was posted on MDE's website on October 22, 2021 (https://mde.maryland.gov/programs/water/wetlandsandwaterways/aboutwetlands/pages/pubnotj15.aspx) and is included in Appendix E. If requested, a public hearing is tentatively scheduled for January 6, 2022 at 6:30 pm at the Madison Volunteer Fire Department, 1154 Taylors Island Rd, Madison, MD 21648. A Section 404(b)(1) evaluation has been drafted for inclusion in the application and is provided as Appendix F4.

Impacts: Implementation of the preferred alternative would have direct impacts on water quality. Water quality would be temporarily impacted negatively by construction efforts. Impacts to nutrient levels, DO, and turbidity could occur during the various construction phases. These impacts would be expected to cease with the completion of construction. Alternatively, implementation of the preferred alternative would have a direct and positive long-term impact on water quality in the near-shore environment by reducing and eliminating erosion and associated sedimentation and turbidity, and nutrient inputs.

4.3 Aquatic Resources

4.3.1. Wetlands

A wetland delineation was performed by USACE in September 2020 (Appendix D). Biologists delineated several classifications of wetlands that ranged from estuarine and palustrine wetlands within the northern and southern extents, in addition to small man-made berms and upland plateaus scattered throughout the island. The northern extent is comprised totally of estuarine systems, ranging from estuarine, intertidal, emergent (E2EM); estuarine, intertidal, forested (E2FO); and estuarine, unconsolidated shore (EUS). The southern extent follows similar characteristics but contains more palustrine emergent (PEM), and estuarine, intertidal, scrub-shrub (E2SS) systems than the northern and central portions of the island. Figure 12 depicts existing wetland habitats on Barren Island. Wetland classifications were determined by ground observations, 2020 aerial imagery and Light Detection and Ranging (LIDAR). All delineated wetlands were classified into system and subsystem according to the *Classification of Wetlands and Deep-Water Habitats of the United States* (Cowardin *et al.*, 1979). The northern extent of Barren Island consists of low marsh and high marsh areas. The vegetation that dominates these wetland areas are consistent with estuarine systems and predominantly encompass saltgrass (*Distichlis spicata*), smooth cordgrass (*Spartina alterniflora*), soft rush (*Juncus effusus*), black needlerush (*Juncus roemerianus*), common reed (*Phragmites australis*), and in areas of less inundation, loblolly pine (*Pinus taeda*). A large upland area is located within the interior of the northern extent and is dominated by loblolly pine. The understory is relatively sparse due to the amount of acidic pine needles that are shed by the trees. The southern extent of Barren Island contains severe erosion around the west to northwest side of the island and exhibits less low/high marsh areas compared to the northern extent. The interior of the island contains areas

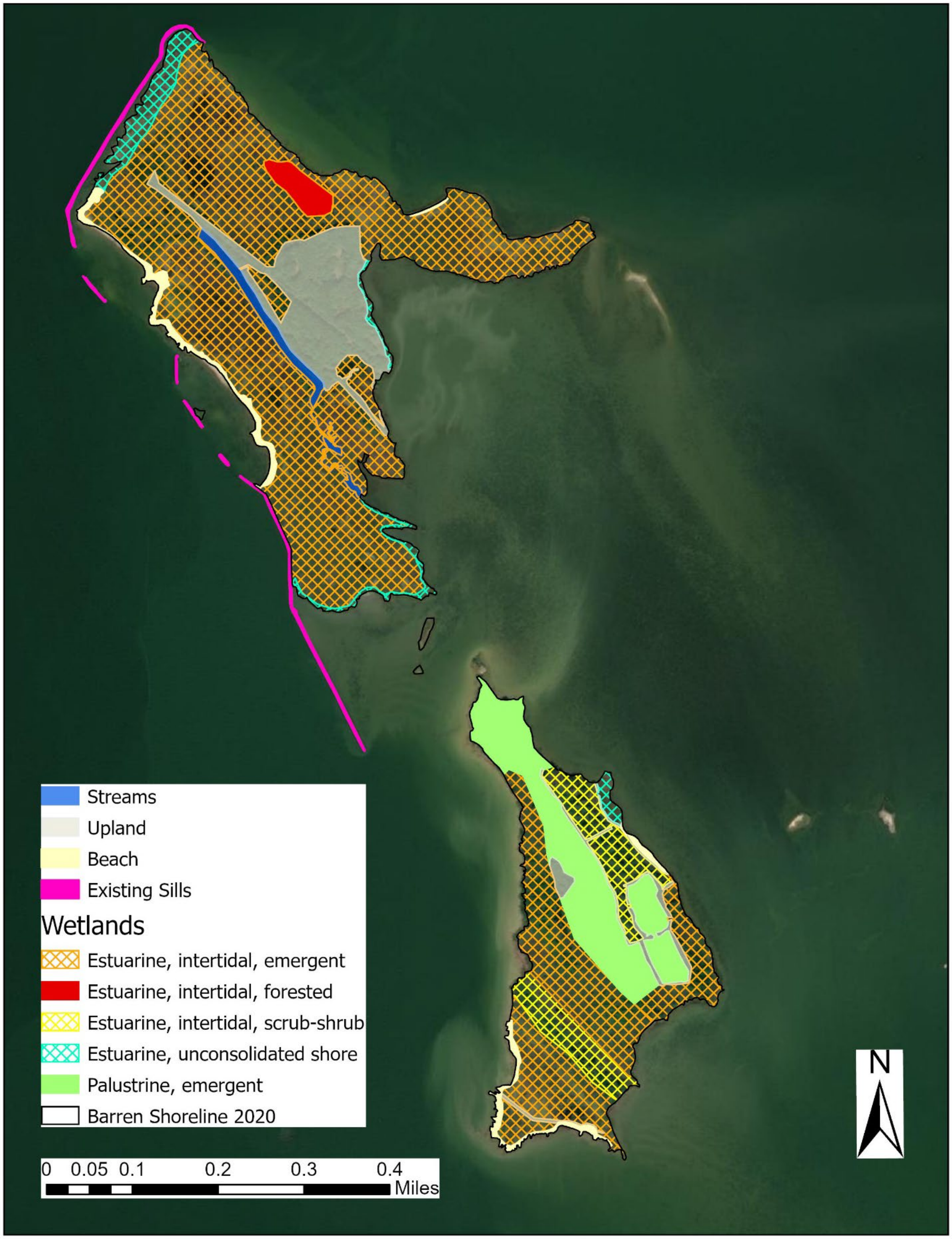

Figure 12. Wetlands Delineation, 2020

of dense greenbriar (*Smilax rotundifolia*), common reed, Japanese stiltgrass (*Microstegium vimineum*), and common persimmon (*Diospyros virginiana*). The western side of the southern extent lacks vegetation due to constant wave energy. The eastern side of the southern extent experiences less wave energy and exhibits similar vegetation as seen within the interior of the island. Table 3 provides the composition of wetland types on Barren Island.

Table 3. Barren Island Wetland Classifications

Barren Island Estimated Wetland Acreage (2020 Field Delineation)	
Wetland Class	**Acres**
Northern Remnant	
E2FO (Estuarine, intertidal, forested)	1.70
EUS (Estuarine, unconsolidated shore)	4.20
E2EM (Estuarine, intertidal, emergent)	67.25
Total	***73.19***
Southern Remnant	
PEM (Palustrine, emergent)	13.92
E2SS (Estuarine, intertidal, scrub-shrub)	8.73
E2EM (Estuarine, intertidal, emergent)	21.49
EUS (Estuarine, unconsolidated shore)	0.58
Total	***44.73***

Impacts: Implementation of the preferred alternative would result in the restoration of approximately 83 ac of wetland habitat along the shorelines of Barren Island. Overall, 27.9 ac of wetlands could be restored behind the northeast sill, 12.4 ac behind the northwest sill, and 42.5 ac behind the southwest sill. This would be a direct, positive, and long-term impact to wetlands resources at Barren Island that have continued to be lost due to shoreline erosion in recent decades. Wetlands will include low and high marsh plantings as well as some intertidal mudflats. Approximately 429,000 cy of authorized maintenance material dredged from small local federal navigation channels will be placed behind the confining stone sills up to the MHW elevation. As the timetable is unknown for dredging to provide material, final wetlands designs are planned to be completed when the dredging cycle is determined. This will enable the most current water levels to be utilized to determine high and low marsh elevations. It is anticipated that approximately 50% of the marsh acreage would be high marsh and 50% would be low marsh. Incorporating higher percentages of high marsh in the design than what was planned during the feasibility phase (80% low marsh to 20% high marsh) would add resiliency to sea level rise and enable migration of wetland habitat to low marsh as opposed to shallow, subtidal open water. Tidal exchange will be established through use of open tidal guts or outfall structures after the material is stabilized. The design will aim to take advantage of any freshwater flow from the island to augment tidal gut flow. To the extent practicable, wetlands will be designed to allow for estuarine connectivity via gaps and tidal creeks to maximize value to fisheries resources.

There would be a direct, but short-term impact to 1.41 ac of existing wetlands from construction of the preferred alternative. This acreage would be temporarily impacted by the construction of containment berms to contain dredged material for wetland restoration and would affect 0.17 ac for restoration of wetlands behind the northeast sill, 0.79 ac for restoration of wetlands behind the northwest sill, and 0.45 ac for restoration of wetlands behind the southwest sill. The berms would be constructed either by placement of sand (likely dredged from a borrow site being identified for future NEPA evaluation) or by building existing shoreline material inland to a sufficient height. Only shoreline where wetlands are being expanded behind sills would be affected. The areas would be returned to wetland habitat once construction and wetland cell development is complete. The limit of disturbance (LOD) for construction would extend to MHW but could extend further where necessary to tie the restored wetlands into the existing island habitats.

Dredging for construction of the northeast sill would occur in a later phase of the project (not phase 1). It has not been determined if dredging would be conducted hydraulically or mechanically. Hydraulic dredging would enable the dredged material to be placed directly into a receiving wetland cell but would most likely require additional freeboard for containment and placement of a pipe, potentially across Barren Island, to transport material from the northeast sill excavation to the wetland cell. If the pipe did transverse the island, there would be temporary impacts to island habitat during construction. Mechanical dredging would require use of a scow to transport material from the excavation site to the placement site. It may prove difficult to use a scow and unload the material given the shallow water depths. A decision on the type of dredging will be made at a future time relevant to the construction phase in coordination with resource agencies.

4.3.2. Intertidal Flats Habitat

Intertidal flats are an extremely valuable and diverse habitat that host numerous benthic macroinvertebrates, finfish, and wading birds. In 2002 and 2003, intertidal habitats were delineated at Barren Island. At the time of the survey, 17.3 ac of intertidal flats were observed and delineated. Consequently, these habitats are most susceptible to climate change and sea level rise and the Island has changed drastically from the 2002 and 2003 surveys. Currently, intertidal flats are estimated at 4.8 ac between both remnants.

Impacts: Impacts related to intertidal flats would be direct, positive, and long-term. Implementation of the preferred alternative would result in the restoration of approximately 5 ac of intertidal mudflat habitat as part of the wetland restoration complex (USACE, April 2009).

4.3.3. Submerged Aquatic Vegetation

Historically, widgeongrass (*Ruppia cirrhosa*) and eelgrass have dominated in areas within and adjacent to the Honga River and mid-Chesapeake Bay. Surveys in the 1960s and 1970s also showed evidence of redhead grass (*Potamogeton perfoliatus*) and sago pondweed (*Stuckenia pectinata*). According to the Virginia Institute of Marine Science (VIMS), SAV achieved maximum historical coverage in the 1960s, which correlated with the Bay's driest period recorded in recent history. Since that time, levels of SAVs have increased and decreased near Barren Island depending on water quality and high temperatures, which are directly associated with SAV growth (VIMS 2021). Typical species in the vicinity of Barren Island are widgeon grass (summer only) and horned pondweed (spring only).

VIMS completes an annual SAV survey. The 2009 Feasibility Report determined that the Barren Island Project had the potential to protect 1,325 ac of SAV habitat adjacent to Barren Island. Figure 13 depicts a composite of SAV habitat from 2014 to 2018. These years were characterized by expansive SAV beds throughout the Chesapeake Bay. SAV coverage was reduced in 2019 and 2020. Figure 14 provides 2019 SAV habitat (VIMS 2021).

SAV surveys were conducted during the Feasibility Phase at Barren Island during Summer 2002, Spring 2003, and Summer 2003. During the summer 2002 (September), a qualitative survey described monotypic (containing only one species) beds of widgeon grass predominantly adjacent to the eastern shoreline of the remnants of Barren Island in waters of about 3 ft in depth. Eelgrass and the macroalgae sea lettuce (*Ulva lactuca)* were also observed washed up on the beach of the northern tip of the northern remnant (USACE 2009). During the spring 2003 surveys, visual diving surveys revealed that horned pondweed was present in varying densities in most of the shallow water areas surrounding the east, northeast, and southeast areas of the islands. SAV crown densities were highest along the northern and eastern shorelines (USACE 2009). The summer 2003 survey identified just 12 observations of SAV. All SAV observed in the summer 2003 survey was horned pondweed in shallow waters, approximately 0.4 to 2.1 m (1.2 to 6.9 ft) in depth. Dense growths of eelgrass were also observed in shallow salt ponds on the northern end of the northern remnant and southwestern end of the southern remnant (USACE 2009).

Updated SAV surveys were completed during PED in the spring of 2020 (June), spring 2021 (June), and summer of 2021 (September) at Barren Island along the northeast shoreline, the western shoreline behind the breakwaters, the area between the north and south remnants, and the southern tip of the southern remnant. The field sampling identified relative water depth, the presence/absence of SAV, total visual percent cover of SAV, and individual SAV species visual percent cover. Transects extended from the shoreline of the island to an extent into the water 300 m past the proposed breakwater/revetment/dike alignments (or to the limit of the SAV 5-year composite coverage, whichever is shorter). Transects were laid out with at least 50 m between transects, and quadrats were sampled with a one-quarter meter square PVC frame along each transect at a 20 m spacing.

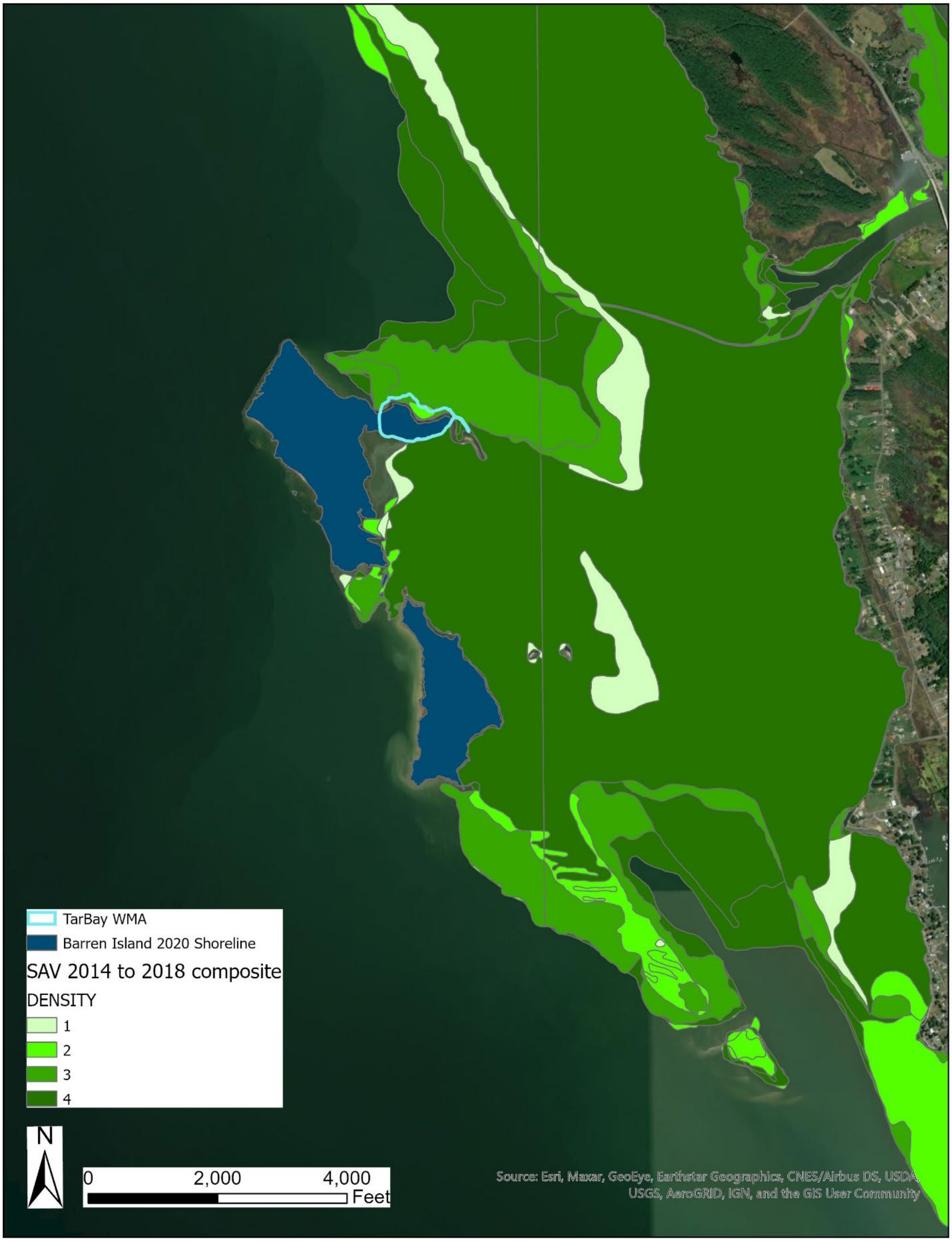

Figure 13. Composite of SAV habitat mapped by VIMS in 2014 to 2018

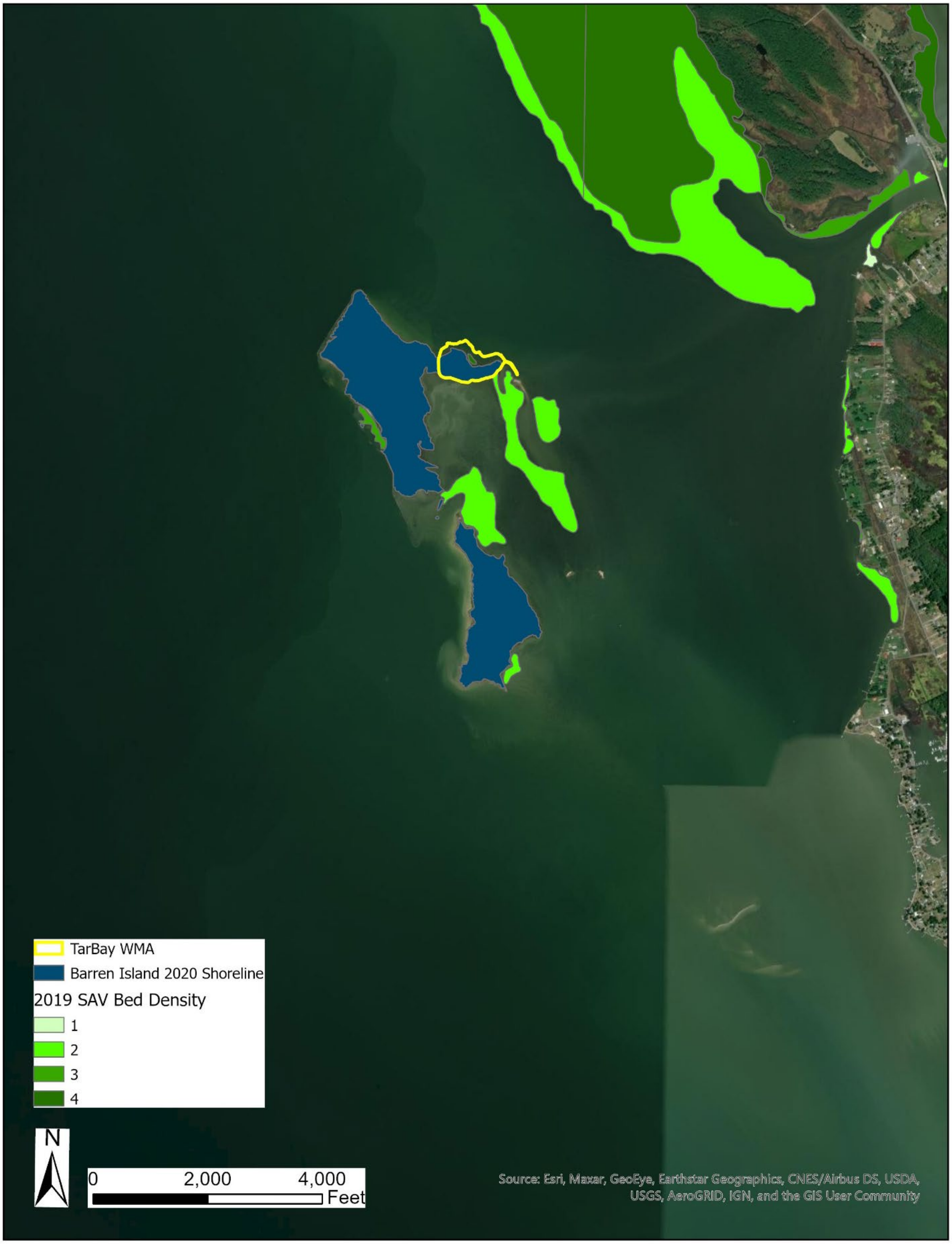

Figure 14. 2019 SAV Habitat

Spring SAV surveys were conducted at Barren Island from June 24 through June 28, 2020. The surveys were directed at sampling for the potential presence of horned pondweed and eelgrass. A total of 19 transects were identified for Barren Island; these areas included the northeast shoreline, the area between the two remnants, and the southern tip of the southern remnant (for specific locations of transects, see Appendix C3 – *Submerged Aquatic Vegetation (SAV) Survey James and Barren Island*, Anchor, 2021b). Individual collection points were spaced between 20 to 40 meters depending on the length of the transect, and a quadrat was used to collect SAV data at each location. The data collected at each quadrat included the presence/absence of SAV, total visual percent cover, identification of each SAV species present, and SAV density. A total of 196 quadrats were sampled in the various locations at Barren Island.

The results from the spring 2020 survey at Barren Island indicated that widgeon grass was the only SAV identified along the sampling transects and was also identified in shallower waters on the eastern side of the Island. Of the 196 quadrats sampled, only 10 of them contained widgeon grass, which is 5% of the total sampled quadrats. The widgeon grass identified around Barren Island was mostly limited to water depths of less than 4 ft, with dense beds observed in protected areas with water depths less than 2 ft. SAV growth along the transects and shallow areas adjacent to the exposed southeastern portion of Barren Island appear to be limited by wave action.

Neither of the targeted species – horned pondweed or eelgrass – were identified at Barren Island in the spring 2020 survey. The absence of horned pondweed in the vicinity of James and Barren Islands likely results from the timing of the survey, natural variability in the extent of horned pondweed's growth, or water quality conditions. Horned pondweed grows annually and reproduces primarily by seed formation and is typically one of the first SAV species to appear in the early spring. As water temperatures in the Bay increase through the early summer, the plants release their seeds and die back, usually in the June/July timeframe. Because this survey was conducted at the end of horned pondweed's spring growth period, it is possible that horned pondweed may have gone through its spring senescence and the growing period was already completed by the time the surveys were conducted. Horned pondweed is also susceptible to regimes with substantial wave action, and in some portions of the project area, that may also have been a limiting factor in seed establishment of horned pondweed. The absence of eelgrass in the vicinity of Barren Island likely results from a combination of water quality parameters, including salinity below the optimal range for the species, poor water clarity, and rising temperatures in the Bay. Eelgrass generally prefers regions of the Chesapeake Bay with high salinity (salinities of 20 ppt and higher), with a range from the Honga River south to the mouth of the Chesapeake Bay. Barren Island is located at the most northern extent of eelgrass' documented range. Although eelgrass was historically observed within salt ponds at Barren Island, SAV studies conducted for the Feasibility Report did not document eelgrass in the waters surrounding Barren or James Island (USACE, April 2009).

Spring and summer surveys conducted in June and September of 2021 identified the presence of both widgeongrass and horned pondweed. During the spring 2021 survey, sparse and patchy areas of widgeongrass were identified along areas of the northeastern shoreline, near the tip of the Tar Bay WMA. SAV percent cover ranged from 0 to 50% and 0 to 70% along the two transects where SAV were detected. In the central span between the two island remnants, both horned pondweed and widgeongrass were identified. Some transects were surveyed on the western shoreline behind the existing sills. One patch (50% cover) of widgeongrass was observed. The southern transects identified one patch (2% cover) of widgeongrass in one transect and one patch of horned pondweed (1% cover) in another transect. Full survey results and maps are provided in Appendix C4 (DNR, 2021). SAV surveys noted that water clarity was typically poor and Secchi depths were approximately 0.5 m or 'on the bottom' in shallow waters. Observed SAV percent cover and mean canopy height were greater during the September survey due to higher biomass and the presence of reproductive shoots.

As discussed in Section 3.2, a portion of the H&H modeling was completed to evaluate the impacts of the proposed alternatives on SAV habitat in Tar Bay. Standards for current velocity exist to quantify suitable habitat for SAV in the Chesapeake Bay. Although it is estimated that SAV can withstand water velocities of up to 180 cm/s, the upper velocity threshold that SAV in this region routinely survive without being damaged or otherwise adversely affected is approximately 100 cm/s (Koch 2001 and CBP 2000). Thus, H&H modeling results were evaluated to determine if water velocities in Tar Bay during storm events remain below that threshold after implementation of the preferred alternative.

Velocity modeling results for the No Action Alternative and Alternative 7 for the 25 modeled storms are provided in Table 4. Minimum, maximum, and average water velocities are provided for all save points within the model domain and for only those save points within Tar Bay SAV habitat. Within SAV habitat, existing maximum currents range from 34.1 to 182.6 cm/sec depending on the storm conditions. With the implementation of Alternative 7, the maximum velocities range from 27.1 to 142.3 cm/sec. All velocities are below the maximum known to be viable (180 cm/sec). Except for maximum velocities for three storms (58, 109, and 118), storm velocities are below the targeted 100 cm/sec. Minimum and average velocities decrease with the implementation of Alternative 7. It is expected that the final modeling of the preferred alternative will provide results similar to Alternative 7.

An additional model evaluation incorporated an increased Manning's n coefficient to represent bottom roughness during storms provided by SAV beds. Accounting for bed roughness resulted in an estimated decrease in the maximum velocities under 'with-Project' values by approximately 20 – 30% below those shown in Table 4.

Impacts: Implementation of the preferred alternative would have a direct and long-term positive impact on SAV habitat in Tar Bay. The preferred alternative would provide velocities that are preferred by SAV and contribute to sustaining SAV habitat in Tar Bay. The effect of the Project on velocities increases from north to south because there is currently no protection to storms in southern Tar Bay. Modeled maximum velocities are either similar to existing conditions or reduced in all areas except northern Tar Bay. Short-term, intermittent impacts could result from increased velocities associated with the northeast sill. For three modeled storms, increased velocities were identified in waters adjacent to the northeast sill. The velocities are below the maximum threshold for SAV (180 cm/sec), but above the targeted velocity for the Project (100 cm/sec). Considerations will be made as final plans are developed to include features or reduce the length of the northeast sill which could reduce storm-related velocities in this area.

There would be long-term negative impacts in discrete areas. SAV habitat within the northeast sill footprint and within the area enclosed by that sill would be converted to sill and wetlands habitat, and result in the loss of 31.7 ac of potential SAV habitat (based on 2014 to 2018 habitat coverage). However, based on 2019 SAV habitat coverage, the preferred alternative would impact only 0.4 ac of SAV habitat. This habitat was Barren Island habitat at one time in the recent past. SAV habitat that currently exists between the northern and southern remnants of Barren Island would be converted to wetlands and potentially tidal channel habitat. These would be direct and long-term impacts to existing SAV habitat. SAV has expanded into these shallow water habitats in recent years as Barren Island has eroded. In total, the preferred alternative would negatively impact 0.4 to 31.7 ac of potential SAV habitat that has developed since the Feasibility Report but benefit the remaining 1,325 ac of SAV habitat within Tar Bay. SAV may re-establish

Table 4. With and Without Project Velocity Data (modeled) within SAV Habitat

	Base (Existing Conditions) - all			*Alt 06 - all Save Points*			*Base (Existing Conditions) -*			*Alt 06 - Save Points in SAV*		
Storm	**min**	**max**	**avg**	**min**	**max**	**avg**	**min**	**max**	**avg**	**min**	**max**	**avg**
57	14.9	83.7	57.2	0	109.0	55.8	18.5	75.7	57.3	16.4	89.7	55.2
58	17.0	90.1	62.9	9.3	121.5	62.6	21.4	83.0	63.2	19.8	105.0	61.4
109	19.9	112.8	83.6	11.3	158.1	83.1	33.8	110.0	86.0	32.5	119.6	84.2
118	15.7	128.0	95.1	0	182.6	93.0	35.3	126.2	97.2	29.3	142.3	94.6
132	0	93.2	42.7	0	90.9	41.4	17.4	54.5	41.2	4.3	56.9	39.3
165	0	72.3	26.5	0	72.2	26.0	12.5	39.6	25.9	7.3	38.8	24.3
177	0	66.1	38.1	0	86.1	36.8	20.3	49.8	37.8	7.6	53.7	35.8
191	0	56.4	32.4	0	73.1	31.2	7.6	44.3	32.3	3.8	44.7	30.5
199	10.5	84.7	49.0	0	106.9	47.9	30.4	62.9	49.0	13.5	70.7	46.1
205	0	54.6	29.3	0	61.9	28.6	16.7	39.0	29.8	7.4	38.8	28.4
218	0	52.0	27.4	0	54.2	26.3	13.2	35.6	26.3	5.2	36.3	25.0
243	0	39.5	23.2	0	49.9	22.3	8.6	32.2	23.2	2.9	31.7	21.8
296	0	50.7	27.3	0	52.0	26.3	13.1	34.2	26.9	6.5	41.2	25.6
354	0	37.3	22.2	0	45.7	21.3	11.6	32.7	21.9	4.5	34.9	20.5
475	0	37.4	24.9	0	47.5	23.8	12.1	32.4	23.8	5.3	34.5	22.4
478	0	34.6	21.0	0	45.1	20.0	8.7	30.4	21.2	3.0	30.0	19.9
533	0	70.5	23.0	0	70.4	22.2	13.7	32.7	22.4	8.3	32.1	21.3
534	0	54.4	26.9	0	54.9	25.9	14.6	36.2	26.8	5.7	36.7	25.6
543	0	49.8	26.6	0	50.8	25.6	13.1	34.1	24.9	5.9	34.6	23.5
630	13.5	129.3	53.0	0	128.6	53.4	25.1	75.0	53.5	22.6	77.3	54.3
642	0	72.2	39.1	0	73.5	37.6	20.0	51.1	38.0	9.1	53.3	36.5
644	0	62.7	24.8	0	62.7	24.0	14.4	36.8	23.9	7.6	35.3	22.9
655	0	45.0	19.2	0	45.0	18.5	9.7	31.3	18.6	4.9	30.3	17.5
933	0	33.6	15.9	0	34.1	15.1	7.3	28.5	16.2	2.7	27.1	14.9
1003	0	79.7	37.1	0	79.4	36.1	20.6	45.0	35.5	10.7	55.3	34.0

within any tidal channel habitat included in the wetland design for the central portion of the island.

Without the Project, Barren Island would eventually be lost to erosion and submarine wave erosion would increase water depths within current SAV habitat past depths that support SAV. Currently the waters on the east side of Barren Island where SAV occurs are 5 ft (1.5 m) deep or shallower MLW and most SAV beds occur in 1 m or less depth with some existing up to 2 m in depth. Over time, loss of Barren Island would allow for that entire area to become than 6 ft in depth, resulting in the loss of SAV habitat.

4.3.4. Oysters

Within the vicinity of Barren Island there are "natural oyster bars" (NOB), which were formally adopted in 1983 and developed to simplify complex oyster bar boundaries of the historic oyster bar locations, Maryland historic oyster bars, defined as the traditional oyster bar boundaries where watermen have traditionally harvested oysters for centuries (MDNR, 2021d) and Yates Bars, which were oyster bars that were surveyed and named between 1906 and 1911 (MDNR, 1997) (Figure 15). NOB 23-2 is situated northwest of Barren Island. NOB 23-4 is east of Barren Island in Tar Bay. Maryland historic oyster bars include Stone Pile, Great Bay, Tar Bay Channel, Dry Rock, Tar Bay, Possum Island, and White Wood.

Impacts: The only oyster bar that is projected to be negatively impacted by implementation of the preferred alternative is a Maryland Historic oyster bar, Great Bay Bar. The northeast sill is situated in this oyster bar. Great Bay Bar is not a legal NOB and has been mapped as SAV habitat in recent years. The extent of impact to the Great Bay Bar will be determined and incorporated into the final design. Based on MDNR harvest records, Great Bay (bar #4) had a harvest of 10 bushels in November 2019.

The area for foundation replacement includes the partial footprint of the sill within Great Bay oyster bar. Foundation replacement would occur within a trapezoidal-shaped cross-section. Estimated volumes, top and bottom widths, and impact footprint will be determined during the final design stages of the project. A preliminary impact assessment within the Great Bay oyster bar is displayed in Figure 16. The impact could only be avoided by removal of the northeast sill from the Project. However, removal would not reduce the exposure to the island from winds and waves.

In accordance with COMAR 23.02.04.13, dredging is prohibited during certain times of the year to protect shellfish. Mechanical dredging within 500 yards of shellfish areas is prohibited from December 16 through March 14, and June 1 through September 30. Hydraulic dredging within 500 yards of shellfish areas is prohibited from June 1 through September 30. MDNR has also requested time of year (TOY) restrictions for non-dredging activities that are within 500 yards of shellfish resources and have potential to produce significant suspended sediment such as bank grading associated with shoreline stabilization or placement of dredge material for a living shoreline. All of Great Bay bar is within this 500-yard buffer zone from the Project. Dredging for construction of the northeast sill would occur in a later phase of the project (not phase 1). It has not been determined if dredging would be conducted hydraulically or mechanically (see section 4.3.1. for discussion). Coordination with MDNR regarding impacts to Great Bay Bar is ongoing. Under the future without project condition, the island would continue to erode and release sediment into Tar Bay with anticipated negative impacts to Great Bay bar. Further, if Barren Island is lost to erosion at a future time, Great Bay bar would become exposed to open bay energies which could negatively impact its suitability as oyster habitat. It is expected that the benefits this project provides would outweigh the negative effects to the Great Bay bar.

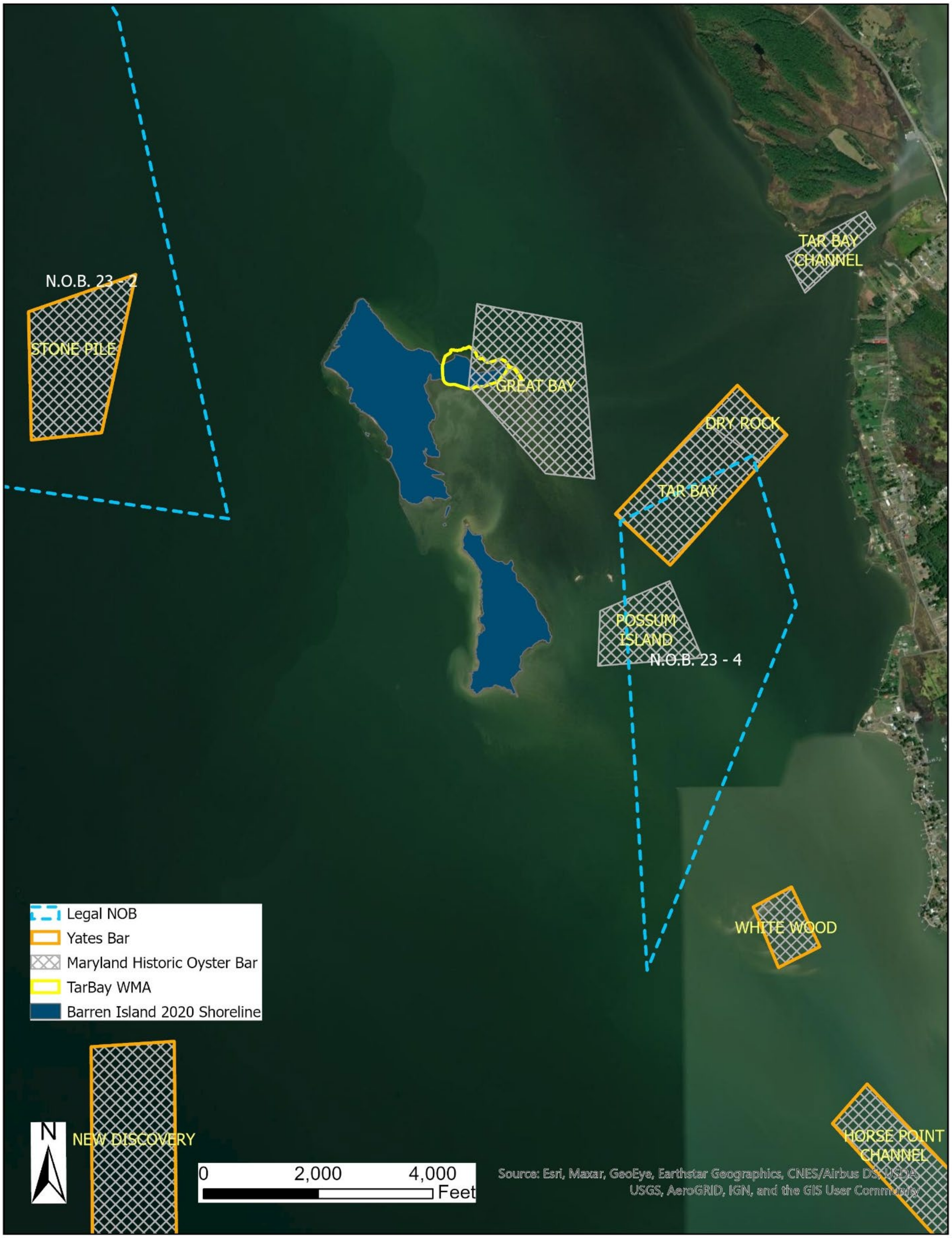

Figure 15. Oyster resources in the vicinity of Barren Island

Figure 16. Impacts to Oyster Resources

In recognition of the direct, long-term impact to oyster resources, planting oysters on the submerged sections of the sill in this area is being considered. Additionally, the extent of the northeast sill will be shortened to reduce the footprint of the sill and subsequent impact within Great Bay bar while still providing some measure of protection to the Tar Bay WMA.

4.3.5. Benthic Macroinvertebrates

The benthic macroinvertebrate assemblage in the Barren Island area is typical of mesohaline, shallow Bay waters. Results of benthic macroinvertebrate surveys conducted in 2002 and 2003 are summarized in the 2009 Feasibility Report. Updated benthic macroinvertebrate surveys were conducted in the summer and fall of 2020, and spring of 2021, from 10 locations in the waters adjacent to Barren Island (Appendix C1, Anchor 2021, Figure 2-3). A complete description of benthic sampling locations, sample dates, and measured water quality parameters is provided in Appendix C1 (Anchor 2021, Table 3-5). Community composition, abundance, and diversity were analyzed and documented for each sample. Additionally, grain size and total organic carbon of sediment samples were determined during the summer seasonal monitoring and sampling event.

4.3.5.1 Habitat Classification

Eight out of ten monitoring locations at Barren were comprised of more than 50% sand; the other locations were comprised of predominately silts and clays (Appendix C1, Anchor 2021, Table 3-6). The bottom salinities measured at all Barren Island benthic sampling locations during the summer, fall, and spring monitoring events were greater than 12 ppt; therefore, each of the Barren Island benthic sampling locations were classified as high mesohaline. There was only one exception at a sampling location southeast of the southern extent which measured bottom salinity at 11.4 ppt; therefore, this one location was classified as low mesohaline.

4.3.5.2 Benthic Community Composition and Metrics

A taxonomic list and abundance (number per square meter) of the benthic fauna collected at the Barren Island benthic sampling locations during the summer 2020, fall 2020, and spring 2021 monitoring events are provided in Appendix C1 (Anchor 2021, Tables 3-7,3-8, and 3-9 respectively). A total of 33 unique benthic taxa were collected during the summer sampling event, 34 unique taxa were collected during the fall sampling event, and 53 unique taxa were collected during the spring sampling event. Bivalves (specifically *Ameritella mitchelli*, *Gemma*, and *Mulinia latera*lis) and polychaetes (specifically *Alitta succinea* and *Mediomastus ambiseta*) were the dominant taxa during the summer sampling event. During the fall sampling event, the bivalve *Ameritella mitchelli* was the dominant taxa at 9 of the 10 benthic community monitoring locations and the reference location, which is directly south of the southern remnant. The dominant taxon in the remaining benthic community for the summer and fall monitoring location was also a bivalve, *Gemma*. The most dominant species identified during both the summer and fall sampling events was the bivalve *Ameritella mitchelli*, representing 25% and 38% of the total count of benthic invertebrate taxa, respectively. The spring sampling event identified similar bivalve species as those in the summer and fall and were also dominant in 9 of the 10 sampling communities. The dominant taxon in the remaining benthic community for the spring survey was a polychaeta (*Mediomastus ambiseta*).

Six metrics were used to describe the overall characteristics of the benthic community at Barren Island—total abundance, unique taxa collected, species richness, species evenness, Simpson's Dominance Index, and the Shannon-Wiener Diversity Index. Results are provided in Appendix C1 (Anchor 2021, Table 3-10). Results for all benthic community metrics measured at the Barren Island benthic community sampling locations were within the range of metrics measured at the Barren Island reference site for the summer, fall, and spring sampling events. Additionally, the high evenness and Shannon-Wiener Species Diversity Indices and low Simpson's Dominance Indices indicate that the benthic community surrounding Barren Island is a diverse community.

4.3.5.3 Chesapeake Bay Benthic Index of Biotic Integrity

The total Benthic Index of Biotic Integrity (B-IBI) score for each location is derived by averaging individual scores for each of the six metrics. A summary of the benthic community metrics and scores used to calculate the Chesapeake Bay B-IBI are presented in Appendix C1 (Anchor 2021, Table 3-11). Only species that met the Chesapeake Bay B-IBI macrofaunal criteria (Versar 2002) were included in the calculation. The B-IBI was derived using data for warmer months and is only indicated for the summer season. However, it was calculated for the fall and spring season for comparative purposes. Total scores for all but the summer season should be used with caution.

The calculated B-IBI scores were low for all Barren Island benthic monitoring locations for summer 2020, fall 2020, and spring 2021 ranging from 1.8 to 2.9, with three exceptions. High scores occurred at Barren Island locations BI-BC-03 during fall 2020 (total B-IBI score of 3.0), BI-BC-06 during summer 2020 (total B-IBI score of 3.2), and BI-BC-07 during summer 2020 (total B-IBI score of 3.7), each of which was classified as meeting the restoration goal. Monitoring location BI-BC-01 received the classification of marginal during the fall and spring monitoring event (total B-IBI scores of 2.9 and 2.7 for fall and spring, respectively). All remaining samples were classified as either degraded or severely degraded. The Barren Island reference site was also classified as severely degraded during the summer sampling event (total B-IBI score of 1.9) and degraded during the fall and spring sampling event (total B-IBI score of 2.2 and 2.3 for fall and spring, respectively; Anchor, 2021a, Table 3-11).

These results were compared to the B-IBI scores calculated from the benthic sampling conducted in 2002 to 2003 and presented in the 2009 Feasibility Report (USACE 2009). During feasibility, total B-IBI scores ranged from 2.2 to 5.0 for all locations at Barren Island, and the total B-IBI calculated for the summer 2002 samples were all greater than 3.0. As a result, the sampling locations were classified to meet restoration goals for all samples during the 2009 Feasibility Report (USACE 2009). B-IBI scores have decreased in the years since the Feasibility Report was conducted and indicate a degradation in benthic habitat quality.

Impacts: There would be direct, long-term, negative impacts to benthic macroinvertebrate habitat within the sill, breakwater, and bird island footprints covering approximately 119.5 ac of shallow, subtidal estuarine habitat. Within that nearly 120-acre impact area, 81.4 ac would be restored to wetlands and would provide value as restored benthic habitat. However, as a result of construction non-motile species would be smothered. Mobile species would likely move from the area during construction. Areas adjacent to the footprint of the preferred alternative would likely experience a short-term, minor, and direct impact characterized by increased turbidity, reduced dissolved oxygen, and possibly a small increase in nutrients as bottom sediments are disturbed during construction. This impact would be expected to subside following the completion of construction. The stone sills and breakwaters constructed would provide structured habitat for colonization by a diverse assemblage of macroinvertebrates.

4.3.6. Fish

An initial survey was conducted in the summer and fall of 2002 and the winter and spring of 2003 for fish and crab species in the proximity of Barren Island. The results are provided in the 2009 Feasibility Report. Updated surveys were completed in the summer and fall of 2020, as well as winter and spring 2021 within the proximal waters around Barren Island. Multiple types of fish collection devices were used for the survey and included, beach seines, bottom trawls, gill nets, and pop nets. A complete breakdown of the methodology, species, size, and amounts can be found in Appendix C1 (Anchor, 2021a). Tables 6 to 9 show the total individuals caught, total number of species caught, as well as a comparison of the 2002-2003 and 2020-2021 survey results for each capture method.

During the 2020-2021 fish surveys, 22 different species of fish and 1 invertebrate were collected throughout the sampling year using the beach seine method (Table 5). This method utilizes nets, operated by hand or small boat to form a circular shape to collect nearshore fish assemblages within the project vicinity. A 100-foot seine net was used to sample the seine locations. The net was deployed in an arc, perpendicular to the shoreline. Two consecutive and adjacent hauls were made at five different locations for a combined shoreline distance of approximately 60 meters. Compared to the 2002-2003 results, 15 new species of fish were captured using this method, and 21 species detected in the Feasibility Report surveys were not captured in 2020-2021. Regarding the most recent surveys to date, the fall 2020 survey resulted in the greatest number of individuals collected, while the lowest number of individuals were observed during the winter 2021 survey. Bay anchovy (*Anchor mitchilli*) and Atlantic silverside (*Menidia menidia*) were overall, the most abundant species captured using the beach seine method, which is similar to the 2002-2003 results. Except for the 2020 fall survey, the 2020-2021 surveys captured a smaller number of species and individuals compared to the 2002-2003 surveys. A winter 2021 survey was not performed using the beach seine capture method (Anchor, 2021a).

Bottom trawling, which involves dragging or towing a net at the very bottom of the sea floor to capture benthic and aquatic species, was another sampling method utilized within the project vicinity (Table 6). Six locations were sampled around Barren Island for the survey and locations were chosen to represent the various types of offshore-zone habitats. Two separate 5-minute otter trawl tows were conducted at each location. The total number of organisms collected during the two trawl tows were summed up to represent 10 minutes of total effort at each station. Compared to the 2002-2003 results, six new species of fish were captured; however, 13 species detected in the feasibility surveys were not captured in 2020-2021. Regarding the most recent surveys to date, the spring 2021 survey resulted in the most individuals collected, while the lowest number of individuals were observed during the fall 2020 surveys. Bay anchovy and spot (*Leiostomus xanthurus*) were among the most abundant species captured using the bottom trawl method (Anchor, 2021a). With the exception of the 2021 spring survey, the 2020-2021 surveys captured a smaller number of species and individuals as compared to the 2002-2003 surveys.

Another capture method used during the surveys included Gill Netting, which are nets attached to poles that are fixed in the substrate or anchored to prevent movement of the net (Table 7). The nets are kept afloat at a specific depth by using a system of weights and/or buoys attached to the nets. Gill nets are used to collect data on fish throughout the water column. Four locations were sampled at Barren Island (one gill net per location). The nets were 100-ft in length with five panels of varying mesh (opening) sizes, ranging from 0.75-inch to 2.5-inch, to target all fish species. Compared to the 2002-2003 results, seven new species of fish were captured using this method, and 17 species detected in the feasibility surveys were not captured during the 2020-2021 surveys. Regarding the most recent surveys to date, the summer 2020 survey resulted in the most individuals collected, while the lowest number of individuals observed were during the spring 2021 surveys. Similar to the results of the 2002-2003 surveys, Atlantic menhaden and spot were among the most abundant species captured (Anchor, 2021a). The 2020-2021 surveys captured a smaller number of species and individuals as compared to the 2002-2003 surveys.

Pop nets were used to collect data on nearshore fish assemblages and blue crab communities within the project vicinity (Table 8). Pop nets are a mechanical spring system that use a 3x3 meter rigid frame with mesh nylon netting. Four pop net stations and eight nets were deployed at Barren Island and placed as close to the beach seine as possible and in areas of SAV, if present. Two pop nets were set at each sampling location to collect two consecutive samples during the daytime high tide. Pop nets were only used for sampling in spring and fall 2003, as well as in summer and spring 2020-2021. Bay anchovy was the most abundant species identified and spot was the only new species observed during the most recent surveys. Seven species detected in the feasibility surveys were not captured in 2020-2021. The spring 2021 survey revealed a steady decline in most species identified in previous surveys using this method (Anchor, 2021a). The 2020-2021 surveys captured a smaller number of species and individuals as compared to the 2002-2003 surveys.

The species caught in the 2020–2021 fisheries surveys were typical of mesohaline areas of the mid-Chesapeake Bay Region. Based on the fisheries survey results, the area around Barren Island is attracting fish in the juvenile and adult life stages. As evident from the beach seine surveys, the habitat immediately adjacent to the island is an important habitat to a variety of juvenile finfish. Overall species diversity appears to have decreased slightly from the 2002–2003 fisheries surveys presented in the 2009 Feasibility Report (USACE 2009). Of note, summer flounder (*Paralichthys dentatus*) were not detected by any of the surveys in 2020–2021 (beach seine, bottom trawl, or gill net) that had identified their presence in 2002–2003. Although survey results were similar, the 2002–2003 fisheries surveys reported greater number of species for all sample gear types. However, bay anchovy, Atlantic menhaden, and Atlantic silverside continue to be present in the greatest numbers.

Impacts: Implementation of the preferred alternative would have a direct, short-term, and minor negative impact on fisheries in the vicinity of Barren Island. Species affected are mobile and would be expected to vacate the project area during construction. These impacts would cease when construction is over. Indirect, short-term, and minor negative impacts could result from disruptions to foraging during construction due to increased turbidity and the possibility that prey may move from the area.

There would also be direct, long-term, and moderate negative impacts to fisheries from conversion of 119.5 ac of shallow, subtidal estuarine habitat to sills, breakwaters, bird islands, and wetlands. Within that nearly 120-acre impact area, 81.4 ac would be restored to wetlands and would provide value as nursery and foraging areas to some fish species. Of the remaining acreage, the sill and breakwater footprint would cover 29.6 ac and 8.5 ac would provide bird island habitat. Implementation of the preferred alternative would conserve the existing Barren Island, and provide an indirect, long-term, positive impact to fisheries resources in the vicinity. Maintaining diverse, connected, terrestrial and aquatic habitats support a diverse food web and ecosystem.

Table 5. Beach Seine Surveys									
Species		**Feasibility Phase**				**PED Phase**			
		2002 Survey		**2003 Survey**		**2020 Survey**		**2021 Survey**	
Scientific Name	**Common Name**	**Summer**	**Fall**	**Winter**	**Spring**	**Summer**	**Fall**	**Winter**	**Spring**
Anguilla rostrata	American eel	1			1	0			0
Brevoortia tyrannus	Atlantic menhaden	2				78	5	1	101
Menidia menidia	Atlantic silverside	1459	45	70	262	58	3376	63	124
Chaetodipterus faber	Atlantic spadefish	2				0			
Fundulus diaphanous	Banded killifish				180		1		0
Anchoa mitchilli	Bay anchovy	4090			251	234	116	3	319
Symphurus plagiusa	Blackcheek toungefish	9				1			
Pogonias cromis	Black drum	4				0			
Callinectes sapidus	Blue crab	108			197	59	11		0
Alosa aestivalis	Blueback herring				43				0
Rhinoptera bonasus	Cownose Ray					1			
Syngnathus floridae	Dusky pipefish				2				0
Gobiidae sp.	Green goby	4				0			
Dorosoma cepedianum	Gizzard Shad							1	
Peprilus alepidotus	Harvest Fish					2			
Trinectes maculatus	Hogchoker	19	6	6	6	0	0	0	0
Menidia beryllina	Inland Silverside						1		3
Hippocampus erectus	Lined seahorse	1				0			
Fundulus heteroclitus	Mummichog	1			54	4	62		75
Gobiosoma bosc	Naked goby	16				0			
Menticirrhus saxatilis	Northern Kingfish						2		
Syngnathus fuscus	Northern Pipefish						1		1
Sciaenops ocellatus	Red drum	137	55			0	57		

Table 5. Beach Seine Surveys									
Species		**Feasibility Phase**				**PED Phase**			
		2002 Survey		**2003 Survey**		**2020 Survey**		**2021 Survey**	
Scientific Name	**Common Name**	**Summer**	**Fall**	**Winter**	**Spring**	**Summer**	**Fall**	**Winter**	**Spring**
Cyprinodon variegatus	Sheepshead minnow				1		40		0
Bidyanus bidyanus	Silver perch	81				12	1		
Gobiesox strumosus	Skilletfish	2	2			0	0		
Menticirrhus americanus	Southern kingfish	166				0			
Leiostomus xanthurus	Spot	4				11	4		50
Cynoscion nebulosus	Spotted seatrout	3				2	3		
Anchoa mitchilli	Striped anchovy	16				4			
Morone saxatilis	Striped bass	1	1	1		0	0	0	
Meiacanthus grammistes	Striped blenny	2				1			
Fundulus majalis	Striped killifish	29	3	10	377	1	12	5	62
Mugil cephalus	Striped mullet		3				0		
Paralichthys dentatus	Summer flounder	2			5	0			0
Clupeiformes sp.	Unknown clupeiform				5				0
Cynoscion regalis	Weakfish	163				5			
Morone americana	White perch	5		1		0		0	15
Pseudopleuronectes americanus	Winter flounder				23				0
Total Individuals		***6327***	***115***	***88***	***1407***	***473***	***3692***	***78***	***750***
Total Number of Species Caught		***26***	***7***	***5***	***14***	***15***	***15***	***5***	***9***

= Species using this method were captured and identified in 2002-2003 investigations but not during the 2020-2021 investigations.

= Species using this method were captured and identified in the 2020-2021 investigations but not during 2002-2003 investigations.

= Species using this method were captured and identified during 2002-2003 and 2020-2021 investigations.

Table 6. Bottom Trawl (Net) Surveys

Species		Feasibility Phase				PED Phase		
		2002 Survey		2003 Survey		2020 Survey		2021 Survey*
Scientific Name	**Common Name**	**Summer**	**Fall**	**Winter**	**Spring**	**Summer**	**Fall**	**Spring**
Alosa pseudoharengus	Alewife		1				0	
Menidia menidia	Atlantic silverside		13				0	
Chaetodipterus faber	Atlantic spadefish	3				0		
Anchoa mitchilli	Bay anchovy	6,400	1		653	0	15	70
Symphurus plagiusa	Blackcheek Tonguefish					3		
Callinectes sapidus	Blue Crab	12				3	4	1
Alosa aestivalis	Blueback herring			1				
Pomatomus saltatrix	Bluefish	1			1	0		0
Hypsoblennius hentz	Feather blenny	1				0		
Dorosoma cepedianum	Gizzard Shad						1	
Gobiidae sp.	Green goby		8				0	
Trinectes maculatus	Hogchoker							
Hippocampus erectus	Lined seahorse	1				0		
Gobiesox strumosus	Skilletfish		1				0	
Leiostomus xanthurus	Spot					2		29
Urophycis regia	Spotted Hake							1
Anchoa mitchilli	Striped anchovy	28				0		
Morone saxatilis	Striped bass		1		1		0	0
Meiacanthus grammistes	Striped blenny	1				0		
Peprilus triacanthus	Butterfish							1
Prionotus evolans	Striped searobin				1			0
Paralichthys dentatus	Summer flounder	2				0		
Cynoscion regalis	Weakfish	5				1		
Total Individuals		***6,454***	***25***	***1***	***656***	***9***	***20***	***102***
Total Number of Species Caught		***10***	***6***	***1***	***4***	***4***	***3***	***5***
	= Species using this method were captured and identified in 2002-2003 investigations but not during 2020-2021 investigations.							
	= Species using this method were captured and identified in the 2020-2021 investigations but not during 2002-2003 investigations.							
	= Species using this method were captured and identified during 2002-2003 and 2020-2021 investigations.							
*No fish were captured using the Bottom Trawl method in Winter 2021								

Table 7. Gillnet Surveys									
Species		Feasibility Phase				PED Phase			
		2002 Survey		2003 Survey		2020 Survey		2021 Survey	
Scientific Name	Common Name	Summer	Fall	Winter	Spring	Summe	Fall	Winter	Spring
Alosa pseudoharengus	Alewife	1				0		3	
Microgonias undulatus	Atlantic croaker	33			29	0			0
Clupea harengus	Atlantic herring			2				0	
Limulus polyphemus	Atlantic horseshoe crab				9				0
Brevoortia tyrannus	Atlantic menhaden	117	3	5	41	71	0	4	3
Symphurus plagiusa	Blackcheek tonguefish	1				0			
Callinectes sapidus	Blue Crab	15	4		11	17	0		0
Alosa aestivalis	Blueback herring			12				0	
Pomatomus saltatrix	Bluefish	43			4	4			0
Dorosoma cepedianum	Gizzard shad					13	2		
Peprilus alepidotus	Harvest Fish					2			1
Alosa mediocris	Hickory Shad								
Trinectes maculatus	Hogchoker	5			2	0			0
Synodus foetens	Inshore lizardfish	14				0			
Ammodytes dubius	Northern Sand Lance					1			
Sciaenops ocellatus	Red drum	3				0			
Bidyanus bidyanus	Silver perch	27				1			
Menticirrhus americanus	Southern kingfish	10				0			
Scomberomorus maculatus	Spanish mackerel					5			
Leiostomus xanthurus	Spot	99			66	98	6		2
Morone saxatilis	Striped bass		4	65	8	2	0	0	0
Mugil cephalus	Striped mullet								

Table 7. Gillnet Surveys									
Species		**Feasibility Phase**				**PED Phase**			
		2002 Survey		**2003 Survey**		**2020 Survey**		**2021 Survey**	
Scientific Name	**Common Name**	**Summer**	**Fall**	**Winter**	**Spring**	**Summe**	**Fall**	**Winter**	**Spring**
Paralichthys dentatus	Summer flounder	1				0			
Cynoscion regalis	Weakfish	54			1	0			0
Morone americana	White perch		7	5	1		0	0	0
Total Individuals		***423***	***18***	***89***	***172***	***214***	***8***	***7***	***6***
Total Number of Species Caught		***14***	***3***	***4***	***10***	***10***	***2***	***2***	***3***
(red)	= Species using this method were captured and identified in 2002-2003 investigations but not during the 2020-2021 investigations.								
(green)	= Species using this method were captured and identified in the 2020-2021 investigations but not during 2002-2003 investigations.								
(blue)	= Species using this method were captured and identified during 2002-2003 and 2020-2021 investigations.								

Table 8. Pop Net Surveys

Species		Feasibility Phase		PED Phase	
		2003 Survey		2020 Survey	2021 Survey
Scientific Name	Common Name	Spring	Fall	Summer	Spring
Strongylura marina	Atlantic needlefish	5	35		0
Menidia menidia	Atlantic silverside	28	31	9	0
Anchoa mitchilli	Bay anchovy		135	199	
Callinectes sapidus	Blue crab	10	4	6	0
Alitta succinea	Clam worm	3			0
Pentidotea resecata	Eelgrass isopod	2	51		0
Apeltes quadracus	Fourspine stickleback		3		
Palaemonetes paludosus	Grass shrimp	268	777		0
Gobiosoma bosc	Naked goby		7		
Amphipoda	Scud	8			0
Gobiesox strumosus	Skilletfish		2		
Leiostomus xanthurus	Spot				8
Anchoa mitchilli	Striped anchovy		8		
Cynoscion regalis	Weakfish	16			
Total Individuals		***340***	***1,053***	***214***	***8***
Total Number of Species Caught		***8***	***10***	***3***	***1***

= Species using this method were captured and identified in 2002-2003 late season investigations but not during the 2020-2021 summer

= Species using this method were captured and identified in the 2020-2021 investigations but not during 2002-2003 investigations.

= Species using this method were captured and identified during 2002-2003 and 2020-2021 investigations.

4.3.7. Bivalves

Two commercially important clams, soft-shell and razor clams, are found in the vicinity of Barren Island. Bivalve surveys were conducted at four locations around Barren Island on December 14, 2020. Four transects approximately 100 to 200m in length were surveyed. Soft-shell and razor clam surveys identified razor clams as more prevalent than soft-shell clams. Survey results as well as water quality parameters, including temperature, DO, salinity, and pH, were measured at each transect and are provided in Appendix C1 (Anchor, 2021a, Table 3-17).

Barren Island surveys identified 15 legal soft-shell clams (no soft-shell clams less than 2 inches in length were identified), 267 razor clams, and 25 oysters. There were no locations in the Barren Island survey with a productive natural clam bar ranking as defined by the Maryland Code of Regulations (COMAR) 08.02.08.11 criteria (producing 500 hard-shell clams per hour, one-half bushel of soft-shell clams per hour, or one-half bushel of razor clams per hour).

Impacts: No impacts to razor or soft-shell clams are anticipated from implementation of the preferred alternative. These species are not anticipated to be in the waters along the shoreline of Barren Island where the preferred alternative would be implemented.

4.3.8. Commercially Important Species and Commercial Fisheries

The Chesapeake Bay is the location of one of the leading fishing industries in the world. The fishing industry is a key component to local and national economics by providing for jobs and tourism. According to a 2019 Fisheries Economics of the U.S. report by NOAA, between 2018 and 2019, Maryland's landings value increased from $68,410,000 to $76,002,000. For 2019, MDNR reports the commercial landings value of Maryland's seafood industry was $77,986,106 (NMFS 2021). In the 2019 report, NOAA identifies that Maryland ranked third in the Middle Atlantic region for number of seafood processers and wholesalers (69), behind New York (304) and Virginia (112). In the 2017 NOAA report (most current year data is available), the total landings revenue supported 13,292 jobs added and $1,389,123 in sales (NMFS, 2018). Commercially and recreationally important finfish species identified during the 2020 fisheries surveys include blue crab (*Callinectes sapidus*), Atlantic menhaden (*Brevoortia tyrannus*), Atlantic silverside (*Menidia menidia*), Bay anchovy (*Anchoa mitchilli*), and striped bass (*Morone saxatilis*) (Anchor, March 2021), along with Eastern oysters (*Crassostrea virginica*).

4.3.8.1 Blue Crabs

The waters around Barren Island are a prime crabbing area. Crabbing is primarily conducted using crab pots. There is very little trot lining for crabs in the waters around Barren Island. Crab pot surveys conducted during the feasibility study are summarized in the 2009 Feasibility Report (USACE 2009). Updated crab pot surveys in the vicinity of Barren Island were conducted in August 2020, September 2020, May 2021, June 2021, and July 2021. The survey area included the Barren Island Project restoration area with an additional 0.25-mile perimeter. The goal of the survey was to document visible buoys marking the location of high use pots with GPS coordinates. Survey results are summarized in Table 9. Complete results and maps are available in Appendix C1 (Anchor, 2021a, Figures 3-1 to 3-5).

In August 2020, 499 crab pots were observed surrounding Barren Island. The majority of the crab pots were observed south of the island, with fewer crab pots observed immediately west and north. No crab pots were observed east of the island.

The September 2020 survey observed 83 crab pots. The crab pot distribution was similar to the August survey, with most crab pots located south of the southern remnant. Again, no crab pots were observed east of the island.

A total of 533 crab pots were counted during the May 2021 survey. One hundred and ninety-two (192) crab pots were located on the north side of the island, with the remaining in the southern project area. A cluster of 231 crab pots were observed due west of the southern part of the island. A dense cluster containing 110 crab pots was located southeast of the island.

In the June 2021 survey, a total of 277 crab pots were observed. One hundred and twenty (120) crab pots were located along the west side and immediately north of Barren Island. The remaining 157 crab pots were located south of Barren Island.

The July 2021 survey documented a total of 264 crab pots. One hundred and ninety-eight (198) crab pots were located along the west side and immediately north of Barren Island. The remaining crab pots were located south of Barren Island.

Table 9. Summary of 2020 – 2021 Crab Pot Surveys

Date of Survey	Number of crab pots observed	Primary location of crab pots
August 30, 2020	499	South; some west and north
September 29, 2020	83	South of southern remnant
May 18, 2021	533	North and southeast
June 23, 2021	277	West and north
July 22, 2021	264	West and north; some south

Impacts: No negative impacts to blue crabs are anticipated as a result of implementing the preferred alternative. Wetland restoration and preserving conditions for SAV habitat would be expected to benefit blue crab populations.

Implementation of the preferred alternative is expected to have potential direct, short-term, and long-term, negative impacts on commercial crabbing in the waters directly adjacent to Barren Island. Crabbers who utilize the Bay bottom within the footprint of the sills, breakwaters, and bird islands would be permanently displaced from those fishing areas. Construction is expected to cause a short-term disruption to crabbing activity based on proximity of crab pots to construction activities. As all construction would be close to the Barren Island shoreline or extend south from the southern tip of the island, this impact is not expected to affect many crabbers, but does have the potential to displace any activity within the nearshore waters. It is expected that the crabbing activity would relocate to other locations in the region.

4.3.8.2 Pound Nets

Pound nets are used by commercial fisherman in the Barren Island vicinity. There are four registered pound nets along the Barren Island shoreline and nearshore waters.

Impacts: There would be direct, long-term negative impacts to three of the four-pound net locations. These three pound nets lie within the sill and breakwater alignments of the preferred alternative and would be permanently displaced. Only one of these pound nets is identified as being active by MDNR. The fourth pound net would experience a direct, short-term, negative impact due to potential disruptions during construction. This pound net is off the western shore of Barren outside the preferred alignment. Construction may disrupt fish activity and affect use of this pound net. Impacts would be expected to cease when construction is complete.

4.3.9. Essential Fish Habitat

"Pursuant to Section 305(b)(2) of the Magnuson-Stevens Fishery Conservation & Management Act, the Corps of Engineers is required to prepare an Essential Fish Habitat (EFH) Assessment for all proposed actions that occur within coastal waters of the United States" (Magnuson-Stevens, 2007). EFH includes habitats such as wetlands, reefs, seagrass, rivers, and coastal estuaries that fish can spawn, breed, feed, and grow to maturity (USFWS 2021). Prior coordination with NMFS during the 2009 Feasibility Report, in 2017 to complete the Record of Decision, and during the current project phase, identified that the proposed project lies within waters designated as EFH for the following species and their life stages:

- Windowpane flounder (*Scopthalmus aquosos*), juvenile and adult stages;
- Bluefish (*Pomatomus saltatrix*), juvenile and adult stages;
- Summer flounder (*Paralicthys dentatus*), larvae, juvenile and adult stages;
- Atlantic butterfish (*Peprilus triancanthus*), eggs and larvae stages;
- Black sea bass (*Centropristus striata*), juveniles and adults;
- Scup (*Stenotomus chrysops*), juveniles and adults; and
- Clearnose skate (*Raja eglanteria*), juveniles and adults.

Sampling during the feasibility study and the current project phase has provided information on the presence of these species in the Barren Island vicinity. Although no butterfish of any life stage were identified in the 2002–2003 sampling, updated seasonal fish surveys in 2020–2021 document the presence of one Atlantic butterfish in spring 2021 bottom trawl sampling. Bluefish juveniles and adults were among the most frequently caught fish in Barren Island waters in sampling conducted for the study in 2002-2003. Several bluefish were caught in summer 2020 and spring 2021 sampling. The 2002–2003 fish surveys identified summer flounder as a minor component (0.06%) of the fish community in the vicinity of Barren Island (MPA, 2005) (no larvae, 10 individuals in summer sampling), but no summer flounder were detected in 2020–2021 sampling. No black sea bass, scup, windowpane flounder, or clearnose skate were captured in any sampling conducted for the project.

The full EFH Assessment is provided in Appendix F2. A summary is provided in the following text. Barren Island area waters constitute EFH for adult and juvenile summer flounder, and adult and juvenile bluefish (in occasional years) based upon EFH habitat preferences and documented occurrences. Accordingly, potential effects to summer flounder EFH are of principal importance for this assessment to ensure compliance with the Magnuson-Stevens Fishery Conservation and Management Act, followed by potential effects to bluefish EFH.

Impacts: The proposed project would convert EFH at Barren Island (entire project area is shallow water habitat) to rock structures, tidal wetlands, and bird island habitat, which would result in a net loss of EFH for summer flounder and bluefish. The marshes and tidal creeks to be created as part of island restoration at Barren would support juveniles of summer flounder and bluefish, as well as a wide variety of their forage species. The creation of this habitat is expected to compensate somewhat for loss of open water and benthic habitats. SAV habitat, which constitutes designated Habitat Areas of Particular Concern (HAPC) for summer flounder, occurs in the area. The preferred alternative would negatively impact 0.4 to 31.7 ac of potential SAV habitat. However, the Project would benefit SAV habitat over the long-term. This would occur principally by reducing wave erosion in Tar Bay, which would otherwise erode the bottom to the active wave depth over time (approximately 6 ft) over an approximately 1,325-acre area. It is expected that SAV habitat would be severely degraded and eventually lost without the proposed conservation of Barren Island and the protection of SAV habitat in Tar Bay.

Barren Island area waters do not appear to constitute EFH (or are perhaps only infrequent or transient EFH) for Atlantic butterfish, black sea bass, scup, windowpane flounder, and clearnose skate. Potential project effects upon these species for which the Barren Island area does not likely constitute EFH are of minimal or negligible concern with respect to the Magnuson-Stevens Act.

USACE-Baltimore has determined that the proposed action would not have a substantial adverse effect on EFH, HAPC, or on species with designated EFH in the project area. Overall, direct, secondary, and cumulative impacts to EFH, associated species, and HAPC would be minimal, and, in the long term, the current project and proposed expansion would enhance some habitat features for species managed under the Magnuson-Stevens Act.

4.3.10. Rare, Threatened and Endangered Species

Extensive biological surveys have been performed and described in previous sections to prepare for the Barren Island Project and to protect and preserve threatened and endangered species (T&E). USACE consulted with Federal and state agencies including USFWS, NMFS, and MDNR on the potential impacts to rare, threatened, and endangered species. USFWS has provided a draft Planning Aid Report (PAR) that identifies species utilizing the habitat within the project area (Appendix F3, *Draft Planning Aid Report: Mid-Chesapeake Bay Island Ecosystem Restoration Project*) (USFWS 2021). Several T&E species were identified through the USFWS Information for Planning and Consultation (IPaC) report (included with the PAR):

- Eastern black rail (*Laterallus jamaicensis jamaicensis),*
- Atlantic Sturgeon (*Acipenser oxyriynchus oxyriynchus*),

- Green Sea Turtle (*Chelonia mydas*),
- Kemp's Ridley Sea Turtle (*Lepidochelys kempii*),
- Leatherback Sea Turtle (*Dermochelys coriacea*), and
- Loggerhead Sea Turtle (*Caretta caretta*).

Surveys conducted in 2020 and 2021 did not identify the presence of any listed species. Bald eagle, which is now delisted, was the only federally listed T&E species identified at Barren in surveys conducted during the feasibility phase (2002 – 2003). Additionally, in feasibility surveys, Eastern narrow-mouthed toad (*Gastrophryne carolinensis*), a state endangered amphibian species and three state endangered avian species: Wilson's plover (*Charadrius wilsonia*), royal tern (*Thalasseus maximus*), and sedge wren (*Cistothorus platensis*), were identified at Barren Island. Of these species, only royal terns were identified in current surveys (September 2020 timed surveys).

Impacts: No impacts to rare, threatened, or endangered species are expected as a result of implementing the preferred alternative. USACE expects a concurrence with a determination of may affect not likely to adversely affect for the project. Although the project will enhance and provide ample habitat for these species, precautions are continually made in order to not disrupt current habitats (USFWS, 2021). Wetland restoration would benefit at-risk species especially restoration of high marsh areas. Restoration of high marsh may benefit salt-marsh sparrow. USFWS is reviewing the saltmarsh sparrow's status and, by the end of September 2023, will decide whether or not the saltmarsh sparrow warrants protection under the Endangered Species Act.

4.4 Terrestrial Resources

4.4.1. Terrestrial Habitats

Most non-wetland or dry, terrestrial habitats are located on the northern remanent within the interior of the island. Table 10 provides acreage of wetlands and non-wetlands habitats on Barren Island. Several upland areas include fill material from past dredged material deposition and construction of the existing airstrip (Barren Final Consolidated Report, 2005). Loblolly pine (*Pinus taeda*), American holly (*Ilex opaca*) and sweet gum (*Liquidambar styraciflua*) trees populate most of the upland areas. The understory and herbaceous layers are relatively sparse, which is likely due to the acidic nature of pine needles that shed from the loblolly pines. Several signs of terrestrial wildlife species were identified during an initial avian and predatory mammals survey in January 2021, conducted by the USDA's Animal and Plant Health Inspection Service (APHIS). Species were identified by sampling locations and camera traps placed throughout the two remnants. Identified mammals included red fox (*Vulpes vulpes*), raccoon (*Procyon lotor*), river otter (*Lontra canadensis*), white-tailed deer (*Odocoileus virginianus*), and muskrat (*Ondatra zibethicus*) (APHIS, 2021). Herpetofauna identified included box turtle (*Terrapene carolina*), diamond back terrapin (*Malaclemys terrapin*), spotted turtle (*Clemmys guttata*), black rat snake (*Pantherophis alleghaniensis*), and black racer snake (*Coluber constrictor*), as well as evidence of Eastern mud (Kinosternon subrubrum) or Eastern musk (*Sternotherus odoratus*) turtle (APHIS, 2021). A bald eagle (*Haliaeetus leucocephalus*) nest was observed in a loblolly pine tree on the eastern part of the northern remnant during a September 2020 field investigation. The full list of terrestrial species identified during surveys is available in Appendix C2.

Impacts: No negative impacts are anticipated to terrestrial habitats as a result of implementing the preferred alternative. Maintaining freshwater ponding and wetlands on Barren Island would allow for continued use of the island by spotted turtles (USFWS 2021). Terrestrial habitats would be lost to erosion without further efforts to stabilize Barren Island. Implementation of the preferred alternative would restore two nesting bird islands, at 3.4 and 4.9 ac in size. These islands would provide critically needed habitat for nesting waterbirds.

Table 10. Barren Island Habitat Coverage

Habitat Type	Northern Remnant (ac)	Southern Remnant (ac)	Total (ac)
***Wetlands**			
PEM		13.9	***13.9***
E2FO	1.7		***1.7***
E2SS		8.7	***8.7***
E2EM	67.3	21.5	***88.7***
EUS	4.2	0.6	***4.8***
Total Wetland Acreage			***117.9***
Beach	2.1	1.4	***3.4***
Upland	12.3	2.2	***14.5***
Stream	1.88/2,411 lf		***1.88/2,411 lf***
*E2FO - Estuarine, Intertidal, Forested			
E2SS - Estuarine, Intertidal, Scrub-Shrub			
E2EM - Estuarine, Intertidal, Emergent			
EUS - Estuarine, Unconsolidated Shore			
PEM - Palustrine, Emergent			

4.4.2. Terrestrial Vegetation

Habitats and vegetation described in the Mid-Bay Feasibility Report (USACE, 2009) and Barren Final Consolidated Report (MDOT MPA, 2005a) are consistent with the dominant vegetation and current habitats observed on both remnants of Barren Island during recent surveys. Table 11 below contains a list of dominant vegetation observed during field investigations conducted in 2020 and 2021.

Table 11. Dominant Vegetation on Barren Island (2020-2021)

	Common Name	*Scientific Name*
Trees	American Holly	*Ilex opaca*
	American Sycamore	*Platanus occidentalis*
	Black Cherry	*Prunus serotina*
	Black Willow	*Salix nigra*
	Common Persimmon	*Diospyros virginiana*
	Eastern Red Cedar	*Juniperus virginiana*
	Hackberry	*Celtis occidentalis*
	Loblolly Pine	*Pinus taeda*
	Sweetgum	*Liquidambar styraciflua*
	White Mulberry	*Morus alba*
Shrubs	Groundsel-Tree	*Baccharis halimifolia*
	Northern Bayberry	*Myrica pensylvanica*
Herbaceous	Arrowhead	*Sagittaria latifolia*
	Black Needlerush	*Juncus roemerianus*
	Bottlebrush Grass	*Hystrix patula*
	Broomsedge	*Andropogon virginicus*
	Common Cattail	*Typha latifolia*
	Common Milkweed	*Asclepias syriaca*
	Common Reed	*Phargmites australis*
	Giant Foxtail Grass	*Setaria faberi*
	Japanese Stiltgrass	*Microstegium vimineum*
	Narrow Leaved Cattail	*Typha augustifolia*
	Pickerel Weed	*Ponterderia cordata*
	Reed Canary Grass	*Phalaris arundinacea*
	Saltmarsh Aster	*Aster tenuifolius*
	Saltmarsh Bulrush	*Bolboschoenus maritimus*
	Saltmarsh Cockspur	*Cenchrus tribuloides*
	Saltmarsh Cordgrass	*Spartina alterniflora*
	Saltmeadow Cordgrass	*Spartina patens*
	Soft Rush	*Juncus effusus*
	Switchgrass	*Panicum virgatum*
	Woolgrass	*Scirpus cyperinus*
Vines	Common Raspberry	*Rubus* sp.
	Fox Grape	*Vitis labrusca*
	Greenbriar	*Smilax rotundifolia*
	Japanese Honeysuckle	*Lonicera japonica*
	Oriental Bittersweet	*Celastrus orbiculatus*
	Poison Ivy	*Toxicodendron radicans*
	Trumpet Creeper	*Campis radicans*

Impacts: No impacts are anticipated to terrestrial vegetation as a result of implementing the preferred alternative. However, terrestrial vegetation would be lost if the habitats continue to erode without further efforts to stabilize Barren Island.

4.4.3. Avifauna

Avian surveys completed in 2002 and 2003 for the 2009 Feasibility Report are summarized in the 2009 EIS. In 2020 and 2021, updated avian surveys of Barren Island were conducted to document species and numbers of nesting birds. Multiple surveys were conducted from September 2020 through October 2021. The baseline survey will be used to evaluate the number and diversity of waterfowl in the vicinity of Barren Island after post-construction and restoration is completed.

A number of surveys were completed to capture the avian community at Barren Island. Point count surveys were completed in September (summer) 2020 and May (spring) 2021 at five sampling locations (Anchor, 2021a). At each sampling location, two 15-minute timed observations were conducted to provide a survey of the entire 360° viewshed. The five sampling locations at Barren Island were based on site conditions, access, and best representation of habitats. The surveys aimed to include a variety of different habitats such as forest, scrub-shrub, salt marsh, open water, and shoreline. Reoccurring point surveys at 8 locations, flush surveys at 4 transects, and opportunistic surveys were completed in January, February, March, April, August, September, and October 2021 on Barren Island (APHIS, 2021). Additionally, Saltmarsh Habitat and Avian Research Program (SHARP) point count and callback surveys were conducted in May and June 2021 (Audubon, 2021).

All avian survey reports and data are provided in Appendix C2. The results of the point count surveys are provided in Appendix C1 and C2, and opportunistic and flush counts in Appendix C2. Full results of the SHARP surveys are provided in Appendix C3. A summary of all bird survey data is provided in Appendix C4.

Results across all surveys have identified 91 species and 5,451 individuals at Barren Island as summarized in Table 12. In the summer 2020 timed survey a total of 37 species and 2,490 individuals were observed at Barren Island. Brown pelican (*Pelecanus occidentalis*; 1,192 individuals) and double-crested cormorant (*Phalacrocorax auritus;* 723 individuals) accounted for more than 75% of all observations made during the surveys. Three migrating shorebird species were identified during the summer 2020 survey, which included the semipalmated plover (*Charadrius semipalmatus*), sanderling (*Calidris alba*), and spotted sandpiper (*Actitis macularius*). A total of 627 birds from 40 different species were observed during the May 2021 timed survey. Double-crested cormorants were observed in the greatest abundance, accounting for 37% of all observations made (236 individuals). One summer resident shorebird species, willet (*Tringa semipalmata*), and one migratory shorebird species, semipalmated plover, were observed on the northern remnant of Barren Island during the spring timed surveys. Focused on saltmarsh habitat, the May and June 2021 SHARP surveys, documented 37 species. Red-winged blackbird were the most abundant (29%), followed by clapper rail (*Rallus crepitans*) (11%), great blue heron (*Ardea herodias)* (9%), and least sandpiper (*Calidris minutilla*) (8%).

The number of individuals and species were higher is 2020 and 2021 surveys compared to those conducted in 2002 and 2003. The number of birds observed during the spring 2021 survey is approximately two times greater than the 2002 survey, likely due to the high number of double-crested cormorants observed during the 2021 survey. In both surveys, double-crested cormorant, great blue heron, and great egret were present in the greatest abundances. Greater diversity was observed during the 2021 survey, with 40 species recorded during the 2021 survey compared to 20 bird species recorded in the 2003 survey (USACE 2009). During the summer 2002 survey, a total of 230 birds were observed at Barren Island. The number of birds observed during the summer 2020 survey is approximately an order of magnitude greater than the 2002 survey. Most of this is likely due to the high numbers of brown pelican and double-crested cormorant observed during the 2020 survey (totaling 1,915 individuals). Additionally, 37 species were observed in the summer 2020 survey, as compared to 16 bird species in the 2002 survey (USACE 2009).

Raptor species (osprey [*Pandion haliaetus*] and bald eagle) were identified along with several nests in the summer 2020 survey. Twenty-three bald eagles and 37 ospreys were observed during the spring 2021 timed surveys. Multiple raptor nests were observed on Barren Island, including several osprey nests and one bald eagle nest on each island remnant. Other osprey nests were observed on channel marker structures near the island. Bald eagle nest building typically occurs between early December and early March, followed by egg laying/incubation between late January and early May, hatching/rearing of young between late February and early July, and fledging of young between late May and late August. The project will continue to consider the protection standards for bald eagles, which includes time-of-year restriction from construction activities (December to June); habitat/nest protection buffers (330-foot and 660-foot zones); and Important High Eagle Use Areas such as communal roosts/concentration areas.

Barren Island plays host to a variety of both resident and migratory bird species as identified in the surveys. Most songbirds observed were year-round or summer residents using the scrub-shrub and forest habitat on the island. Barren Island does play a role in providing a stopover point for resting and foraging migratory birds. The late summer survey (September) did not provide evidence of breeding birds presence on Barren Island, which may be due in part to the date the survey was conducted. However, evidence of breeding was confirmed during the timed surveys or incidentally for many of these species, including eastern kingbird, brown-headed nuthatch, Carolina wren, eastern bluebird (*Sialia sialis*), European starling (*Sturnus vulgaris*), common grackle (*Quiscalus quiscula*), boat-tailed grackle (*Quiscalus major*), red-winged blackbird (*Agelaius phoeniceus*), and northern cardinal. Downy woodpecker (*Picoides pubescens*) was the only species of woodpecker observed during the spring 2021 surveys, and breeding was confirmed in the pine forests on the northern remnant (Anchor, 2101a). Fourteen species were confirmed as breeding on the two Barren Island remnants, and several other species were observed that are likely to breed on the island.

Barren Island is located within a MDNR Sensitive Species Project Review Area noted to feature colonial water bird nesting. Two multi-species colonial water bird nesting sites including a heron rookery were noted on the southern remnant during avian surveys conducted in 2003 and 2004 (BBL 2004). Based on MDNR surveys, great blue heron, brown pelican, and gulls nested on Barren Island in the early 2000s. The nesting sites have diminished due to erosion over the past 20 years. However, the heron rookery was observed on the island and nests of great blue heron and great egret were observed during the summer 2021 survey throughout the southern remnant of Barren Island, indicating that nearly the entire southern remnant serves as a rookery for these species. Great blue herons accounted for approximately 10% of the total number of birds observed during the spring 2021 timed surveys.

The Atlantic Coast Joint Venture (ACJV), a regional partnership company that collaborates to restore and sustain native bird populations and habitats throughout the Atlantic Coast region, has identified the project area as a landbird, shorebird, waterbird, and waterfowl focus area. The bay and wetlands in the project area support ACJV priority species such as bald eagle, black scoter (*Melanitta nigra*), clapper rail, dunlin (*Calidris alpine arcticola*), golden eagle (*Aquila chrysaetos*), lesser yellowlegs (*Tringa flavipes*), long-tailed duck (*Clangula hyernalis*), northern gannet (*Morus bassanus*), purple sandpiper (*Calidris maritima*), red-breasted merganser (*Mergus serrator*), red-throated loon (*Gavia stellate*), ruddy turnstone (*Arenaria interpres morinella*), seaside sparrow (*Ammodramus maritimus*), semipalmated sandpiper (*Calidris pusilla*), surf scoter (*Melanitta perspicillata*), and white-winged scoter (*Melanitta fusca).* Species that have been identified as present and breeding in the project area but are terrestrial and/or not likely to be found breeding in the project area include black-billed cuckoo (*Coccyzus erythropthalmus*), bobolink (*Dolichonyx oryzivorus*), common loon (*Gavia immer*), prairie warbler (*Dendroica discolor*), prothonotary warbler (*Protonotaria citrea)*, red-headed woodpecker (*Melanerpes erythrocephalus*), and wood thrush (*Hylocichlia mustelina*) (ACJV 2008, USFWS 2021).

Saltmarsh sparrow has experienced an 80 percent decline in its population size during the past 15 years. They nest in high marsh grasses, just above mean high tide. However, due to increasing sea levels, the species has not been able to keep up with the higher frequency of flooding as well as the higher water levels. The Saltmarsh Sparrow Habitat Prioritization Tool has designated the Barren Island project area as the only site with high-quality habitat for Saltmarsh Sparrow (ACJV Saltmarsh Sparrow 2020).Similar to saltmarsh sparrow, seaside sparrow nest in high marsh and are threatened by habitat degradation and rising sea levels. Seaside sparrow (*Ammodramus maritimus*) is a relatively common species found within its limited range on the east coast. No seaside sparrows or saltmarsh sparrows were identified by the SHARP surveys, but one seaside sparrow was identified in the August point count survey and one in each of the September and October flush surveys (APHIS, 2021). One marsh wren was also identified in the August point count survey (APHIS, 2021).

Although it was once one of the most abundant dabbling ducks in North America, the American black duck had lost more than half of their population by the 1980s. Since then, populations have stabilized, but are still below objectives set by the 2018 North American Waterfowl Management Plan (NAWMP 2018). The ACJV Prioritization Tool for American black duck has identified the bay and wetlands within the project area as prioritized habitat, and more specifically as a Maintenance Hydrologic Unit Code (HUC), which currently contains enough food to support population objectives. HUC data sets are used to aggregate population objectives specific to each 12-digit HUC in the watershed. Seven American black duck were identified in opportunistic surveys conducted in 2021 (APHIS, 2021).

Another ACJV priority species, clapper rails were common in the SHARP surveys. Three clapper rails (*Rallus crepitans*) were also seen or heard within saltmarsh habitat on the island in the September 2020 timed point counts (Anchor, 2021a). This species likely breeds on the Barren Island remnants.

Priority species identified at Barren Island in the updated survey work include bald eagle, clapper rail, semipalmated plover, and seaside sparrow.

Table 12. Summary of Avian Survey Results: Number of Observations

	APHIS (Jan - Oct 2021 compiled)				*Anchor QEA*			*Audubon*
	Point Count (>50 m)	**Point Count** (<50 m)	**Flush Count**	**Opportunistic**	**Point Count – Summer 2020**	**Point Count - Spring AM 2021**	**Point Count - Spring PM 2021**	**SHARP Callback Count Survey 2021**
American Bittern				1				
American Black Duck				7				
American Crow	4			2	6	4	1	2
American Goldfinch		2					1	
American Redstart		1			1			
Bald Eagle	10	2		9	11	12	11	2
Bank swallow					9			
Barn Swallow		5			217	7		2
Belted Kingfisher				1				
Black-and-white Warbler		1			2			
Blackburnian Warbler								1
Black-crowned Night-Heron		1						1
Blackpoll Warbler								1
Blue Grosbeak	1							
Blue-gray gnatcatcher					2			
Boat-tailed grackle						13	11	12
Bobolink					1			
Brown Pelican	5			282	1192		25	

	APHIS (Jan - Oct 2021 compiled)				Anchor QEA			Audubon
	Point Count (>50 m)	Point Count (<50 m)	Flush Count	Opportunistic	Point Count – Summer 2020	Point Count - Spring AM 2021	Point Count - Spring PM 2021	SHARP Callback Count Survey 2021
Brown-headed Cowbird	4	2				2		
Brown-headed Nuthatch	1	25		2	3	1		
Bufflehead	2			16				
Canada Goose	147							1
Carolina Chickadee		5				2		2
Carolina Wren	14	43		3	10	8	3	15
Chimney Swift								1
Clapper Rail	1		1	1	3	8		29
Common Grackle		1				4	5	3
Common Yellowthroat	2				1			4
Common/Forster's tern						3	2	
Cooper's Hawk	2	1						
Double-crested Cormorant	154	89		270	723	89	147	1
Downy Woodpecker		1		1		1		
Eastern Bluebird	3	23		5		1		
Eastern Kingbird	2	7		1	1	5	5	9
Eastern Phoebe		3						
Eastern wood-pewee					1	1		
European Starling		17				2	4	1
Forster's Tern	3	22			62		2	
Glossy ibis							5	
Golden-crowned Kinglet		14						
Gray Catbird		1		1	1			
Great black-backed gull					5		2	
Great Blue Heron	54	46	2	186	18	32	31	23
Great Crested Flycatcher		3			3	6	2	6
Great Egret	36	43			15	21	15	4
Greater Yellowlegs	2							
Green Heron		1						
Herring Gull	4				17	2	1	

	APHIS (Jan - Oct 2021 compiled)				Anchor QEA			Audubon
	Point Count (>50 m)	Point Count (<50 m)	Flush Count	Opportunistic	Point Count – Summer 2020	Point Count - Spring AM 2021	Point Count - Spring PM 2021	SHARP Callback Count Survey 2021
Laughing Gull	1	1			106		1	
Least flycatcher					1			
Least sandpiper								21
Least tern						1		
Mallard				4				5
Marsh Wren		1						
Mute Swan				2				
Northern Cardinal	7	28		5	9	3	2	4
Northern Flicker	2	1		2				
Northern Mockingbird	2	1				2	1	1
Northern Parula								1
Orchard Oriole						3	1	6
Osprey	11	15			27	17	20	3
Pine Warbler	1				3	5		6
Prairie Warbler								1
Purple Martin		3						4
Red-bellied Woodpecker		1		2				
Red-eyed Vireo		6				2		
Red-winged Blackbird	21	29	7	2	6	21	20	75
Ring-billed gull					3			
Royal Tern	3				10	3		
Ruby-crowned Kinglet		2						
Ruby-throated Hummingbird	1	3			4			
Sanderling		20			6			
Seaside Sparrow		1	2					
Semipalmated plover					2	5		
Song Sparrow	2	28		2				
Spotted sandpiper					1			
Summer Tanager	1	1						1
Swamp Sparrow	1	19	10	3				
Tree swallow					5	1	3	1
Tricolored Heron								3
Tufted Titmouse		1						

	APHIS (Jan - Oct 2021 compiled)				***Anchor QEA***			***Audubon***
	Point Count (>50 m)	**Point Count** (<50 m)	**Flush Count**	**Opportunistic**	**Point Count – Summer 2020**	**Point Count - Spring AM 2021**	**Point Count - Spring PM 2021**	**SHARP Callback Count Survey 2021**
Tundra Swan				177				
Turkey Vulture		1			3		10	2
Unidentified gull							1	
Unidentified peep						6		
Unidentified shorebird						1		
Virginia Rail		1		1				
White-throated Sparrow		6		1				
Willet						1		2
Yellow Warbler		2						3
Yellow-rumped Warbler		28		2				

Impacts: Impacts to avifauna are anticipated to be minimal during construction and restoration activities for the preferred alternative. Post construction will provide ample habitat and Barren Island will continue to be a hospitable environment for avifauna. There could be direct, minor, and short-term disruption to avian use of Barren Island and the waters adjacent to the island during construction activity. Impacts would be expected to cease when construction is complete. Wetland restoration would benefit migratory birds and at-risk species as a result of restoration of high marsh areas.

Restoration of isolated islands for nesting birds would provide a direct, major, positive, and long-term impact to nesting waterbirds such as terns and skimmers. Nesting bird island habitat is becoming increasingly rare in the mid-Chesapeake Bay region.

Based on the draft PAR, wetlands restoration that mimics natural conditions of the coastal barrier island marshes is anticipated to increase use of the wetlands by willets, American black duck, seaside sparrow, and saltmarsh sparrow. None of the proposed alternatives are expected to impact habitat for these species negatively other than possible temporary displacement during construction. Further, if dredge material is used to restore high marsh habitat such that it mimics the natural conditions of the Bay's island marshes, with elevation high enough to reduce the potential for flooding of nesting habitat, it would be expected that the project would increase use of the marshes by seaside and saltmarsh sparrow for foraging, nesting, and breeding (USFWS 2021).Including shrubs or trees in hummock areas of the wetland restoration, would provide additional nesting habitat for wading birds.

Creation of remote sand/shell bird islands (beaches) would provide additional nesting habitat for black skimmers, brown pelicans, and terns (least, royal, and common) as well as American oystercatcher. Creating additional nesting habitat may create more preferred nesting habitat for gulls and cormorants. If nesting occurs by these non-desired species, deterrents may be needed to decrease competition for other less abundant and high priority species, and to reduce damage to native vegetation.

Various avian species of conservation concern such as black scoter, dunlin, golden, lesser yellowlegs, long-tailed duck, northern gannet, purple sandpiper, red-breasted merganser, red-throated loon, ruddy turnstone, semipalmated sandpiper, surf scoter, and white-winged scoter commonly migrate through the project area and may be present during construction. No species of conservation concern are expected to breed within the project area due to the lack of appropriate terrestrial nesting habitat. Some of these species could experience temporary disturbance during construction. However, because the project area is not within their breeding habitat and forage areas are not limited, none of the proposed alternatives are expected to have any impacts on these species. Using materials that mimic preferred habitat for ruddy turnstone and other migratory birds could enhance or increase foraging habitat.

With the exception of bald eagle, American black duck, saltmarsh sparrow, ruddy turnstone, and seaside sparrow, ACJV priority species are not known to nest in the project area. Non-nesting ACJV priority species may experience temporary disturbance during construction but would be otherwise not impacted by the project.

TOY restrictions may be needed to minimize and/or avoid impacts to Birds of Conservation Concern during breeding season. A list of potential TOY restrictions is provided in the PAR (Appendix F3) and cumulatively span from April 1 to October 31. Bald eagle TOY restrictions are typically December to June. As the full list of potential TOY restrictions cover the full calendar year, coordination of any applicable TOY restrictions will continue with USFWS as designs are finalized.

4.4.4. Invasive Species

Although Barren Island is separate from major land masses, invasive species are a part of the Barren Island ecosystem. Several factors contribute to invasive species, which include construction, exposed soil, and availability of nearby seed (USFWS, 2021). During the September 2020 wetland delineation, USACE biologists observed an abundance of, oriental bittersweet (*Celastrus orbiculatus*), reed canary grass (*Phalaris arundinacea*), common reed and Japanese stiltgrass (*Microstegium vimineum*) throughout the southern extent of Barren. Invasive vegetation can incumber growth of native plant species that can be a vital habitat or food source for native wildlife.

Along with invasive vegetation, invasive mammals and birds can be detrimental to native wildlife. As stated in the Mid-Bay PAR produced by USFWS, nutria (*Myocastor coypus*), which are native to South America, pose risks to native marshes and wetland areas within the Delmarva region. Nutria are known to digest root systems of cattails, cordgrass, and bulrush, which are extremely common and valuable marsh vegetation that hold wetland soil together (USFWS, 2021). Another invasive presence includes mute swan (*Cygnus olor*), which are native to Eurasia. Mute Swans typically feed on emergent wetland vegetation such as SAVs and can consume up to eight pounds of vegetation per day (USFWS2021). Mute swans are also waste eaters as they only consume about half of the SAVs that they uproot, while the rest of the vegetation can be found floating in the area where feeding just occurred.

Impacts: Implementation of the preferred alternative is not expected to have a major impact on invasive species. The Project is not expected to be a pathway for introduction of new invasive species to Barren Island. However, to address this concern, the USFWS recommends that the restoration project include monitoring for the presence of invasive vegetation, nutria, and mute swan and provide implantation measures to manage the species if the need arises (USFWS, 2021). Management of and preventing the introduction of invasive species such as common reed is important for promoting habitat for priority species such as saltmarsh sparrow.

4.5 Community Setting

4.5.1. Land Use

As part of the Chesapeake Marshlands National Wildlife Refuge Complex, Barren Island is owned and maintained by USFWS. The island is undeveloped and consists of estuarine, palustrine, and intertidal wetlands, pine forests, and small upland inclusions. The nearest landmass to the island is Hoopers Island where land use is mainly low to medium density residential. Across the Bay from Barren Island is the federally owned Patuxent Naval Air Station that is used for aircraft testing.

Impacts: Implementation of the preferred alternative would not affect land use, but it will add acreage to the existing extent of Barren Island. Shallow, subtidal water would be converted to sills, breakwaters, bird islands, wetlands, and tidal channels.

4.5.2. Recreation

Ecotourism has increased within the last few decades, specifically in the middle Chesapeake Bay counties that include numerous open waters, tidal rivers, land and water trails, as well as educational, and scientific opportunities at nearby wildlife refuges. The public can partake in activities around and adjacent to Barren Island and Dorchester County that include fishing, fly-fishing, oystering, crabbing, boating, bike riding, hiking, trips to museums, swimming, hunting, picnicking. Local watermen and boaters may crab or fish commercially or recreationally around Barren Island but are prohibited from entering onto the island. Fishermen, boaters, and hunters represent a large group of users who contribute to the local economy. According to MDNR, "eighty-five percent of the funding for Maryland's state wildlife programs comes from hunting license fees and federal excise tax on sport hunting devices and ammunition" (MD DNR, 2021c).

Impacts: Implementation of the preferred alternative would be expected to result in a direct, minor, and short-term negative impact to recreational activities in the vicinity of Barren Island during construction. Construction activities would temporarily displace recreational activities.

4.5.3. Cultural and Historic Resources

Coordination with the Maryland Historic Trust determined there were no cultural or historical resources within the project area.

Impacts: No impacts.

4.5.4. Hazardous, Toxic, and Radioactive Waste

Based upon a review of the USEPA Envirofacts and NEPA assist databases, no hazardous materials or reports exist within the project area limits (USEPA, 2021 & NEPAassist, 2021).

Impacts: No impacts.

4.5.5. Air Quality

The USEPA has established national ambient (outdoor) air quality standards for six common pollutants: ozone, carbon monoxide, sulfur dioxide, particulate matter, oxides of nitrogen, and lead. Ambient air quality in Maryland is determined by measuring ambient pollutant concentrations and comparing the concentrations to the corresponding national standard. Attainment means that the area has met the National Ambient Air Quality Standards (NAAQS) for a particular pollutant for which NAAQS have been established. Nonattainment is the opposite; it means that the NAAQS for a particular pollutant were not met. Dorchester County is in attainment for all criteria pollutants (USEPA 2021a).

Impacts: Implementation of the preferred alternative would produce emissions from construction equipment during construction activities. Impacts to air quality are expected to be minor, direct, and short-term. Once construction is complete, construction emissions would cease, and there would be no further impacts.

4.5.6. Socioeconomic Conditions

Dorchester County and the area surrounding Barren Island have low population densities and are relatively rural. In 2019, approximately 32,138 individuals resided in Dorchester County in contrast to 6,045,680 in the State of Maryland (US Census Bureau, 2019). Dorchester County is forecasted to include approximately 35,160 individuals in 2030 and 37,300 individuals in 2040 (MD Dept of Planning, 2021). The census block (240199708041) containing the project area extends from Taylor's Island south through Hoopersville. The census block has a population of 1,067 and covers 87.4 square miles. Dorchester County's demographics are relatively consistent with those of the State of Maryland. In Dorchester County males make up 47.2% and females represent 52.8% of the population. These percentages are consistent with the State of Maryland which are represented by 48.4% of males and 51.6% of females. White persons account for 65.5% of Dorchester County's population followed by Black or African American (26.6%) (ACS 2019). However, the census block that contains the project is 96% non-Hispanic white. The largest age range that resides in Dorchester County are the 45 to 54-year-olds (13.2%).

Within Dorchester County, 15.4% of the population lives below the poverty level compared to 9.1% in the State of Maryland. Average household income is $46,862, substantially below the state average of $83,076 (CDC 2019). Within the county, 36% of the population is considered to be low income. A smaller percentage, 23%, is designated low income within the project's census block. The 2019 employment rate is 56.9% distributed across five primary occupations (Table 13) (ACS 2019). Nearly a third of the workforces is employed in management, business, science, education, and arts occupations. The second leading occupation is sales and office.

Table 13. Occupations in Dorchester County

Occupations by Industry Sector	Percent
Management, business, science, education, and arts	33%
Sales and office	22%
Service	19%
Production, transportation, and material moving	15%
Natural resources, construction, and maintenance	10%

Impacts: Implementation of the preferred alternative is expected to have direct and indirect, and short and long-term positive impact on the socioeconomic conditions within the project area. Construction of Barren Island is expected to have a direct, short-term, positive impact by providing an opportunity for jobs during construction. Maintaining Barren Island and restoring additional habitat would provide an indirect, long-term positive impact to the economy within the project area by adding value for tourism and recreation associated businesses, and the commercial fisheries professions.

4.5.7. Environmental Justice

On February 11, 1994, President Clinton issued Executive Order 12898, Federal Actions to Address Environmental Justice in Minority and Low-Income Populations. This order requires that "each federal agency make achieving environmental justice part of its mission by identifying and addressing, as appropriate, disproportionately high and adverse human health or environmental effects of its programs, policies, and activities, on minority populations and low-income populations" (Executive Order 12898, 59 Federal Register 7629 [Section 1-201]).

Based on 2019 estimates, minority groups made up 4 percent of the population in the project's census block, and 31.4% in the larger population of Dorchester County. The largest minority group in the county is Black or African American at 27.7% (ACS 2019). With respect to income, 23% of the population is designated low income within the project's census block (USEPA 2021b).

The USEPA's EJScreen can be utilized to evaluate indicators for a specified area to gauge whether there are potential EJ communities in the area. Based on the Environmental Justice (EJ) indices from EJScreen for the project area's census block, there are no potential EJ communities in the immediate vicinity. The indices consider air pollutant levels; respiratory hazards; cancer risk; traffic levels; lead paint; proximity to Superfund sites, hazardous waste, and wastewater discharge; as well as demographic indicators such as minority populations, low income, linguistic isolation, education level, and age (under 5 and over 64 years of age).

Impacts: The proposed project is not expected to result in disproportionately high or adverse human health or environmental effects on minority or low-income populations.

4.5.8. Visual and Aesthetic Resources

Barren Island and the mid-Chesapeake Bay area are considered to have high aesthetic value. Low levels of development, low topographic relief, extensive open water features, wetlands with natural vegetation, and diverse wildlife make this area of the Bay visually pleasing and attractive to the public. There are no National Scenic Byways or Wild and Scenic Rivers in Dorchester County; however, Barren Island can be viewed from Maryland State road 335 along Hoopers Island shoreline. The road meanders through the Blackwater National Wildlife Refuge and Taylors Island WMA, as well as through small fishing towns and tidal marshes (USACE, 2009).

Impacts: Implementation of the preferred alternative would have a direct and permanent impact on the aesthetic view of Barren Island from close range where the addition of the stone sills and breakwaters will be an evident change to the natural shoreline. Over time and with the development of wetland habitat, the alternation is expected to be less noticeable. Viewing from a distance, the aesthetics would not be discernible. Maintaining the existing extent of Barren Island and restoring additional habitat is expected to have a direct, positive, and long-term impact to the aesthetic resources in the region.

During construction, short-term, negative impacts to aesthetics would be expected due to the presence of construction equipment. These impacts would occur intermittently over the multiple phases of the Project.

4.5.9. Noise

Noise is defined as unwanted sound that is disruptive and diminishes the quality of the surrounding environment. It is emitted from many sources including airplanes, factories, railroads, power generation plants, and highway vehicles, etc. The magnitude of noise is described by its sound pressure. A logarithmic scale is used to relate sound pressure to a common reference level, as the range of sound pressure varies greatly. This is called the decibel (dB). A weighted decibel scale is often used in environmental noise measurements (weighted-A decibel scale or dBA). This scale emphasizes the frequency range to which the human ear is most susceptible. The threshold of human hearing is 0 dBA. A 70-dBA sound level can be moderately loud (similar to an indoor vacuum cleaner) with values above 85-90 dBA considered loud and potentially harmful to hearing depending on length of exposure. A 120 dBA can be uncomfortably loud, as in a military jet takeoff at 50 ft, and a 40-dBA sound level can be very quiet and is the lowest limit of urban ambient sound.

To ensure a suitable living environment, the Department of Housing and Urban Development has developed a noise abatement and control policy, as seen in 24 CFR Part 51. According to this policy, noise not exceeding 65 dBA is considered acceptable. Noise above 65 dBA but not exceeding 75 dBA is normally acceptable, but noise above 75 dBA is unacceptable. Normal freeway traffic noise levels range from 70 to 90 dBA.

Uninhabited islands have few on-site noise sources and have generally low sound levels. However, substantial noise can be generated from boat traffic in adjacent waters and natural sound sources such as wind, waves, and bird colonies may contribute to measured sound levels. Personal watercraft and powerboats may generate noise levels of 70 to 85 dBA at 50 ft (Noise Unlimited, 1995) similar to normal freeway traffic. Background noise levels for residents in the vicinity of Barren Island might typically be 40 dBA with occasional acute noise sources such as a lawnmower, which will generate 65 to 95 dBA at 50 ft or a leaf blower (110 dBA at 50 ft). Barren Island is generally free of anthropogenic noises other than occasional fishing boats or recreational boats, and the island is far enough away from any major roadway or shipping lanes. Air traffic may cause more frequent noise due to Barren's proximity to the Patuxent Naval Air Station.

Many wildlife species in the Chesapeake Bay use noise to communicate, navigate, breed, and locate sources of food. The sensitivity varies among species, location, and season (e.g., breeding, migration, and roosting). Underwater noise influences fish and other marine animal behavior, resulting in changes in their hearing sensitivity and behavioral patterns. Sound is important when hunting for prey, avoiding predators, or engaging in social interaction. Fish can also suffer from acoustically induced stress in their own habitat. Changes in vocalization behavior, breathing and diving patterns, and active avoidance of noise sources by marine life have all been observed in response to anthropogenic noise (Earth Island Institute, 2002).

Underwater ambient noise levels have not been identified for the project area. Underwater noise levels can vary with time of day, weather, tide, season, and other factors. Ambient sound sources could include biological sources (e.g., birds, marine mammals) and anthropogenic sources such as from vessels and aircraft overflights.

Impacts: Construction activities, including operation of construction vehicles, dredging equipment, and barges would result in a temporary increase in noise levels that may temporarily affect wildlife. Impacts associated with implementing the preferred alternative are expected to be direct, minor, and short-term in duration. Impacts would cease when construction is complete. Impacts would be similar to any that occurred in the past during construction of the existing sill, channel dredging, or material placement. The project would be constructed following local noise ordinances and all applicable worker safety regulations.

4.5.10. Protected Areas

Due to the location of Barren Island in the Chesapeake Bay, various types of protected areas could be temporarily impacted during restoration. Such areas include navigation channels, coastal zones, and critical areas (USACE, 2009).

4.5.10.1 Navigation Channels

Barren Island is located 1.62 nautical miles east of the navigation shipping channel in the main-stem Chesapeake Bay. A shallow draft Federal navigation channel is situated approximately 1,900 ft north of the northern tip of Barren Island.

4.5.10.2 Coastal Zones

The Coastal Zone Management Program (CZMP) is a Federal-state partnership established by the Coastal Zone Management Act of 1972. The goal of the Coastal Zone Management Act is to "preserve, protect, develop and, where possible, to restore and enhance the resources of the nation's coastal zone for this and succeeding generations." The partnership established by the Act provides an avenue for consultation between local, state, and Federal governments as they work on complex resource management problems (MDNR, 2002). The State of Maryland's CZMP consists of laws and policies that work to achieve a balance between development and coastal zone protection. MDNR is the lead agency for the state CZMP. Due to its location in the Chesapeake Bay, Barren Island is within the defined coastal zone of Maryland (MDNR, 2002). Shoreline erosion of Barren Island, and the potential for erosion of nearby shorelines currently sheltered by Barren Island could be considered a coastal hazard. Reducing threats and losses from coastal hazards is a supporting goal to achieve the themes of the Maryland CZMP.

4.5.10.3 Critical Areas

In 1984, the Maryland General Assembly enacted the Critical Area Act to address the increasing pressures placed on Chesapeake Bay resources from an expanding population. The Act defines a critical area as "all land within 1,000 ft of the MHW Line of tidal waters or the landward edge of tidal wetlands and all waters of and lands under the Chesapeake Bay and its tributaries" (MDNR, 2004a). Due to Barren Island's location in the Chesapeake Bay and their natural resources, Barren Island falls within the definition of a critical area.

The Critical Area Law mandates that local governments preserve "Habitat Protection Areas", which include nontidal wetlands and a surrounding 25-foot buffer; a 100-foot vegetated buffer zone on the landward edge of tidal waters, wetlands, or tributary streams; threatened and endangered species and their habitat; significant plant and wildlife habitat; and anadromous fish spawning areas. Significant plant and wildlife habitat is defined as colonial water bird nesting areas, historic waterfowl concentration areas, riparian forests, undisturbed forest tracts (100 ac or more) containing breeding populations of forest interior-dwelling birds, areas that contain the "best examples" of plant and animal communities, and other areas determined to have local significance. The Critical Area Law also categorizes land as Intensely Developed Areas, Limited Development Areas, or Resource Conservation Areas, and regulates development that can occur in each (MDNR, 2004a).

Barren Island is designated as Resource Conservation Areas under the Critical Area Law (MDNR, 2004b). Rare, threatened, and endangered species utilizing Barren Island have been documented in Section 4.3.9 and the island is within waterfowl concentration and staging areas that are protected under Critical Area Law (MDNR, 2004b). Habitat utilized by rare, threatened, or endangered species can be protected under critical area regulations (MDNR, 2004a). Habitat on Barren Island designated as colonial waterbird nesting may also be afforded protection under critical area regulations.

Impacts: Implementation of the preferred alternative is expected have a direct, positive impact on local federally maintained navigable channels. Dependent upon funding, maintenance dredging is planned to provide material to the project to restore wetlands. No other impacts to navigable channels are expected.

Implementation of the preferred alternative is expected to be consistent with Maryland's CZMP as it will address shoreline erosion and resulting coastal hazards. Implementation is also expected to align with the Critical Area Act as it will conserve and restore habitat within a Resource Conservation Area.

4.6 Cumulative Effects

Implementation of the preferred alternative at Barren Island will provide a cumulative positive impact to remote island resources in the Chesapeake Bay. In combination, restoration projects at Barren Island, Poplar Island, Poplar Expansion, and the future implementation of James Island, will restore 3,870 ac of remote island habitat to the mid-Chesapeake Bay. This is a substantial step to restore the loss of approximately 10,500 ac of remote island habitat that has been documented throughout the past several decades in the Bay. The restored habitat will serve a diverse assemblage of species including nesting and foraging birds, and finfish that utilize the tidal channels and shallow waters adjacent to the projects as well as the structure provided by sills, dikes, and breakwaters. This network of islands will play a vital role to migrating birds along the Atlantic Flyway. Proposed island restoration projects would cause a loss of bottom and open water habitat for EFH and other species inhabiting shallow water habitats. However, regionally this habitat is abundant, and expanding with sea level rise and erosion. Therefore, no significant cumulative impacts to habitat or populations of aquatic species are expected to result from the project.

5 ENVIRONMENTAL COMPLIANCE

Pertinent public laws applicable to the Barren Island Project are presented below. In some situations, the laws have been previously discussed and prior section references are provided. The status of compliance with applicable environmental laws and executive orders is summarized in Table 14.

5.1 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. An EIS was developed during the Feasibility Report (2009) that included both the Barren Island portion of the Mid-Bay Island Project and the James Island portion. This document is a supplemental EA that builds on the 2009 EIS and focuses on the Barren Island portion of the Mid-Bay Island Project. Additional, future NEPA documents will be developed to address the proposed action at James Island as well as a source of borrow material for actions proposed at Barren Island as part of the preferred alternative.

5.2 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. Dorchester County is in attainment for all priority pollutants. Upon completion of the draft sEA, EPA and MDE will be forwarded a copy for their review to confirm compliance with Section 309 of the Clean Air Act.

5.3 Clean Water Act, 33 U.S.C. 1251, et seq.

Coordination is underway to ensure the preferred alternative is in compliance with the Clean Water Act of 1977 and subsequent amendments (A 404(b)1 Assessment is included as Appendix F4). A Section 401 Water Quality Certification is required for the project and is part of an application submitted to the State by the MDOT MPA for the Barren Island Project component. Upon completion of the State's permitting process, implementation of the preferred alternative would not result in permanent negative changes in water quality. Following construction activities, the additional wetland habitat, stabilized shorelines, and protection of SAV habitat will have long-term positive impacts to water quality in the areas surrounding Barren Island. All state water quality standards would be met. A public hearing is tentatively scheduled for 6 January 2022 at Madison Fire Department, 1154 Taylors Island Rd, Madison, MD 21648.

5.4 Coastal Barrier Resources Act and Coastal Barrier Improvement Act of 1990

The Coastal Barrier Resources Act (CBRA) and its amendments prohibit the spending of new federal expenditures that tend to encourage development or modification of coastal barriers that are within the defined Coastal Barrier Resource System. Barren Island falls within the jurisdiction of the CBRA; however, it is classified as an "Otherwise Protected Area" (OPA), MD-21P. Under the Act, OPAs are not subject to restriction of Federal funds; therefore, no consultation with USFWS is required specific to CBRA (USACE 2009). The beneficial impacts derived from shoreline restoration and protection and wetland restoration at Barren Island are consistent with the goals of the Act.

5.5 Coastal Zone Management Act of 1972

The proposed project at Barren Island is within the coastal zone, which is managed under MDNR's CZMP. Although construction of the island habitat restoration project would displace shallow water habitat, which is protected under the Coastal Zone program, beneficial impacts from the proposed action are consistent with other goals of the CZMP. The CZMP includes goals to protect coastal land and water habitat. Construction of the projects along the western shorelines of Barren Island would protect exposed portions of the remnant Islands from further erosion and prevent additional loss of unique Chesapeake Bay Island habitats. It is also expected that restoration/protection at Barren Island would help reduce the exposure of populated Hoopers Island to future erosion and land loss.

A Federal consistency determination in accordance with 15 CFR 930 Subpart C has been made stating that the preferred alternative is consistent with the enforceable policies of the State of Maryland's federally approved coastal management program. MDNR must review USACE's determination of consistency with Maryland CZMP's enforceable policies. The draft sEA will be submitted for review by the State concurrent with public review.

5.6 Endangered Species Act of 1973

The preferred alternative will be in compliance with the Endangered Species Act of 1973 (ESA). The preferred alternative is not anticipated to affect rare, threatened, or endangered species.

5.7 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.

USFWS has provided a draft Fish and Wildlife Coordination Act Report for inclusion in the draft sEA at the request of USACE toward fulfillment of Section 2(b) of the FWCA (48 Stat.401, as amended, 16 U.S.C. 661 *et seq.*) (Appendix F3). Coordination with USFWS and NMFS will be ongoing through the remainder of the study.

5.8 Magnuson-Stevens Fishery Conservation and Management Act

The Magnuson-Stevens Fishery Conservation & Management Act 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 for the Barren Island project. The draft assessment is provided in Appendix F2. See Section 4.3.8 for a discussion of EFH in the study area and a summary of the EFH assessment. Coordination with NMFS for EFH will be ongoing through the remainder of the study.

5.9 Marine Mammal Protection Act

The Marine Mammal Protection Act (MMPA), enacted in 1972, prohibits, with certain exceptions, the taking of marine mammals in U.S. waters and by U.S. citizens on the high seas, and the importation of marine mammals and marine mammal products into the U.S. Feasibility investigations identified the potential for Atlantic Bottlenose dolphin to be in the vicinity of Barren Island. At that time, consultation with NMFS concluded that Atlantic Bottlenose dolphins are not federally or state listed as an endangered species and that exclusionary techniques to avoid impacts would not be required. The potential presence of marine mammals will be revisited once all recent survey data is available and evaluated. The preferred alternative complies with the MMPA.

5.10 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. The preferred alternative is in compliance with the MBTA and Executive Order 13186.

5.11 Section 106 of the National Historic Preservation Act of 1966, as amended

The National Historic Preservation Act (NHPA) of 1966, as amended (54 U.S.C. § 306108), and its implementing regulations require USACE, in consultation with the Maryland Historic Trust (MHT), to consider the effects of the undertaking on historic properties in the project area. If any historic properties listed on or eligible for inclusion in the National Register of Historic Places will be adversely affected, USACE must develop mitigation measures in coordination with the MD State Historic Preservation Office (SHPO). Coordination with MHT and tribal nations has been ongoing since the feasibility phase and has determined that there were no cultural or historical resources within the project area.

5.12 River and Harbors Act, 33 U.S.C. 401, et seq.

Section 9 of this law and its implementing regulations prohibit the construction of any bridge, dam, dike, or causeway over or in navigable waters of the U.S. without Congressional approval. The U.S. Coast Guard administers Section 9 and issues bridge crossing permits over navigable waters. Section 10 of the Rivers and Harbors Act of 1899 requires authorization from the Secretary of the Army, acting through the Corps of Engineers, for the construction of any structure in or over any navigable water of the United States. The preferred alternative would be in compliance with the Rivers and Harbors Act.

5.13 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). Hazardous materials are discussed in Section 4.5.4. There are no hazardous materials concerns associated with the preferred alternative. The preferred alternative is in compliance with the RCRA.

5.14 Comprehensive Environmental Response, Compensation, and Liability Act, 42 U.S. C. 9601, *et.seq.*

The Comprehensive Environmental Response, Compensation and Liability Act (CERCLA or Superfund) governs the liability, compensation, cleanup, and emergency response for hazardous substances released into the environment and the cleanup of inactive hazardous substance disposal sites. There are no Superfund sites in the project area. The preferred alternative is in compliance with the CERCLA.

5.15 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 alternative is in compliance with Executive Order 11990. Approximately 1.4 ac of existing wetlands would be temporarily impacted by implementation of the preferred alternative, but that impact would enable restoration of approximately 83 ac of wetlands and protection of the existing 118 ac of wetlands on Barren Island.

5.16 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 preferred alternative is in compliance with Executive Order 11988 and would have no effect on development within floodplains.

5.17 Executive Order 12898, Environmental Justice

This Executive Order directs Federal agencies to determine whether a federal action would have a disproportionate adverse impact on minority or low-income population groups within the project area. See Section 4.5.7 for a discussion of Environmental Justice considerations for the preferred alternative. The preferred alternative is not expected to result in disproportionately high or adverse human health or environmental effects on minority or low-income populations.

5.18 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 preferred alternative.

Table 14. Compliance with Federal Environmental Protection Statutes and Executive Orders

Federal Statutes	Level of Compliance*
Archaeological and Historic Preservation Act	Full
Bald and Golden Eagle Protection Act	Full
Clean Air Act	Full
Clean Water Act	Partial
Coastal Barrier Resources Act	Full
Coastal Zone Management Act	Full
Comprehensive Environmental Response, Compensation and Liability Act	Full
Endangered Species Act	Full
Estuary Protection Act	Full
Farmland Protection Policy Act	Full
Fish and Wildlife Coordination Act	Full
Magnuson-Stevens Fishery Conservation and Management Act	Full
Marine Mammal Protection Act	Full
National Environmental Policy Act	Full
National Historic Preservation Act	Full
Resource Conservation and Recovery Act	Full
Rivers and Harbors Act	Full
Wild and Scenic Rivers Act	N/A
Executive Orders (EO), Memoranda, etc.	
Migratory Bird (EO 13186)	Full
Protection and Enhancement of Environmental Quality (EO 11514)	Full
Protection and Enhancement of Cultural Environment (EO 11593)	Full
Floodplain Management (EO 11988)	Full
Protection of Wetlands (EO 11990)	Full
Environmental Justice in Minority and Low-Income Populations (EO 12898)	Full
Invasive Species (EO 13112)	Full
Protection of Children from Health Risks and Safety Risks (EO 13045)	Full
Prime and Unique Farmlands (CEQ Memorandum, 11 August 1980)	N/A
*Level of Compliance Relevant to the current study phase: *Full Compliance (Full)*: Having met all requirements of the statute, E.O., or other environmental requirements. *Not Applicable (NA)*: No requirements for the statute, E.O, or other environmental requirement for the current stage of planning.	

6 PUBLIC INVOLVEMENT AND COORDINATION

The purpose of public participation and agency coordination in the NEPA process is to ensure the productive use of inputs from, private citizens, public interest groups, and government agencies to improve the quality of the environmental decision-making process (Canter, 1996). CEQ regulations (Title 40 CFR, Chapter V and Part 1506.6) require the incorporation of public participation into multiple phases of the NEPA process, including project scoping and the review process of draft documents.

6.1 Public Involvement

A Notice of Intent to prepare the sEA for the Project was published on 27 July 2020. A public webinar was hosted by MDOT MPA on 31 March 2021 and an outreach meeting with the Dorchester County Watermen's Association was held on 16 June 2021. A community meeting was held on 6 November 2021 at the Madison Volunteer Fire Department in Madison, MD. Public review of the draft sEA will occur in December 2021.

6.2 Agency Coordination

Agency coordination was initiated with a kick-off meeting on 22 January 2020. A series of four coordination meetings have been held thus far with resource agencies that have covered kick-off through 35% Design. Coordination letters were sent to EPA, MDNR, MDE, NMFS, USFWS, and MHT. Table 15 summarizes public and agency correspondence activities that have been completed.

Table 15. Summary of Agency and Public Correspondence

Date	Summary of Correspondence
22 January 2020	USACE conducts Agency Coordination meeting #1 with resource agencies – Kick-off Meeting (Appendix E)
20 June 2020	USACE conducts Agency Coordination meeting #2 with resource agencies – Project Update (Appendix E)
27 July 2020	USACE publishes Notice of Intent to prepare a Supplemental EA (Appendix F1)
14 August 2020	USACE provides initial coordination letter to federal and state agencies (Appendix F1)
11 September 2020	Response received from USEPA to coordination letter (Appendix F1)
24 September 2020	USACE conducts Agency Coordination meeting #3 with resource agencies – Project Update (Appendix E)
23 February 2021	USACE conducts Agency Coordination meeting #4 with resource agencies –Project Update and 35% Design Review (Appendix E)
17 March 2021	USACE provides coordination letter to MHT (Appendix F1)
26 March 2021	USFWS provides draft Planning Aid Report (PAR) (Appendix F3)
31 March 2021	Joint Evaluation Committee Meeting for Tidal Wetlands License (Appendix E)
19 May 2021	MDOT MPA Hosts a Public Webinar through their Spotlight Series on the Mid-Chesapeake Bay Ecosystem Restoration Project with featured speakers from MDOT MPA, USACE, and
16 June 2021	USACE conducts outreach meeting with Dorchester County Watermen's Association
11 August 2021	USACE receives email from NMFS finalizing the list of species for the EFH Evaluation (Appendix F1)

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