US Army Corps
of Engineers
Baltimore District

DRAFT SUPPLEMENTAL ENVIRONMENTAL IMPACT STATEMENT - APPENDIX A

MID-CHESAPEAKE BAY ISLAND ECOSYSTEM RESTORATION PROJECT: JAMES ISLAND

DORCHESTER COUNTY, MARYLAND

MARCH 2024

Prepared by: U.S. Army Corps of Engineers, Baltimore District

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A1: Mid-Chesapeake Bay Islands Ecosystem Restoration Project Environmental Surveys – Sampling and Analysis Report (Anchor QEA, 2022)

November 2021
Mid-Chesapeake Bay Island Environmental Surveys

Sampling and Analysis Report

Prepared for Maryland Environmental Service

In coordination with Maryland Department of Transportation, Maryland Port Administration

November 2021
Mid-Chesapeake Bay Island Environmental Surveys

Sampling and Analysis Report

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ABBREVIATIONS

µg/L	micrograms per liter
B-IBI	Benthic Index of Biotic Integrity
CBWQM	Chesapeake Bay Water Quality Monitoring Program
COMAR	Maryland Code of Regulations
DGPS	differential global positioning system
DO	dissolved oxygen
EIS	environmental impact statement
FS	feasibility study
ft	feet
g	gram
m^2	square meter
MDNR	Maryland Department of Natural Resources
MDOT MPA	Maryland Department of Transportation Maryland Port Administration
mg/kg	milligrams per kilogram
mg/L	milligrams per liter
NTU	Nephelometric Turbidity Unit
ppt	parts per thousand
Project	Mid-Chesapeake Bay Island Ecosystem Restoration Project
RGI	Restoration Goal Index
SAR	Sampling and Analysis Report
SAV	submerged aquatic vegetation
su	standard unit
TSS	total suspended solids
USACE	U.S. Army Corps of Engineers

1 Introduction

Maryland Environmental Service, Maryland Department of Transportation Maryland Port Administration (MDOT MPA), and the U.S. Army Corps of Engineers (USACE) Baltimore District are proposing to restore 2,144 acres of remote island habitat in the Chesapeake Bay. In 2009, USACE Baltimore District prepared an integrated feasibility study (FS) and environmental impact statement (EIS) for the Mid-Chesapeake Bay Island Ecosystem Restoration Project (Project), which focuses 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 (USACE 2009). The FS/EIS identified James Island and Barren Island, located in western Dorchester County, Maryland, as the preferred alternatives for island restoration (Figure 1-1).

James Island is a privately owned, uninhabited island, situated near the mouth of the Little Choptank River, approximately 1 mile north of Taylors Island. Since 1847, more than 800 acres have eroded from the privately owned island, approximately 89% of its historical acreage. Since 1847, more than 800 acres have eroded, and James Island currently consists of three eroding island remnants totaling approximately 3 acres. The Project will restore 2,072 acres of this island.

Barren Island is an uninhabited island, located in the Chesapeake Bay in Dorchester County, Maryland, near the Honga River and immediately west of Hoopers Island. At the time of the FS (2004), Barren Island consisted of three eroding island remnants totaling approximately 180 acres in size (197 acres including tidal flats). Based on 2020 surveys, only 138 acres of Barren Island remains. Barren Island experiences a long-term erosion rate of 14 feet per year (3 to 4 feet per year in recent years) or approximately 4.1 acres per year. At this rate, Barren Island could be completely lost by the early 2050s (2050-2055) without ongoing and future protection measures. The Project will restore 72 acres of Barren Island while also protecting approximately 1,325 acres of potential submerged aquatic vegetation (SAV) habitat adjacent to the island.

USACE and MDOT MPA began the Project in the 1990s to achieve the following three main goals:

1. Restore remote island habitat within the Mid-Chesapeake Bay.
2. Optimize the placement capacity for sediment dredged from shipping channels.
3. Cause no harm to the environment around the restoration site.

As part of the FS, a sampling program was implemented to document the existing environmental conditions on and adjacent to James Island and Barren Island (USACE 2009). Four seasonal studies were completed in 2002 and 2003 to document baseline environmental conditions. Both aquatic and terrestrial sampling were conducted, and the environmental surveys included water quality and nutrient analyses, fish and plankton sampling, benthic sampling and sediment testing, vegetation identification and mapping (both aquatic and terrestrial), SAV surveys, avian and other wildlife observations (both aquatic and terrestrial), horseshoe crab spawning surveys, diamondback terrapin nesting surveys, crab pot surveys, clam surveys, and pound net fishers phone surveys (USACE 2009).

Currently, the FS/EIS is being updated to provide timely data to support design of the Project elements at James Island and Barren Island. The purpose of this Sampling and Analysis Report (SAR) is to summarize the results of site-specific environmental surveys that were conducted consistent with the baseline sampling program completed in 2002 and 2003 and to document the current environmental conditions at the Project area. Design for the island restoration is ongoing, and the conditions documented in this SAR will serve as the baseline environmental conditions of the Project area prior to the initiation of restoration activities.

The purpose of this sampling effort is to sample benthic communities, fish assemblages, and clam populations to provide the data necessary to document the existing environmental conditions in the Project area during each of the four seasons.

The specific objectives of the Mid-Chesapeake Bay Island Environmental Surveys sampling program are as follows:

- In the spring, summer, and fall seasons, collect benthic community samples to document baseline (pre-construction) seasonal benthic communities in the vicinity of James Island and Barren Island.
- In each season (spring, summer, fall, and winter), collect surface water samples to measure baseline (pre-construction) seasonal water quality conditions in the vicinity of James Island and Barren Island.
- In each season (spring, summer, fall, and winter), conduct fisheries surveys using a variety of sampling gear (including beach seines, trawls, gillnets, and pop nets) to document baseline (pre-construction) seasonal fish and crab communities in the vicinity of James Island and Barren Island.
- In the fall, conduct soft-shell and razor clam surveys to document baseline (pre-construction) clam populations in the vicinity of James Island and Barren Island.
- Conduct monthly crab pot surveys during the months of May, June, July, August, and September in the proposed restoration footprint (plus an additional 0.25-mile perimeter) to document crab fishing in the vicinity of James Island and Barren Island.
- In the spring, conduct pound net telephone surveys of licensed pound net owners in the vicinity of James Island and Barren Island to document ownership and use of pound nets and harvest amounts in the Project area.
- In the spring and summer, conduct avian surveys to document baseline (pre-construction) bird populations and behaviors in the vicinity of James Island and Barren Island.

Figure 1-1
Mid-Chesapeake Bay Island Ecosystem Restoration Project Area

1.1 Project Overview

The environmental sampling framework for the Project includes water quality, benthic community sampling, fish and crab assemblage documentation, bivalve population study, and avian surveys. These pre-construction environmental sampling studies will determine the baseline environmental conditions in the Project. The results of this investigation will be used to compare to post-construction environmental monitoring that will be conducted after island restoration is completed and to document environmental conditions or changes, if any, in the Project area.

Surface water sampling documents water quality in the vicinity of James Island and Barren Island each season, measures nutrient concentrations, and supports the interpretation of biological (benthic, fish, and clam) data. Water quality samples were tested for the same parameters tested in the Chesapeake Bay Program (Chesapeake Bay Program 2017).

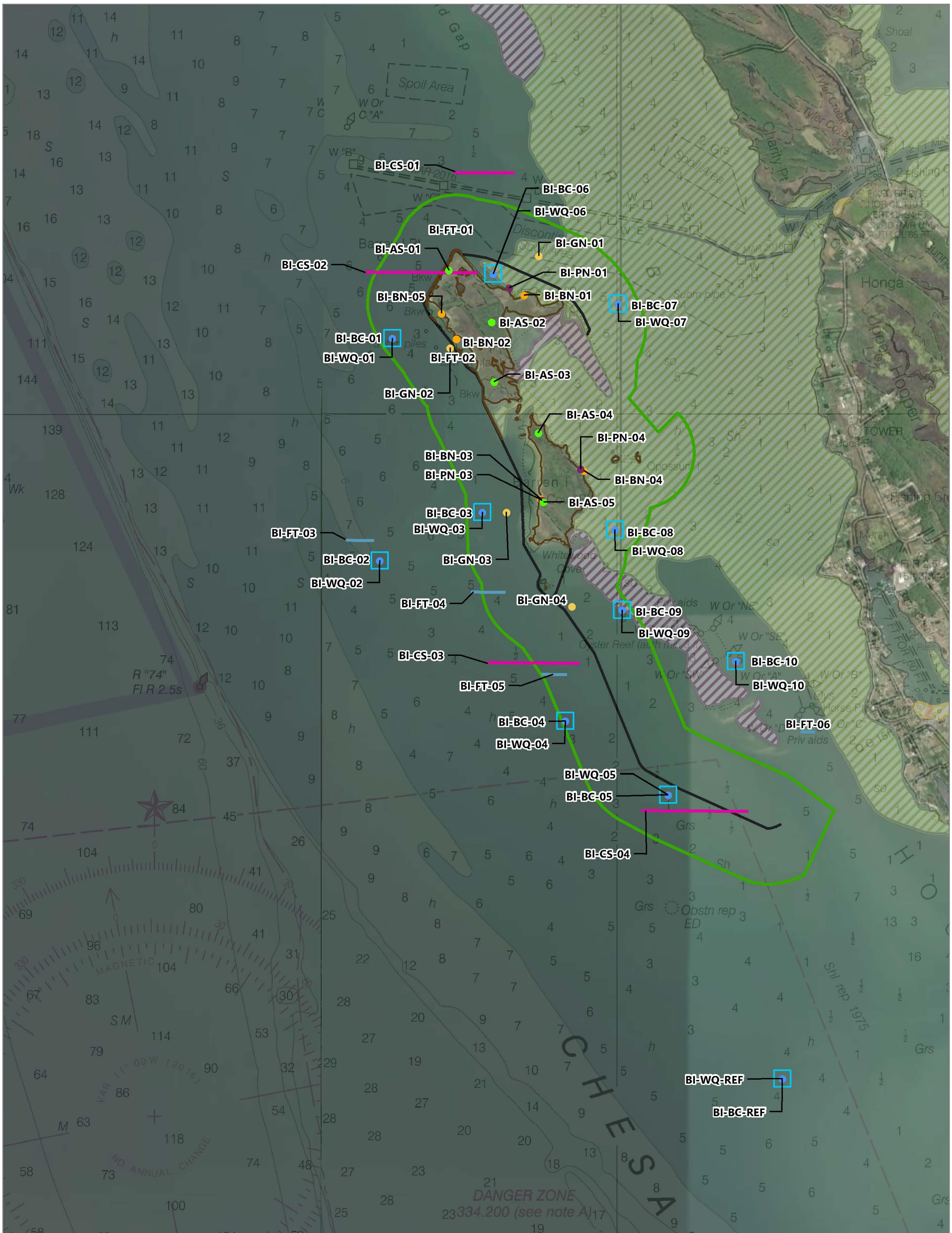
Benthic community sampling characterizes the benthic community in the Project area at James Island and Barren Island. Community composition, abundance, and diversity are documented in each sample. During the summer seasonal sampling event, additional sediment from each benthic community sampling location was collected and analyzed for grain size and total organic carbon.

Fisheries surveys document the use of proximal waters in the Project area by measuring fish and crab populations and densities in a variety of habitats. The waters in the vicinity of James Island and Barren Island were sampled using beach seines, trawls, gillnets, and pop nets.

Avian surveys document species and numbers of birds nesting on or using James Island and Barren Island. These baseline avian surveys will be used to evaluate if there is an increase in number and diversity of waterfowl in the vicinity of James Island and Barren Island area after island restoration is completed.

The data collected through the fisheries, bivalve, and avian surveys will be used in conjunction with the results of previous seasonal fisheries surveys (USACE 2009) to establish baseline information on the fish and crab communities in the area of the Chesapeake Bay surrounding Barren Island and James Island. All components of the environmental sampling framework and sampling locations are shown in Figures 1-2 and 1-3 for Barren Island and James Island, respectively.

Figure 1-2
Barren Island Environmental Survey Components



LEGEND:

- Avian Survey
- Beach Seine
- Benthic Community
- Gill Net
- Pop Net
- Water Quality
- Fisheries Trawl
- Soft-Shell and Razor Clam Trawl
- Crabpot Survey
- Barren Island Remnants
- Proposed Barren Island Protection

Existing SAV Bed

- Dense 70-100% cover
- Moderate 40-70% cover
- Sparse 10-20% cover

NOTES:
1. Basemaps obtained from Esri aerial imagery and NOAA raster nautical charts streaming services.
2. Crabpot survey boundary includes the area within 0.25 mile of the proposed restoration footprint and Barren Island remnants.

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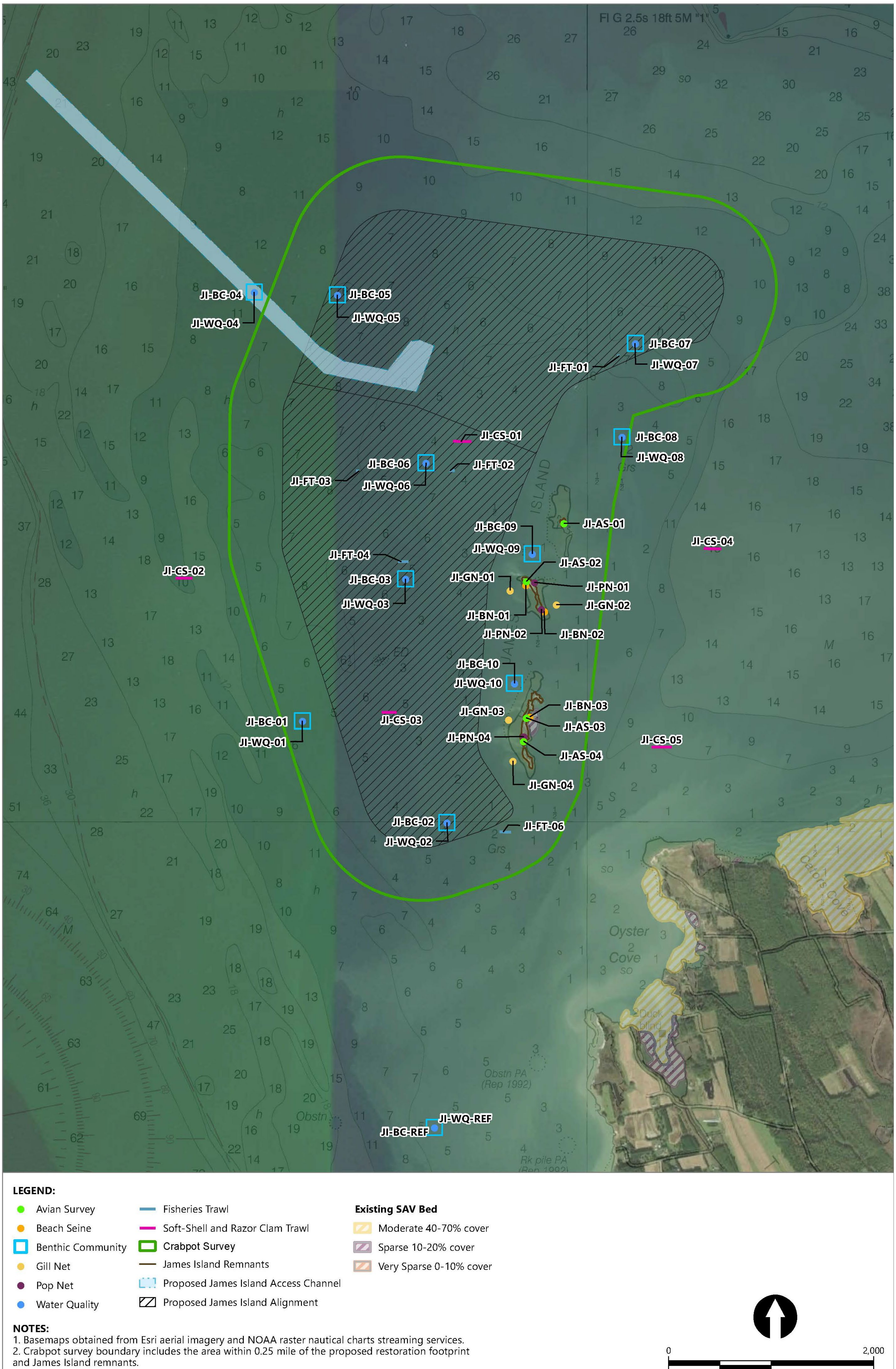
Figure 1-3
James Island Environmental Survey Components



NOTES:
1. Basemaps obtained from Esri aerial imagery and NOAA raster nautical charts streaming services.
2. Crabpot survey boundary includes the area within 0.25 mile of the proposed restoration footprint and James Island remnants.

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1.2 Project Schedule

Sampling to evaluate existing conditions is conducted seasonally, consistent with the timing of the sampling completed in 2002 and 2003 as part of the FS (USACE 2009). The sampling conducted to complete the environmental surveys occurs during the following seasons:

- Summer 2020: June, July, and August
- Fall 2020: September, October, and November
- Winter 2021: December, January, and February
- Spring 2021: March, April, and May

A summary and schedule of the completed Project components completed is provided in Table 1-1.

Table 1-1
Mid-Chesapeake Bay Island Ecosystem Restoration Project Sampling Schedule

Season	Task	Dates Completed
Summer (June, July, and August)	Water quality sampling	August 31, 2020, to September 1, 2020
	Benthic community sampling (including grain size and total organic carbon analyses)	August 24 to 28, 2020
	Fisheries surveys	August 25, 2020, to September 4, 2020
	Beach seining	
	Bottom trawling	
	Gillnetting	
	· Pop netting	
	Crab pot survey	June 23, 2021
		July 22, 2021
		August 30, 2020
	Avian surveys	September 2 to 3, 2020
Fall (September, October, and November)	Water quality sampling	October 21, to 22, 2020
	Benthic community sampling	October 19 to 23, 2020
	Fisheries surveys	November 4 to 9, 2020
	Beach seining	
	Bottom trawling	
	Gillnetting	
	Crab pot survey	September 29, 2020
	Bivalve surveys	December 14 and 19, 2020

Season	Task	Dates Completed
Winter (December, January, and February)	Water quality sampling	March 9 to 10, 2021
	Fisheries surveys	February 25 to 28, 2021
	Beach seining	
	Bottom trawling	
	Gillnetting	
Spring (March, April, and May)	Water quality sampling	May 24 to 25, 2021
	Benthic community sampling	May 24 to 28, 2021
	Fisheries surveys	May 4 to 10, 2021
	Beach seining	
	Bottom trawling	
	Gillnetting	
	Pop netting	
	Avian surveys	May 26 to 27, 2021
	Crab pot surveys	May 18, 2021

2 Sampling Methodology

This section provides a brief description of the methodology used for each Project component and a summary of the results. Details regarding sampling methodology are provided in the *Sampling and Analysis Plan and Quality Assurance Project Plan* (Anchor QEA 2020).

2.1 Water Quality Sampling

Water quality issues in the Chesapeake Bay range from variation in physical properties, such as temperature, salinity, dissolved oxygen (DO), and turbidity to loadings of nutrients. Excessive nutrients, such as nitrogen and phosphorus, cause the greatest impairments of water quality in the Chesapeake Bay. Surface water samples were collected from Barren Island and James Island to measure water quality. Standard protocols provided in *Methods and Quality Assurance for Chesapeake Bay Water Quality Monitoring Programs* (Chesapeake Bay Program 2017) were followed for target analytes, detection limits, methodologies, and sample holding times for the water samples.

Surface water samples were collected at 22 locations around James Island and Barren Island during the summer, fall, winter, and spring seasonal sampling events. Eleven locations were sampled from the area surrounding Barren Island (Figure 2-1) and 11 locations were sampled from the area surrounding James Island (Figure 2-2) during each of the seasonal sampling events (summer, fall, winter, and spring). A summary of the water quality sampling program, including sample locations and analyses, is provided in Table 2-1.

Water quality was analyzed by measuring a variety of physical properties and chemical constituents that can affect the health of the ecosystem and its living resources. During in situ water quality sampling, physical properties including temperature, pH, conductivity, salinity, DO, and turbidity were recorded using a water quality instrument placed directly in the waterbody. Water quality parameters were recorded at the surface, mid-depth, and bottom (within 1 foot) of the water column at each location.

Water was collected from the mid-depth of the water column, with care not to disturb the sediment, using a peristaltic pump and Tygon tubing. After the tubing was lowered to the appropriate depth, the water sample was then pumped directly into the appropriate pre-labeled sample containers. One 2-liter bottle of whole water was collected from each location. A 250-milliliter aliquot of water was filtered in the field using a syringe filter. All samples were placed in an ice filled cooler immediately after collection to ensure samples do not exceed the 4°C holding temperature. Samples were hand-delivered to Chesapeake Biological Laboratory in Solomons, Maryland for analysis on the same day as sample collection.

Sample filtration was conducted in the laboratory for particulate nitrogen, particulate phosphorus, particulate carbon, and total suspended solids analysis requirements within 8 hours of sample collection. The water samples were analyzed for total dissolved nitrogen, particulate nitrogen, nitrite, nitrate+nitrite, organic nitrogen, total dissolved phosphorus, orthophosphate, particulate phosphorus, particulate carbon, dissolved organic carbon, total nitrogen, total phosphorus, chlorophyll *a*, phaeophytin *a*, and total suspended solids (Table 2-1).

The Maryland Department of Natural Resources (MDNR) has a Chesapeake Bay Water Quality Monitoring Program (CBWQM) that has routinely sampled year-round in the Chesapeake Bay since 1985 and in the Coastal Bays since 1999. Five years of water quality data (2016 to 2020) from the CBWQM were summarized for the fixed monitoring stations closest to Barren Island (station CB5.1) and James Island (station EE2.2) (Figure 2-3) to provide context to the data collected during this effort.

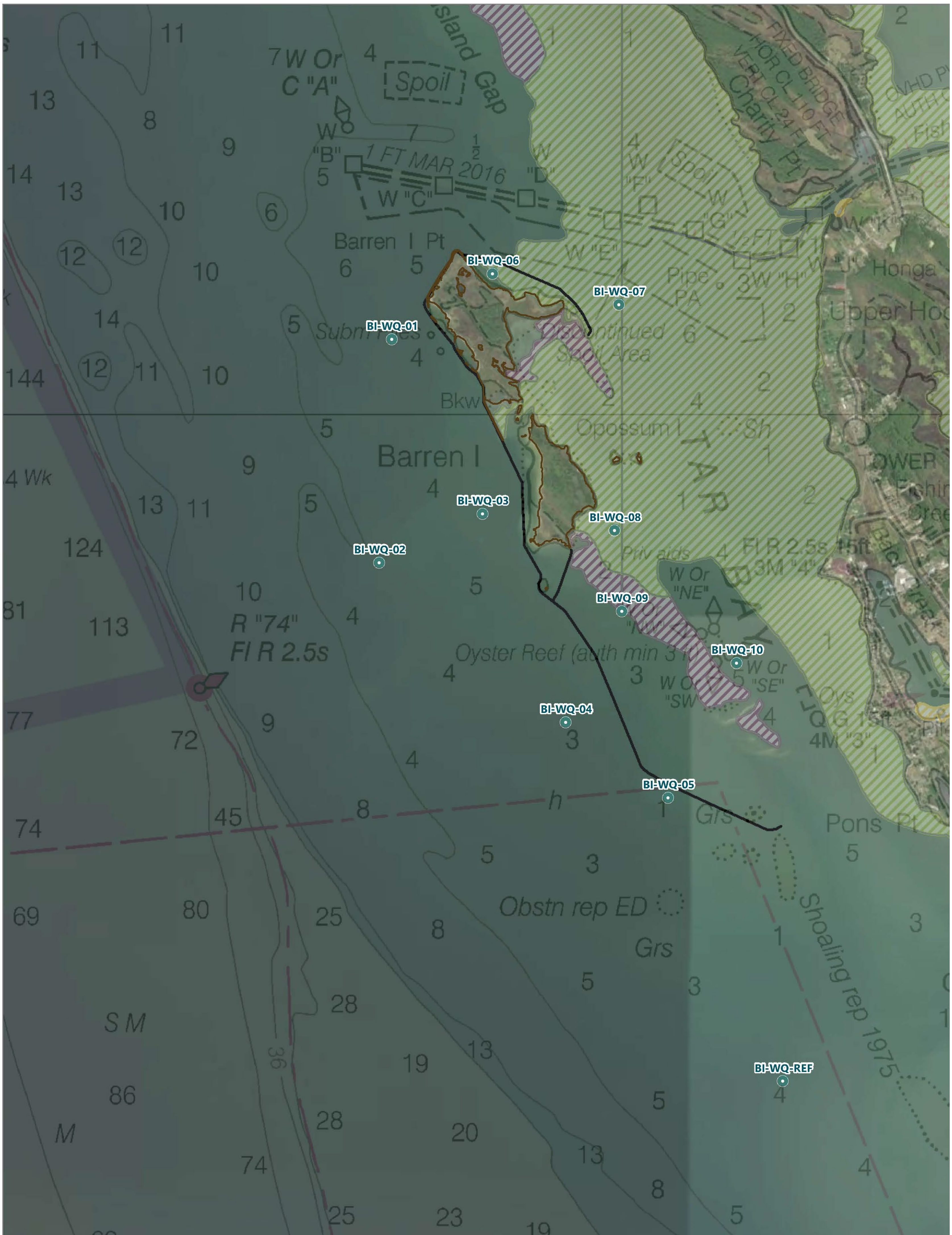
Station CB5.1 is located in the Mid-Chesapeake Bay, west of Barren Island in approximately 34.7 m (114 feet) of water. Station EE2.2 is located in approximately 12.5 m (41 feet) of water, near the mouth of the Little Choptank River approximately 1 mile northeast of James Island. The most recent 5 years of surface water quality data were used as a representative comparison to existing seasonal conditions because these samples most closely resemble the conditions during the sampling conducted for this study

Table 2-1
Surface Water Sampling and Analysis Program

Area	Location	Coordinates		Analyses																	
		Northing	Easting	Chlorophyll, Active	Phaeophytin	Chlorophyll	Dissolved Organic Carbon	Organic nitrogen	Organic phosphorus	Ammonium	Nitrite	Nitrite + Nitrate	Particulate Carbon	Particulate Nitrogen	Ortho Phosphate	Particulate Phosphorus	Dissolved Nitrogen	Dissolved Phosphorus	Total Nitrogen	Total Phosphorus	TSS
Barren Island	BI-WQ-01	245397.89	1522101.17	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
	BI-WQ-02	240208.01	1522056.52	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
	BI-WQ-03	241336.39	1524267.20	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
	BI-WQ-04	236431.80	1526327.91	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
	BI-WQ-05	234724.12	1528713.04	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
	BI-WQ-06	247001.33	1524609.28	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
	BI-WQ-07	246287.87	1527478.70	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
	BI-WQ-08	240986.37	1527469.03	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
	BI-WQ-09	239083.25	1527615.61	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
	BI-WQ-10	237930.38	1530390.49	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
	BI-WQ-REF	228030.52	1531651.51	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X

Area	Location	Coordinates		Analyses																	
		Northing	Easting	Chlorophyll, Active	Phaeophytin	Chlorophyll	Dissolved Organic Carbon	Organic nitrogen	Organic phosphorus	Ammonium	Nitrite	Nitrite + Nitrate	Particulate Carbon	Particulate Nitrogen	Ortho Phosphate	Particulate Phosphorus	Dissolved Nitrogen	Dissolved Phosphorus	Total Nitrogen	Total Phosphorus	TSS
James Island	JI-WQ-01	306620.99	1495951.99	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
	JI-WQ-02	304226.65	1499644.99	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
	JI-WQ-03	310221.64	1498541.50	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
	JI-WQ-04	317348.69	1494645.77	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
	JI-WQ-05	317283.65	1496764.28	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
	JI-WQ-06	313107.53	1499020.16	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
	JI-WQ-07	316178.11	1504175.97	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
	JI-WQ-08	313848.94	1503823.15	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
	JI-WQ-09	310872.55	1501695.80	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
	JI-WQ-10	307629.99	1501284.99	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
	JI-WQ-REF	228030.14	1531605.27	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X

Figure 2-1
Barren Island Water Quality Locations



LEGEND:

- Water Quality Sampling Location
- Barren Island Remnants
- Proposed Barren Island Protection

Existing SAV Bed

- Dense 70-100% cover
- Moderate 40-70% cover
- Sparse 10-20% cover

NOTES:
1. Basemaps obtained from Esri aerial imagery and NOAA raster nautical charts streaming services.

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Figure 2-2
James Island Water Quality Locations

LEGEND:

- Water Quality Sampling Location
- James Island Remnants
- Proposed James Island Access Channel

Existing SAV Bed

- Moderate 40-70% cover
- Sparse 10-20% cover
- Very Sparse 0-10% cover

NOTES:
1. Basemaps obtained from Esri aerial imagery and NOAA raster nautical charts streaming services.

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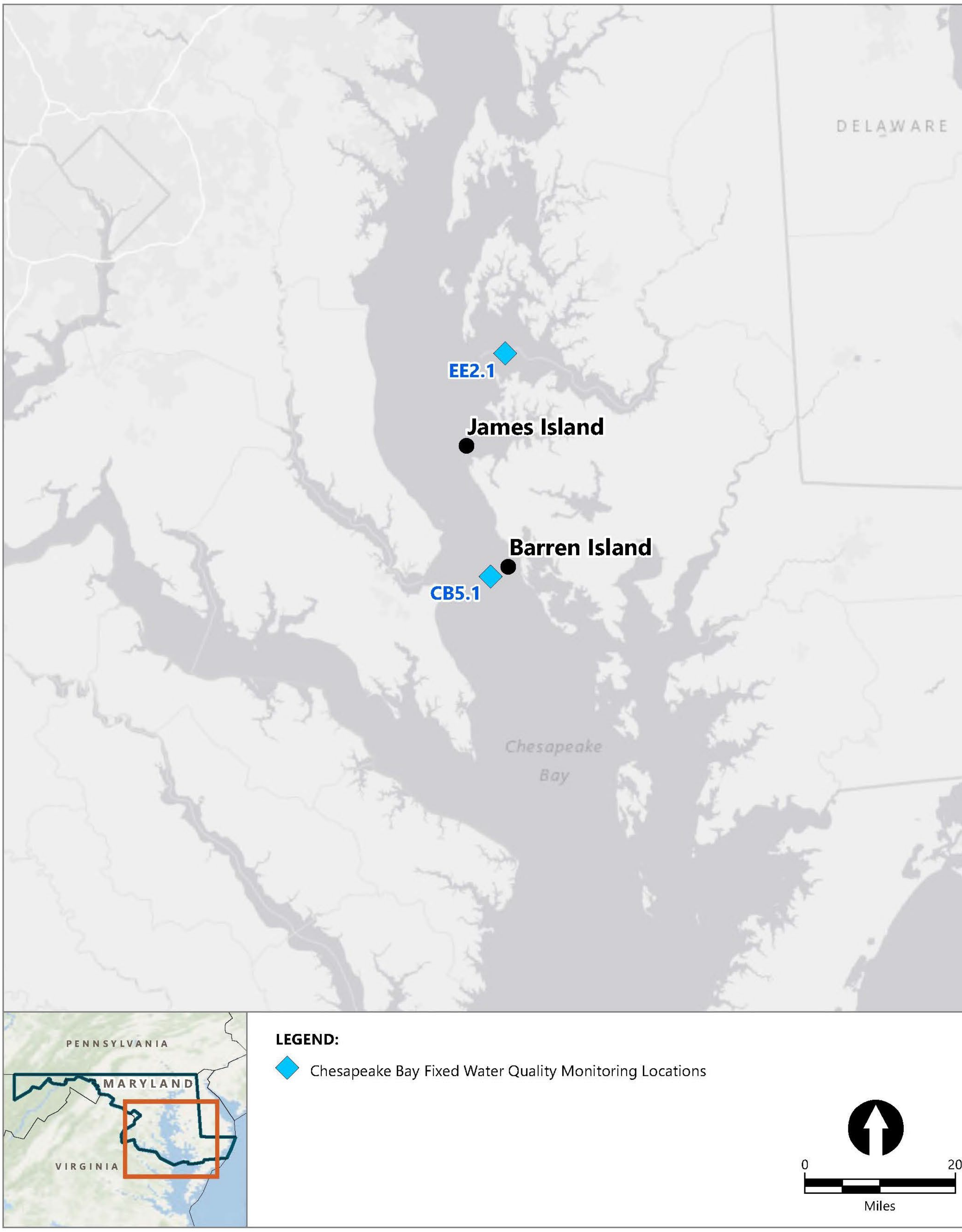
Figure 2-3
Chesapeake Bay Fixed Water Quality Monitoring Locations



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2.2 Benthic Community Sampling

Benthic community sample locations were colocated with the surface water sample locations. Ten locations were sampled from the area surrounding James Island (Figure 2-4), and 10 locations were all sampled from the area surrounding Barren Island (Figure 2-5) during the summer, fall, and spring sampling events. Additionally, benthic community reference sites were sampled for each island to evaluate the data collected from the sampling locations. Reference sites were sampled at the same time as the sampling locations to assess benthic community conditions outside the influence of restoration activities for each of the islands. The Barren Island reference sample was located approximately 1.5 miles south of the Project site (Figure 2-4). The James Island reference sample was located approximately 2 miles south of the Project site (Figure 2-5).

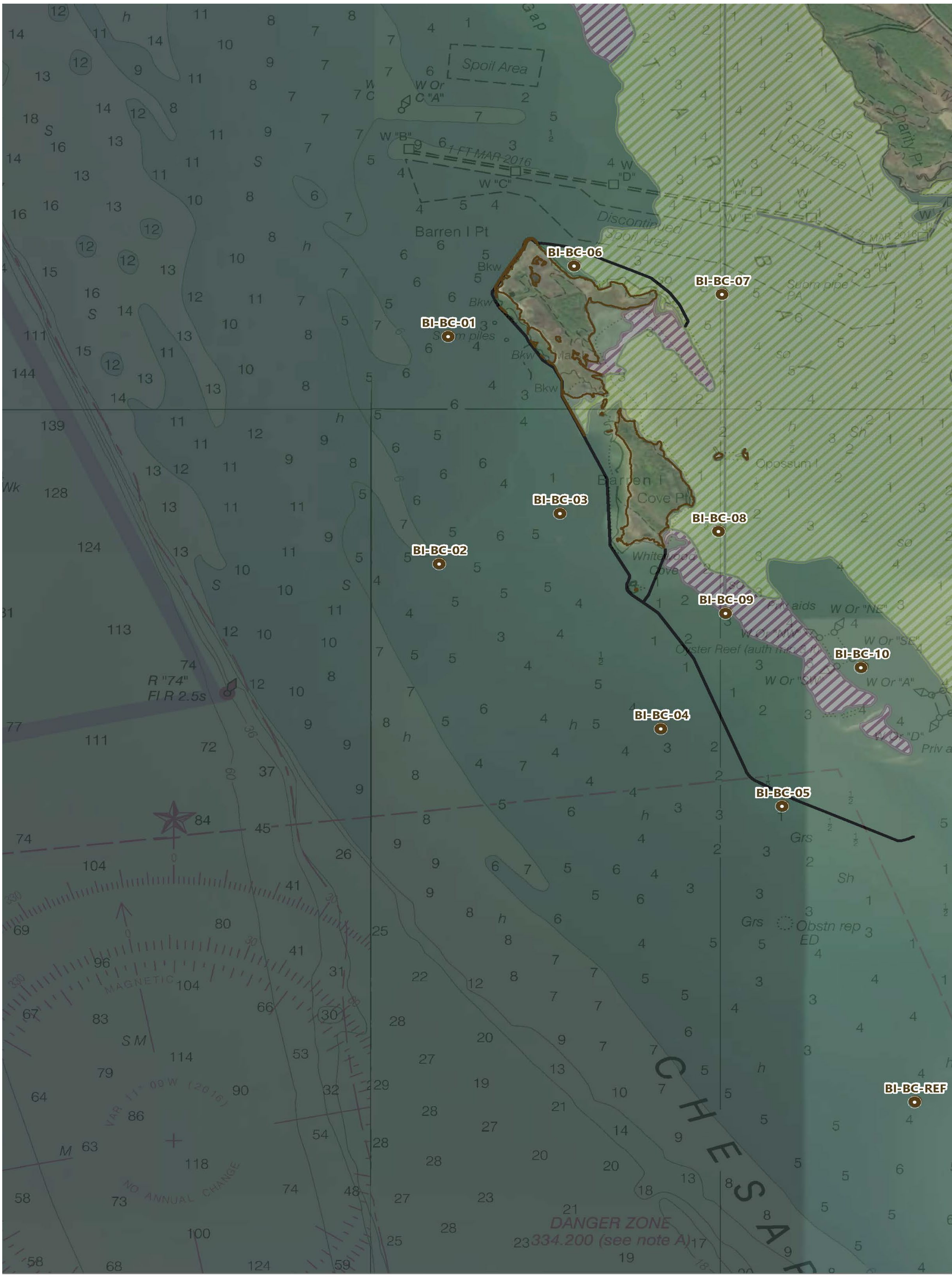
At each location, the water depth and in situ water quality parameters (including salinity, temperature, DO, and pH) were measured and recorded.

Sediment samples were collected using a stainless-steel sediment grab sampler (Ponar or equivalent), which is used to collect large-volume, undisturbed surficial sediment samples representative of the top 0 to 6 inches of the sediment. Triplicate grab samples were collected at each location to determine the benthic community composition. The top 0 to 6 inches of the sediment was collected and sieved in the field through a 500-micron screen to remove fine sediment particles. Individual replicates were transferred to sample containers and preserved in the field using buffered 10% formalin and rose-bengal solution. During the summer sampling event, sediment was collected at each location prior to the benthic community sample collection and submitted to an analytical laboratory for grain size and total organic carbon analysis.

The benthic community samples were delivered to Cove Corporation in properly preserved conditions and according to the requirements of the chain-of-custody protocols for sorting and identification. Cove Corporation conducted benthic sorting and taxonomic identification of organisms to the lowest practicable taxon for each of the samples.

In the laboratory, each sample was washed with tap water through a 500-micron sieve to remove the preservation in preparation for laboratory processing. All organisms were removed from the sample material. Representative organisms of each species from each location were collected and identified to the lowest practical taxonomic level. Because James Island and Barren Island are in the mesohaline portion of the Chesapeake Bay, determination of species biomass was required (Versar 2002).

Figure 2-4
Barren Island Benthic Community Locations



LEGEND:

- Benthic Community Sampling Location
- Barren Island Remnants
- Proposed Barren Island Protection

Existing SAV Bed

- Dense 70-100% cover
- Moderate 40-70% cover
- Sparse 10-20% cover

NOTES:
1. Basemaps obtained from Esri aerial imagery and NOAA raster nautical charts streaming services.

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Meters

Figure 2-5
James Island Benthic Community Locations

LEGEND:

- Benthic Community Sampling Location
- James Island Remnants
- Proposed James Island Access Channel

Existing SAV Bed

- Moderate 40-70% cover
- Sparse 10-20% cover
- Very Sparse 0-10% cover

0

Meters

NOTES:
1. Basemaps obtained from Esri aerial imagery and NOAA raster nautical charts streaming services.

2.2.1 Benthic Community Data Analysis

Results of the benthic community analysis from James Island and Barren Island were compared to Project-specific reference locations (JI-BC-REF and BI-BC-REF), to regional Chesapeake Bay Benthic Index of Biotic Integrity (B-IBI) values and the Chesapeake Bay Restoration Goal Index (RGI).

The following metrics were used to characterize the benthic community at sampling and reference locations at Barren Island and James Island:

- **Total Number of Taxa**: This is the total number of distinct taxa. This metric reflects the health of the community through a measurement of the variety of taxa present.
- **Shannon-Wiener Species Diversity Index (H')**: This index is one of the most widely used indices in the ecology community. The Shannon-Wiener Species Diversity index is calculated as shown in Equation 2-1:

Equation 2-1

$$H' = -\sum_{i=1}^{S} p_i \times \ln(p_i)$$

where:

H'	=	Shannon-Wiener Species Diversity Index
S	=	number of species per sample
p_i	=	proportion of total individuals in the ith species

- **Simpson's Dominance Index (c):** This varies from 0 to 1 and gives the probability that two individuals drawn at random from a population belong to the same species (Ludwig and Reynolds 1988). Simpson's Dominance Index incorporates species richness and evenness into a single value. The Simpson's Dominance Index is calculated as shown in Equation 2-2:

Equation 2-2

$$c = \sum \left(\frac{n_i}{N}\right)^2$$

where:

c	=	Simpson's Dominance Index
n_i	=	number of individuals in species i
N	=	total number of species

- **Species richness (d)**: This is the number of species in the community and is dependent on the sample size (Ludwig and Reynolds 1988). This index expresses the variety of one component of species diversity. Species richness at each location is the ratio between the total number of species (taxa) and the total number of individuals. It removes abundance variability among locations so that comparisons between locations are possible. This index expresses variety independent of an evenness index, which is incorporated in general indices of diversity. The Species Richness Index is calculated as shown in Equation 2-3:

Equation 2-3

$$d = \frac{S - 1}{\log N}$$

where:

d	=	species richness
S	=	number of species
N	=	number of individuals

- **Evenness (e)**: This is how the species abundances (e.g., the number of individuals, biomass) are distributed among the species (Ludwig and Reynolds 1988). Evenness is a measurement of the similarity of the abundances of different species. When all species are equally abundant, then evenness is 1, but when the abundances are very dissimilar (some rare and some common species), the value increases. Evenness is calculated as shown in Equation 2-4:

Equation 2-4

$$e = \frac{\overline{H}}{\log S}$$

where:

e	=	evenness
$\overline{H}$	=	Shannon-Wiener Species Diversity Index value
S	=	number of species

2.2.2 Chesapeake Bay Benthic Index of Biotic Integrity

Benthic invertebrates are used extensively as indicators of estuarine environmental status and trends because numerous studies have demonstrated that benthos respond predictably to many kinds of natural and anthropogenic stresses (Weisberg et al. 1997). The Chesapeake Bay B-IBI was developed by Weisberg et al. (1997) to assess benthic community health and environmental quality in the Chesapeake Bay. The Chesapeake Bay B-IBI evaluates the ecological condition of a sample by comparing values of key benthic community attributes, or metrics, to reference values expected under nondegraded conditions in similar habitat types (Versar 2002). Alden et al. (2002) conducted a series of statistical and simulation studies to evaluate and optimize the B-IBI. The results of Alden et al. (2002) indicated the Chesapeake Bay B-IBI is sensitive, stable, robust, and statistically sound.

Because the major factors that control the structure of benthic communities in the Chesapeake Bay are salinity and sediment type (Versar 2002), results of the grain size analysis and bottom salinity data were used to classify habitats for sampling locations at James Island and Barren Island. These habitat classifications were used to determine the metrics used to calculate the B-IBI for each location. Before Chesapeake Bay B-IBI metrics were calculated, samples were assigned to one of the following five salinity classes (Weisberg et al. 1997):

- Tidal freshwater (0 to 0.5 parts per thousand [ppt])
- Oligohaline (≥0.5 to 5 ppt)
- Low mesohaline (≥5 to 12 ppt)
- High mesohaline (≥12 to 18 ppt)
- Polyhaline (≥18 ppt)

The results of the salinity levels measured during the summer and fall benthic community sampling events and the grain size results from samples collected during the summer benthic community sampling event are provided in Table 2-2. All but one of the James Island sampling locations were classified high mesohaline sand (JI-BC-09 was classified as mesohaline mud) and the Barren Island benthic community sampling locations were classified as either high mesohaline mud or high mesohaline sand.

Table 2-2
Habitat Classification for Benthic Index of Biotic Integrity (B-IBI) Calculation

Area	Location	Salinity		Silt + Clay (%)	Habitat Classification
		Summer	Fall		
James Island	JI-01	13.4	15.8	2.1	High mesohaline sand
	JI-02	13.2	15.9	5.5	High mesohaline sand
	JI-03	13.2	16.5	7.2	High mesohaline sand
	JI-04	13.6	16.7	3.8	High mesohaline sand
	JI-05	13.4	16.6	6.1	High mesohaline sand
	JI-06	13.4	14.2	3.2	High mesohaline sand
	JI-07	13.4	16.5	2.5	High mesohaline sand
	JI-08	13.2	16	3.3	High mesohaline sand
	JI-09	13.2	16.3	49	High mesohaline mud
	JI-10	13.2	15.9	2.9	High mesohaline sand
	JI-REF	13.6	16	8.6	High mesohaline sand
Barren Island	BI-01	13	16.3	15.8	High mesohaline sand
	BI-02	13.3	16.5	5.5	High mesohaline sand
	BI-03	12.8	16	3.8	High mesohaline sand
	BI-04	13	15.7	5.4	High mesohaline sand
	BI-05	13.3	15.7	8.5	High mesohaline sand
	BI-06	12.9	15.5	72.9	High mesohaline mud
	BI-07	12.8	15.5	45.5	High mesohaline mud
	BI-08	13.1	15.7	48.6	High mesohaline mud
	BI-09	13	15.9	7.2	High mesohaline sand
	BI-10	13.5	15.6	66.6	High mesohaline mud
	BI-REF	13.7	16	5.2	High mesohaline sand

Notes:
salinity between 12 and 18 ppt = high mesohaline
silt + clay: <40% = sand; >40% = mud

The following are metrics used in the B-IBI calculations for mesohaline habitats:

1. **Shannon-Wiener Species Diversity Index (*H′*):** This index is one of the most widely used indices in ecology community. The Shannon-Wiener Species Diversity Index is calculated using Equation 2-1.
2. **Total Species Abundance:** Total number of organisms present in a sample after dropping the epifauna and incidental species excluded from the B-IBI calculation (Versar 2002). The total species abundance will be normalized to the number of organisms per unit area. The conversion factor for the Ponar grab is 1 count = 20.4 individuals per square meter (m^2).

3. **Total Species Biomass:** The total biomass (measured as ash free dry weight) of organisms present in a sample after dropping the epifauna and incidental species excluded from the B-IBI calculation (Versar 2002). The total biomass is normalized to the biomass of organisms per unit area.
4. **Percent Abundance of Carnivores and Omnivores:** Percent abundance contribution of taxa classified as carnivores or omnivores to the total abundance of organisms in a sample. The list of taxa that are defined as carnivores or omnivores is provided in Versar (2002).
5. **Percent Abundance of Stress-Indicative Taxa:** This metric will be calculated as the percentage of total abundance represented by stress-indicative taxa. This metric is included only in the high mesohaline sand classification for the B-IBI. This metric is not appropriate for use in areas of high mesohaline mud because the metric may not be sensitive (or indicative) in all benthic habitats. Benthic communities differ significantly according to habitat type, and the metrics appropriate to each type were chosen based upon their sensitivity within various benthic habitats. The list of taxa that are defined as pollution-indicative for the Chesapeake Bay is provided in Versar (2002).
6. **Percent Abundance of Stress-Sensitive Taxa:** This metric will be calculated as the percentage of total abundance represented by stress-sensitive taxa. This metric is included only in the high mesohaline sand classification for the B-IBI. The list of taxa that are defined as pollution-indicative for the Chesapeake Bay is provided in Versar (2002).

Based on the habitat type, the results from the appropriate metrics specific to the habitat type were used to calculate the B-IBI for each benthic community sampling location. The metrics and resulting scores for high mesohaline sand and high mesohaline mud habitats used to calculate the Chesapeake Bay B-IBI are presented in Table 2-3.

The Chesapeake Bay B-IBI approach involves scoring each metric as 5, 3, or 1, depending on whether its value at a location approximates (5), deviates slightly (3), or deviates greatly (1) from conditions at reference sites (Weisberg et al. 1997). The final Chesapeake Bay B-IBI score is derived by summing individual scores for each metric and calculating an average score.

Table 2-3
Scoring Criteria for Biotic Integrity (B-IBI) Calculations

Metric	Scoring Criteria for Mesohaline Habitat		
	5	3	1
High Mesohaline Sand			
Shannon-Wiener Species Diversity Index	≥3.2	2.5 to 3.2	<2.5
Abundance (organisms/m^2)	≥1,500 to 3,000	1,000 to 1,500 or ≥3,000 to 5,000	<1,000 or ≥5,000

Metric	Scoring Criteria for Mesohaline Habitat		
	5	3	1
Biomass (g/m^2)	≥3 to 15	1 to 3 or ≥15 to 50	<1 or ≥50
Abundance pollution-indicative taxa (%)	≤10	10 to 25	>25
Abundance pollution-sensitive taxa (%)	≥40	10 to 40	<10
Abundance of carnivores and omnivores (%)	≥35	20 to 35	<20
High Mesohaline Mud			
Shannon-Wiener Species Diversity Index	≥3.0	2.0 to 3.0	<2.0
Abundance (organisms/m^2)	≥1,500 to 2,500	1,000 to 1,500 or ≥2,500 to 5,000	<1,000 or ≥5,000
Biomass (g/m^2)	≥2 to 10	0.5 to 2 or ≥10 to 50	<0.5 or ≥50
Abundance pollution-indicative taxa (%)	≤5	5 to 30	>30
Abundance pollution-sensitive taxa (%)	≥60	30 to 60	<30
Abundance of carnivores and omnivores (%)	≥25	10 to 25	<10
Biomass deeper than 5 centimeters (%)	≥60	10 to 60	<10

The B-IBI is used to establish benthic restoration goals for the Chesapeake Bay (Weisberg et al. 1997). The Chesapeake Bay RGI (Ranasinghe et al. 1994) was patterned after the same approach used to develop the IBI for freshwater systems (Karr et al. 1986). A Chesapeake Bay RGI value of 3.0 represents the minimum restoration goal, and Chesapeake Bay RGI values of less than 3.0 are indicative of a stressed community. Values of 3.0 or greater indicate habitats that meet or exceed the restoration goals (Ranasinghe et al. 1994).

Based on the Chesapeake Bay RGI, the Chesapeake Bay Benthic Monitoring Program classifies the benthic community in four levels (Versar 2002):

- Meets restoration goals (Chesapeake Bay B-IBI that is ≥3.0)
- Marginal (Chesapeake Bay B-IBI of 2.7 to 2.9)
- Degraded (Chesapeake Bay B-IBI of 2.1 to 2.6)
- Severely degraded (Chesapeake Bay B-IBI that is ≤2.0)

A Chesapeake Bay B-IBI value of 3.0 is the threshold value between degraded and nondegraded conditions at a location.

2.3 Fisheries Surveys

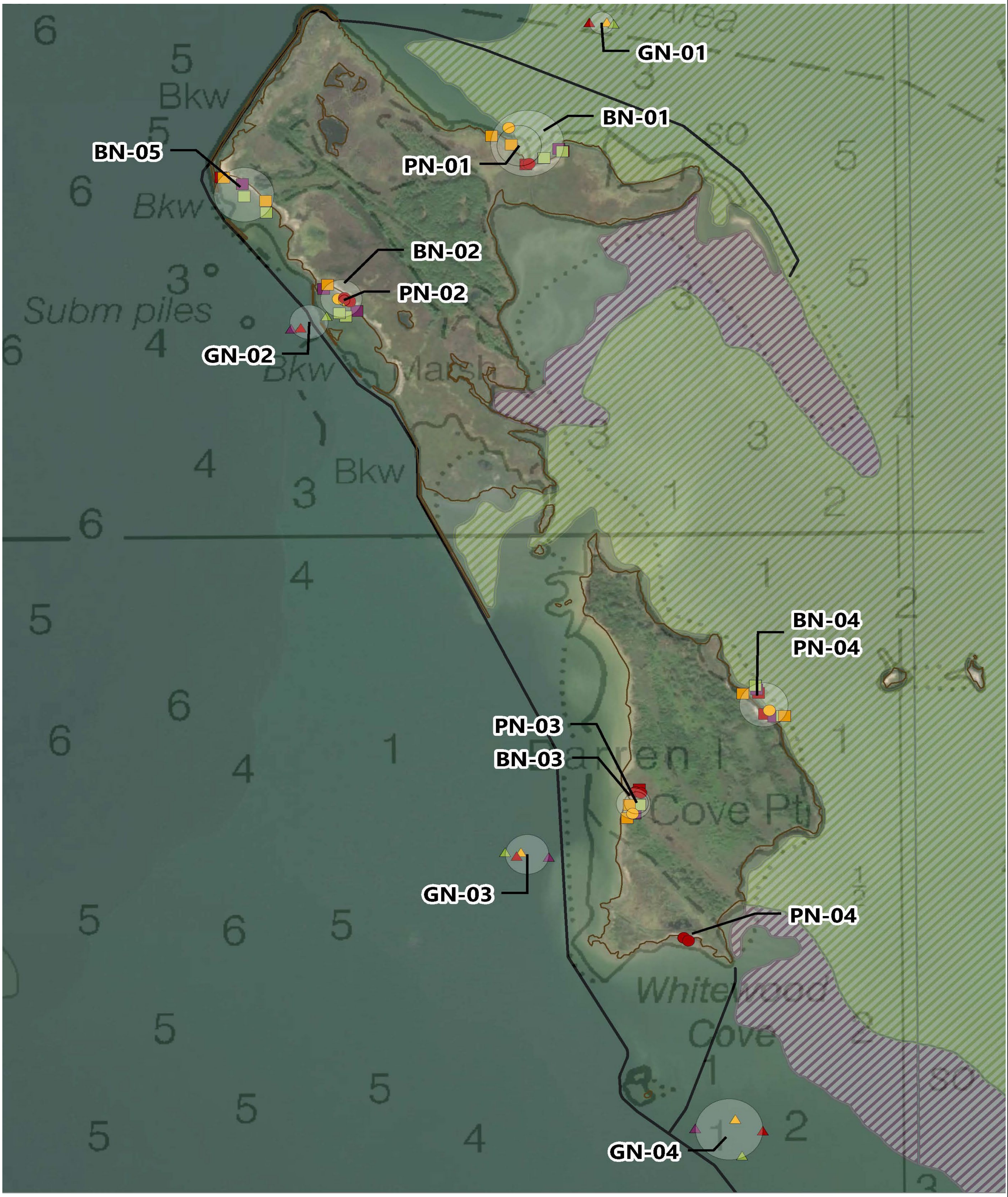
Littoral and subtidal habitats support diverse populations of numerous species of finfish and macroinvertebrates. These habitats are used as rearing areas, migration corridors, spawning areas, and places of refuge from predators. Fisheries surveys were conducted to document existing fish and blue crab (*Callinectes sapidus*) communities in the vicinity of James Island and Barren Island.

The fish community surveys were completed using multiple types of fish collection gear, depending on the habitat in which the sampling gear will be used. Sample gear will include beach seines, bottom trawls, gillnets, and pop nets. Sample locations for Barren Island and James Island fisheries surveys are provided in Figures 2-6a and b and 2-7a and b, respectively.

Beach seining, bottom trawls, and gillnets were used during all four sampling seasons (summer, fall, winter, and spring). Pop nets were used only during the summer sampling season (August 2020) and the spring sampling season (May 2021). All captured species were returned to the water immediately following processing.

At each location for each type of sampling, water depth, and water quality parameters (temperature, pH, DO, turbidity, and salinity) were measured from the mid-depth of the water column.

Figure 2-6a
Barren Island Fisheries Survey Locations



LEGEND:

- Barren Island Remnants
- Proposed Barren Island Protection

Existing SAV Bed

- Dense 70-100% cover
- Sparse 10-20% cover

SAMPLING EVENT:

Popnet Samples	Gillnet Samples	Beach Seine Samples	Fisheries Trawl
Summer	Summer	Summer	Summer
Spring	Fall	Fall	Fall
	Winter	Winter	Winter
	Spring	Spring	Spring

NOTES:

1. Basemaps obtained from Esri aerial imagery and NOAA raster nautical charts streaming services.

2. PN-04 was re-located during the spring sampling event due to changes in habitat conditions at the original sampling location.

0 400
Meters

Figure 2-6b
Barren Island Fisheries Survey Locations

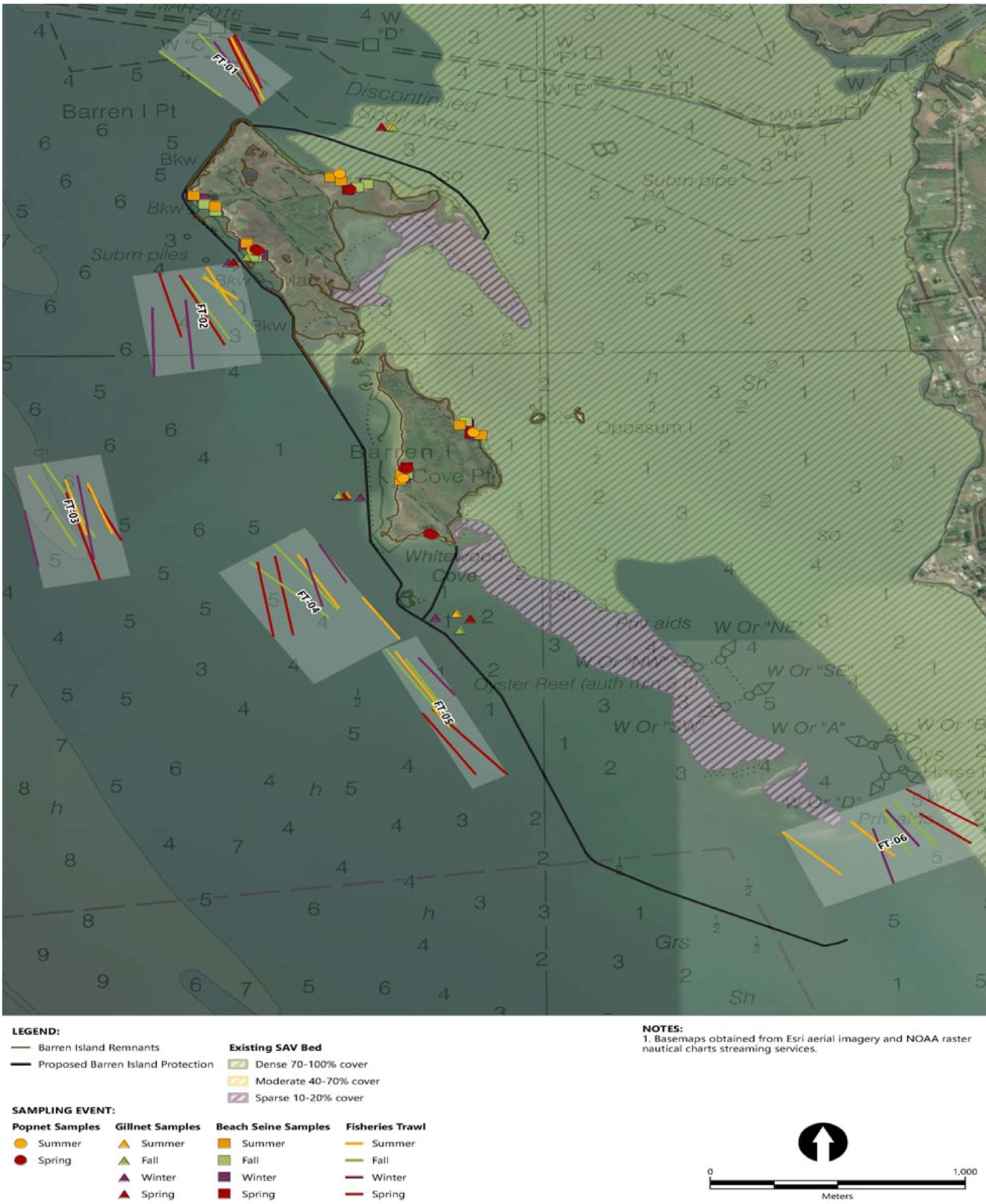
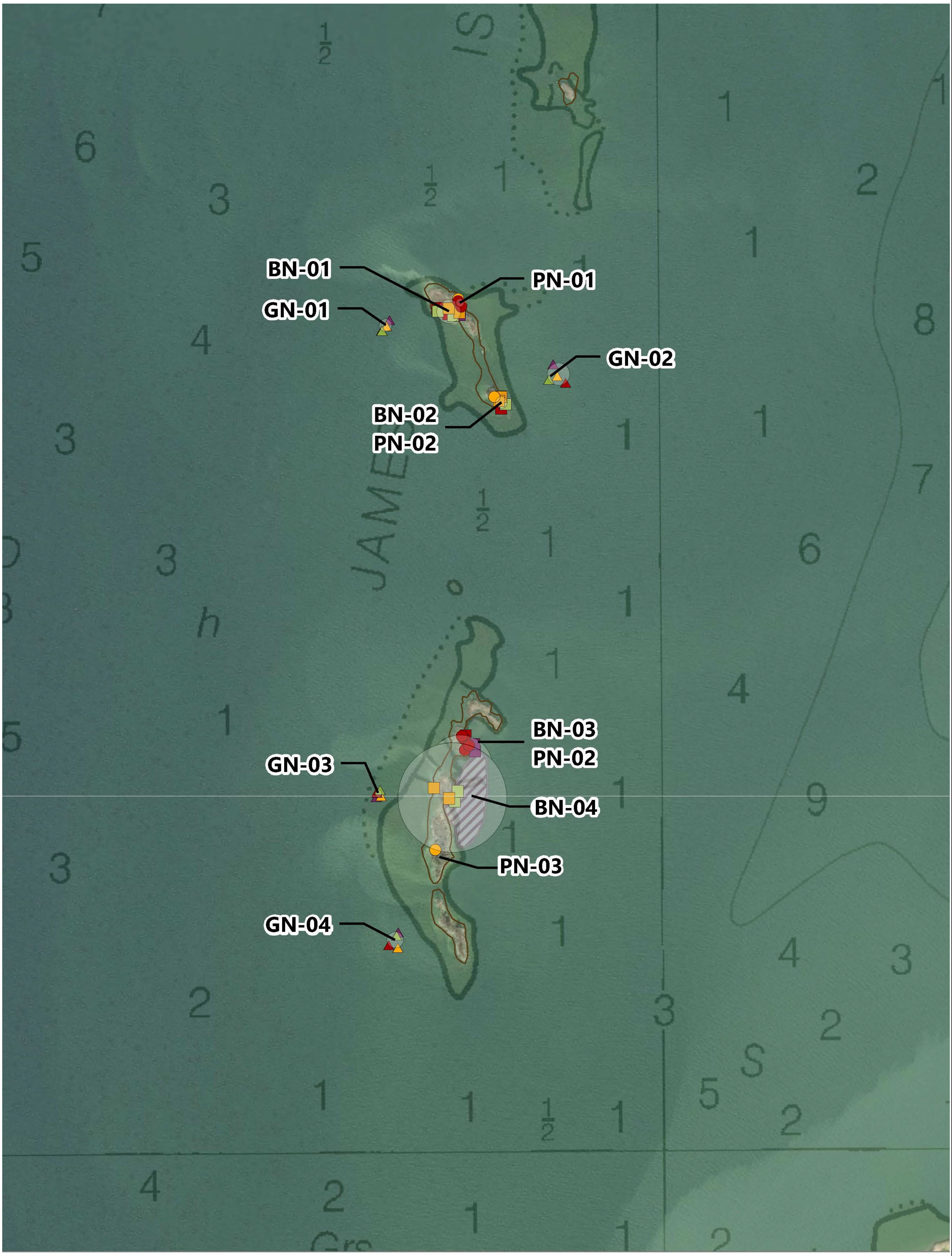


Figure 2-7a
James Island Fisheries Survey Locations



LEGEND:

James Island Remnants

Existing SAV Bed

Sparse 10-20% cover

NOTES:

1. Basemaps obtained from Esri aerial imagery and NOAA raster nautical charts streaming services.

2. PN-02 was re-located during the spring sampling event due to changes in habitat conditions at the original sampling location.

SAMPLING EVENT:

Popnet Samples	Gillnet Samples	Beach Seine Samples	Fisheries Trawl
Summer	Summer	Summer	Summer
Spring	Fall	Fall	Fall
	Winter	Winter	Winter
	Spring	Spring	Spring

0 400
Meters

Figure 2-7b
James Island Fisheries Survey Locations

LEGEND:

- James Island Remnants
- Proposed James Island Access Channel

Existing SAV Bed

- Moderate 40-70% cover
- Sparse 10-20% cover

SAMPLING EVENT:

Popnet Samples	Gillnet Samples	Beach Seine Samples	Fisheries Trawl
Summer	Summer	Summer	Summer
Spring	Fall	Fall	Fall
	Winter	Winter	Winter
	Spring	Spring	Spring

NOTES:
1. Basemaps obtained from Esri aerial imagery and NOAA raster nautical charts streaming services.

0 1,000
Meters

2.3.1 Beach Seining

Beach seines were used to collect data on nearshore fish assemblages in the Project area. Locations were chosen to represent various types of offshore-zone habitat as well as the eastern and western sides of the islands. Three locations were sampled at James Island (Figure 2-7a and b), and five locations were sampled at Barren Island (Figure 2-6a and b) during all seasons. Coordinates for all sampling locations were documented by differential global positioning system (DGPS).

A 100-foot seine net was used to sample the seine locations. The net was deployed in an arc, perpendicular to the shoreline, to sample approximately 30 meters of shoreline. Two consecutive and adjacent hauls were made at each of the locations for a combined shoreline distance of approximately 60 meters.

All fish and crab collected in the seine net were identified to the lowest practicable taxon and counted before being returned to the water. A representative subsample of up to 50 individuals for each species for each haul were measured to the nearest millimeter. For each location, the total number of organisms collected during the two hauls were summed for a total count. During the spring sampling event only, a representative subsample of up to 50 individuals for each species for each haul was weighed to the nearest 0.1 gram (g).

2.3.2 Bottom Trawling

Bottom trawls were used to collect data on the benthic or demersal assemblages present in the vicinity of the Project. Bottom trawl surveys were conducted during all four seasons (summer, fall, winter, and spring).

Bottom trawling was conducted at 12 locations: six at Barren Island (Figure 2-6a and b) and six at James Island (Figure 2-7a and b). Locations were chosen to represent various types of offshore-zone habitat as well as the eastern and western sides of the islands. Two separate 5-minute otter trawl tows were conducted at each location. For each location, the total number of organisms collected during the two trawl tows were summed to represent 10 minutes of total effort. All fish and crab collected in the bottom trawls were identified to the lowest practicable taxon and counted before being returned to the water. A representative subsample of up to 50 individuals for each species at each location were measured to the nearest millimeter. During the spring sampling event only, a representative subsample of up to 50 individuals for each species for each haul was weighed to the nearest 0.1 g.

2.3.3 Gillnetting

Gillnetting was used to collect data on fish present throughout the water column near James Island and Barren Island. Gillnet surveys were conducted during all four seasons (summer, fall, winter, and spring).

Gillnets were set at eight locations, four at James Island (Figure 2-7a and b) and four at Barren Island (Figure 2-6a and b). Coordinates for all sampling locations were documented by DGPS. One gillnet was set per location. The gillnets were 100 feet in length with five panels of varying mesh sizes ranging from 0.75 inch to 2.5 inches to target all fish species. All organisms collected in the gillnets were identified to the lowest practicable taxon and counted before being returned to the water. A representative subsample of up to 50 individuals for each species from each location was measured to the nearest millimeter. During the spring sampling event only, a representative subsample of up to 50 individuals for each species was weighed to the nearest 0.1 g.

2.3.4 Pop Nets

Pop nets were used to collect data on nearshore fish assemblages and blue crab communities present near the Project area. Pop nets were used only during the summer sampling season (August 2020) and the spring sampling season (May 2021).

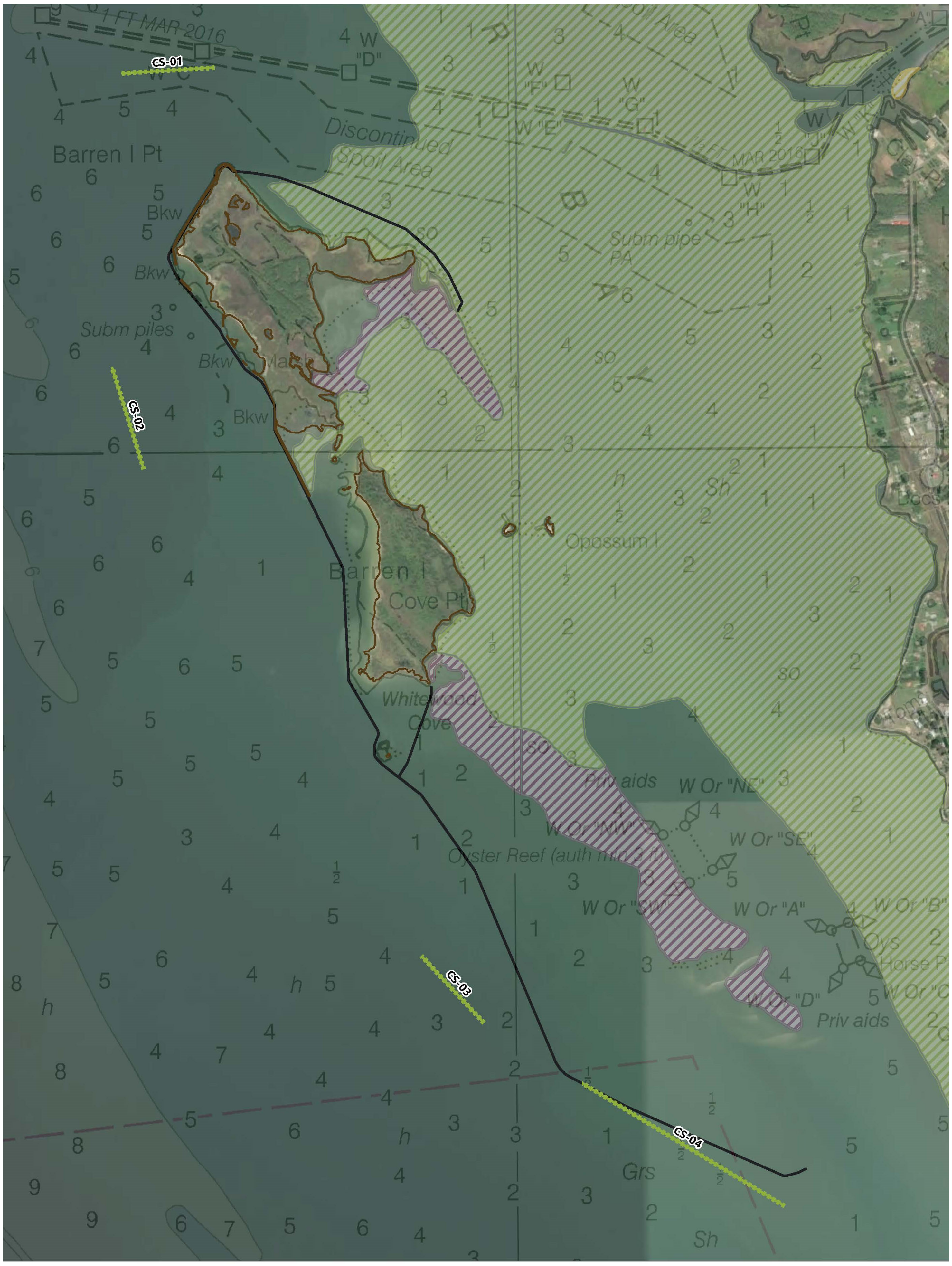
Pop nets were deployed at seven locations, three at James Island (Figure 2-7a and b) and four at Barren Island (Figure 2-6a and b). Coordinates for all sampling locations were documented by DGPS. Pop nets were set in areas as close to the beach seine locations as possible and in areas of SAV, if present. Two pop nets were set at each sampling location to collect two consecutive samples during the daytime high tide. Pop nets were set for at least one full tidal cycle to reduce interference from deploying the pop net. The pop nets were released approximately 2 hours after peak daytime high tide. All organisms collected in the pop nets were identified to the lowest practicable taxon and counted before being returned to the water. The total length of a representative subsample of up to 50 individuals for each species was measured from each pop net. During the spring sampling event, a representative subsample of up to 50 individuals for each species for each haul was weighed to the nearest 0.1 g.

2.4 Bivalve Surveys

A commercial clammer licensed to catch soft-shell clams was contracted to perform the bivalve surveys in the Project area. This survey was completed during the fall season only. Nine transects were surveyed in total: four transects at Barren Island (Figure 2-8) and five transects at James Island (Figure 2-9). The transects were approximately 100 to 200 meters in length and required approximately 15 minutes to complete. For each transect, the water depth and in situ water quality parameters were measured. The water quality parameters were measured from the mid-depth of the water column and included temperature, salinity, pH, and DO.

A hydraulic dredge was used to conduct the bivalve surveys. After each transect had been completed, the bivalves collected during the survey were processed. Soft-shell clams were sorted into two categories based on size: 1) legal harvestable size of 2 inches or greater; and 2) sublegal size less than 2 inches. The number of individuals in each size class were counted. All other bivalves were identified, counted, and measured.

Figure 2-8
Barren Island Bivalve Survey Locations



LEGEND:

- Barren Island Remnants
- Proposed Barren Island Protection

Existing SAV Bed

- Dense 70-100% cover
- Moderate 40-70% cover
- Sparse 10-20% cover

SAMPLING EVENT:

Clam Survey

- Fall

NOTES:
1. Basemaps obtained from Esri aerial imagery and NOAA raster nautical charts streaming services.

0 760
Meters

Figure 2-9
James Island Bivalve Survey Locations

LEGEND:

- James Island Remnants
- Proposed James Island Access Channel

Existing SAV Bed

- Moderate 40-70% cover
- Sparse 10-20% cover

NOTES:
1. Basemaps obtained from Esri aerial imagery and NOAA raster nautical charts streaming services.

SAMPLING EVENT:
Clam Survey

- Fall

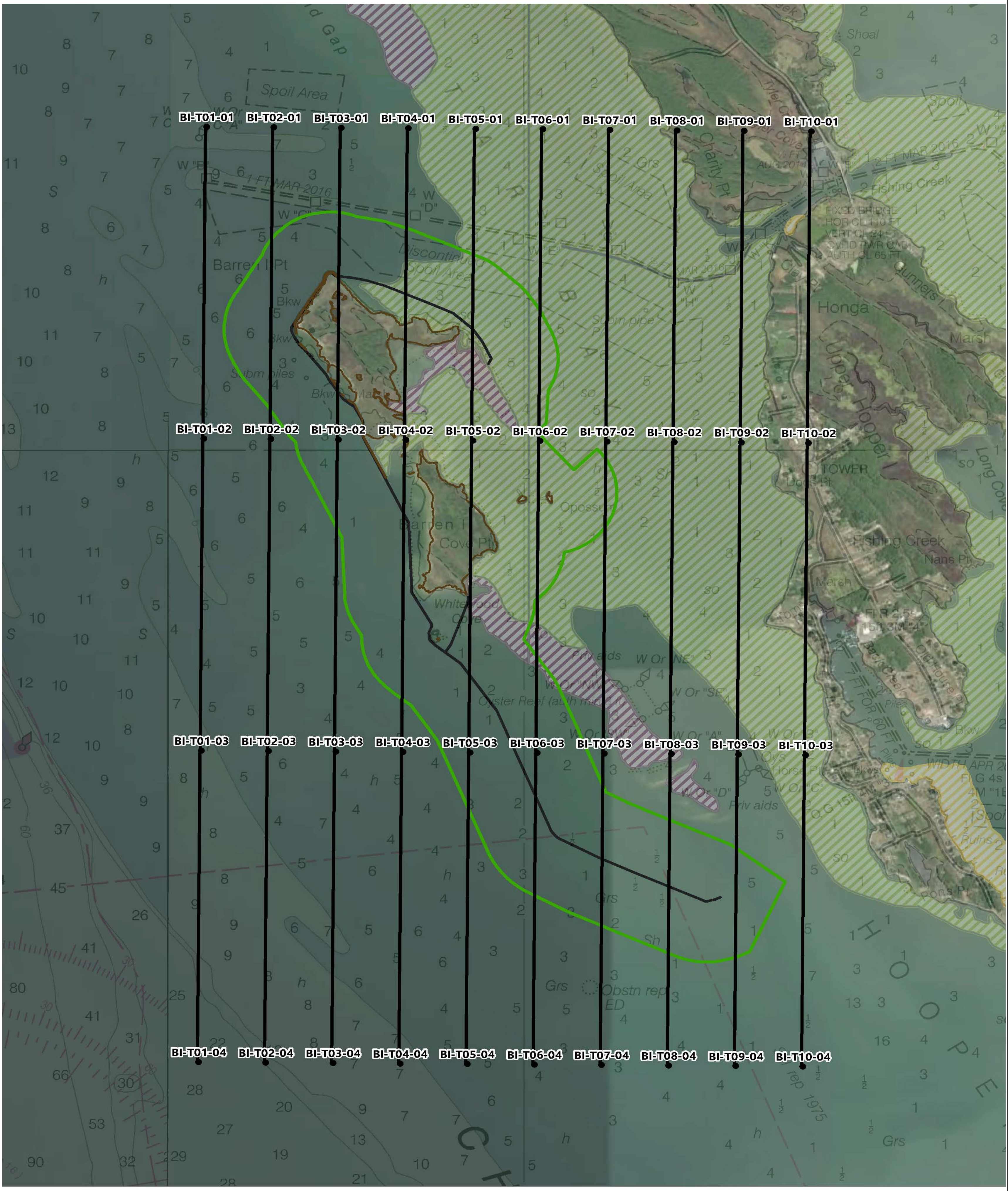
0 700
Meters

2.5 Crab Pot Surveys

Crab pot surveys were completed in August 2020, September 2020, May 2021, June 2021, and July 2021 at Barren Island and James Island. The survey area included the proposed restoration footprint plus a 0.25-mile perimeter. The crab pot survey area at Barren Island is 1,619 acres, and the survey area at James Island covers a total of 3,846 acres.

Crab pots were enumerated by counting the visible buoys marking the locations of crab pots. Transects were established within the survey area to ensure complete coverage of the crab pot survey area. Transects were drawn from north to south over the survey area, and two mid-transect points were used to document the location and relative density of the crab pots observed between the points along each transect. Figures 2-10 and 2-11 show the survey transects and survey areas for Barren Island and James Island, respectively. Only crab pots within the survey boundary were included in the total counts for the survey.

Figure 2-10
Barren Island Crab Pot Survey Transects



LEGEND:

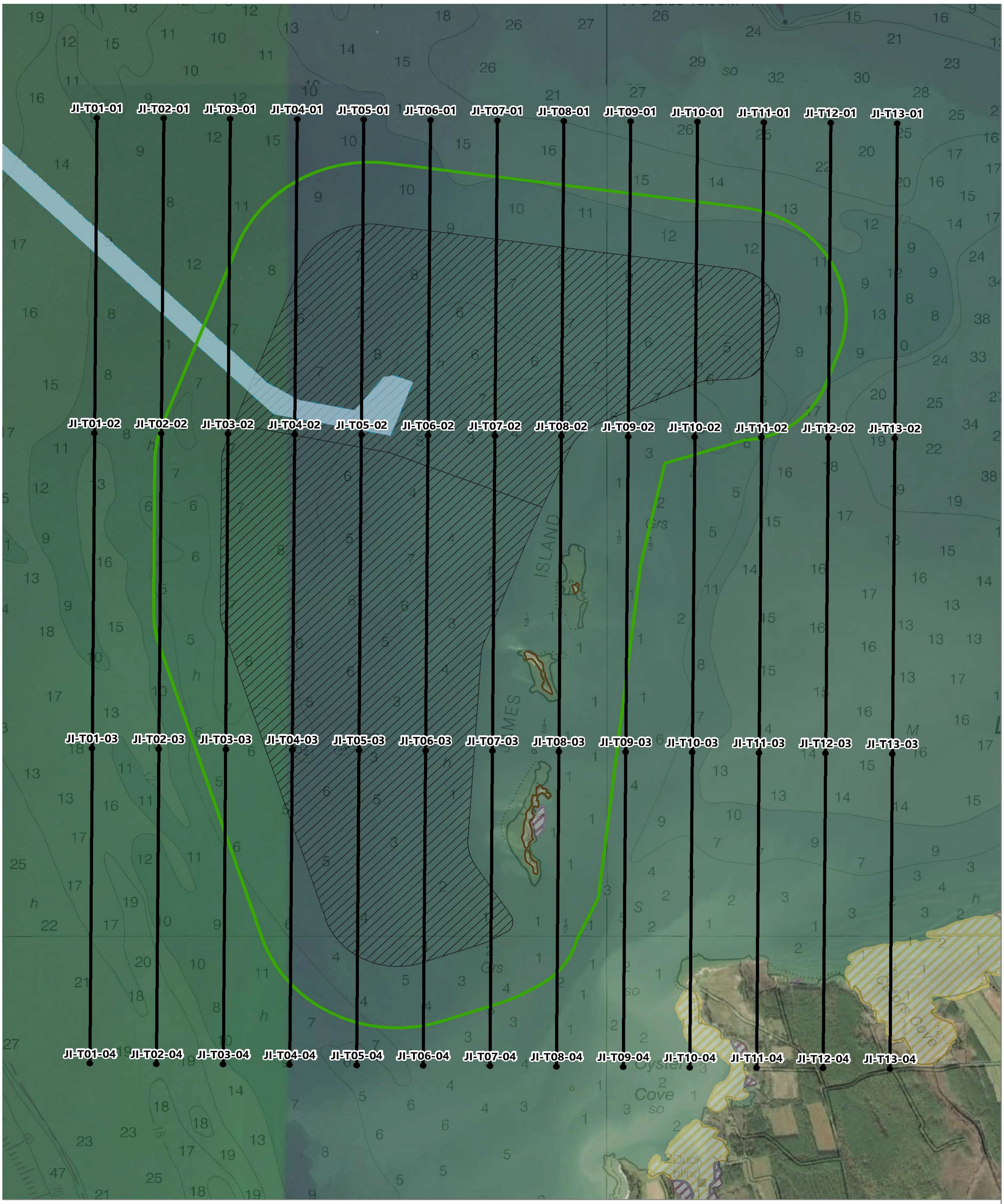
- Barren Island Remnants
- Proposed Barren Island Protection
- Crabpot Survey Footprint
- Crabpot Survey Point
- Crabpot Survey Transect

Existing SAV Bed

- Dense 70-100% cover
- Moderate 40-70% cover
- Sparse 10-20% cover

NOTES:
1. Basemaps obtained from Esri aerial imagery and NOAA raster nautical charts streaming services.
2. Crabpot survey boundary includes the area within 0.25 mile of the proposed restoration footprint and remnants.

Figure 2-11
James Island Crab Pot Survey Transects



LEGEND:

- James Island Remnants
- Proposed James Island Access Channel
- Proposed James Island Alignment
- Crabpot Survey Footprint
- Crabpot Survey Point
- Crabpot Survey Transect

Existing SAV Bed

- Moderate 40-70% cover
- Sparse 10-20% cover
- Very Sparse 0-10% cover

NOTES:
1. Basemaps obtained from Esri aerial imagery and NOAA raster nautical charts streaming services.
2. Crabpot survey boundary includes the area within 0.25 mile of the proposed restoration footprint and remnants.

2.6 Avian Surveys

Avian surveys were conducted at nine locations in summer 2020: four at James Island and five at Barren Island. Sampling locations aimed to capture the range of habitats available (e.g., forest, scrub-shrub, salt marsh, open water, mudflat, and shoreline). Final locations were determined in the field based on site conditions, site access, and representativeness of the habitat conditions. The Barren Island avian survey locations are provided in Figure 2-12. The avian survey locations for the northern and southern remnants of James Island are provided in Figures 2-13 and 2-14, respectively.

At each sampling location, two 15-minute timed observations were conducted to provide a survey of the entire 360° viewshed. The first observation was oriented in a 180° arc along the shoreline and running out to open water. For the second observation, the observer turned 180° to observe the remaining shoreline and an arc running over the island. The pair of timed observations were conducted twice at each location during the surveys, once in the early morning and once at midday, so that surveys were conducted during both high- and low-tide conditions. At each of the sampling locations during the observation period, all birds heard or observed with binoculars or a spotting scope were identified and counted, and behavioral observations were recorded. Incidental bird observations made outside the survey periods were also noted.

Figure 2-12
Barren Island Avian Observation Locations

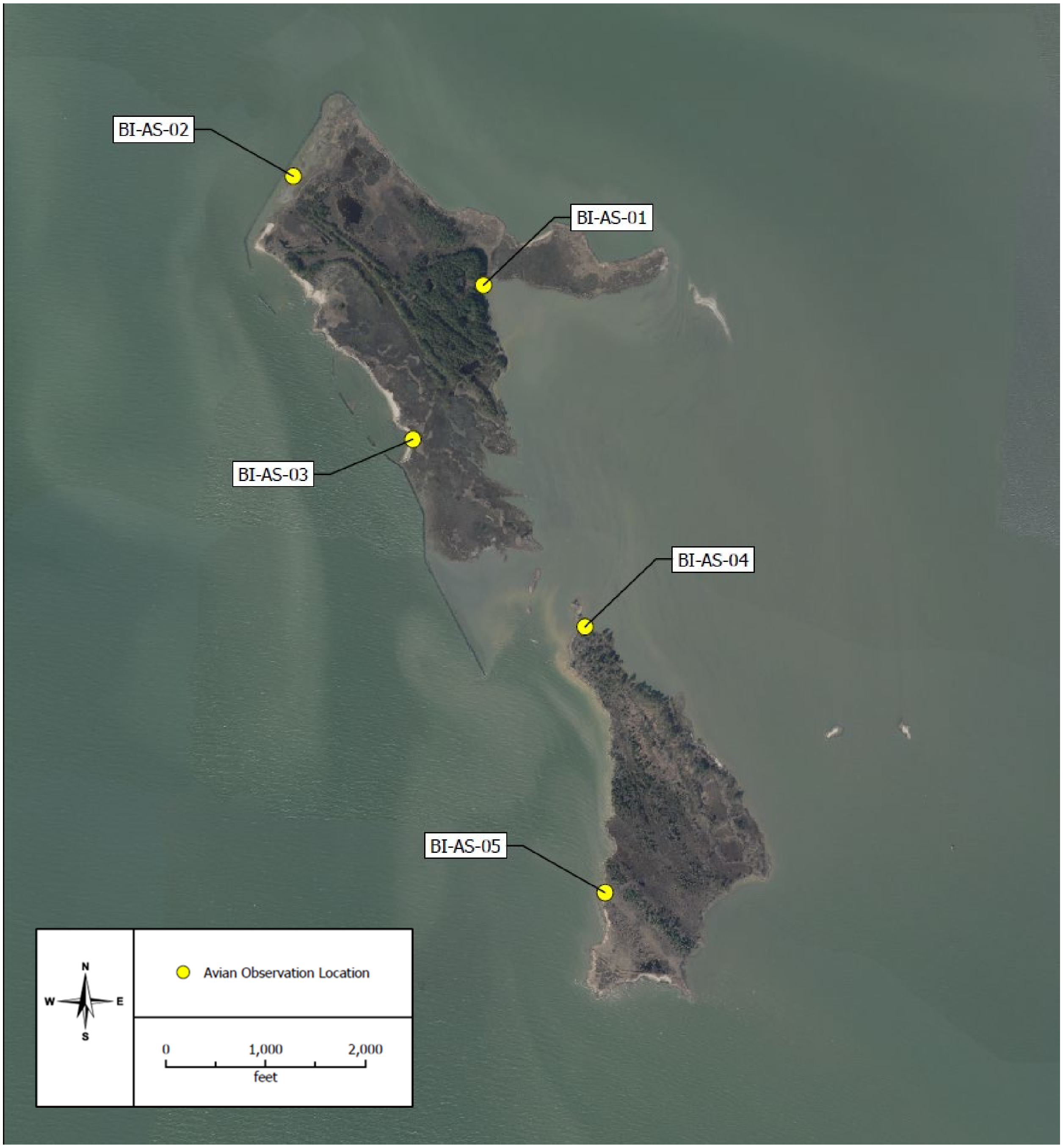


Figure 2-13
James Island Avian Observation Locations (Northern Remnants)

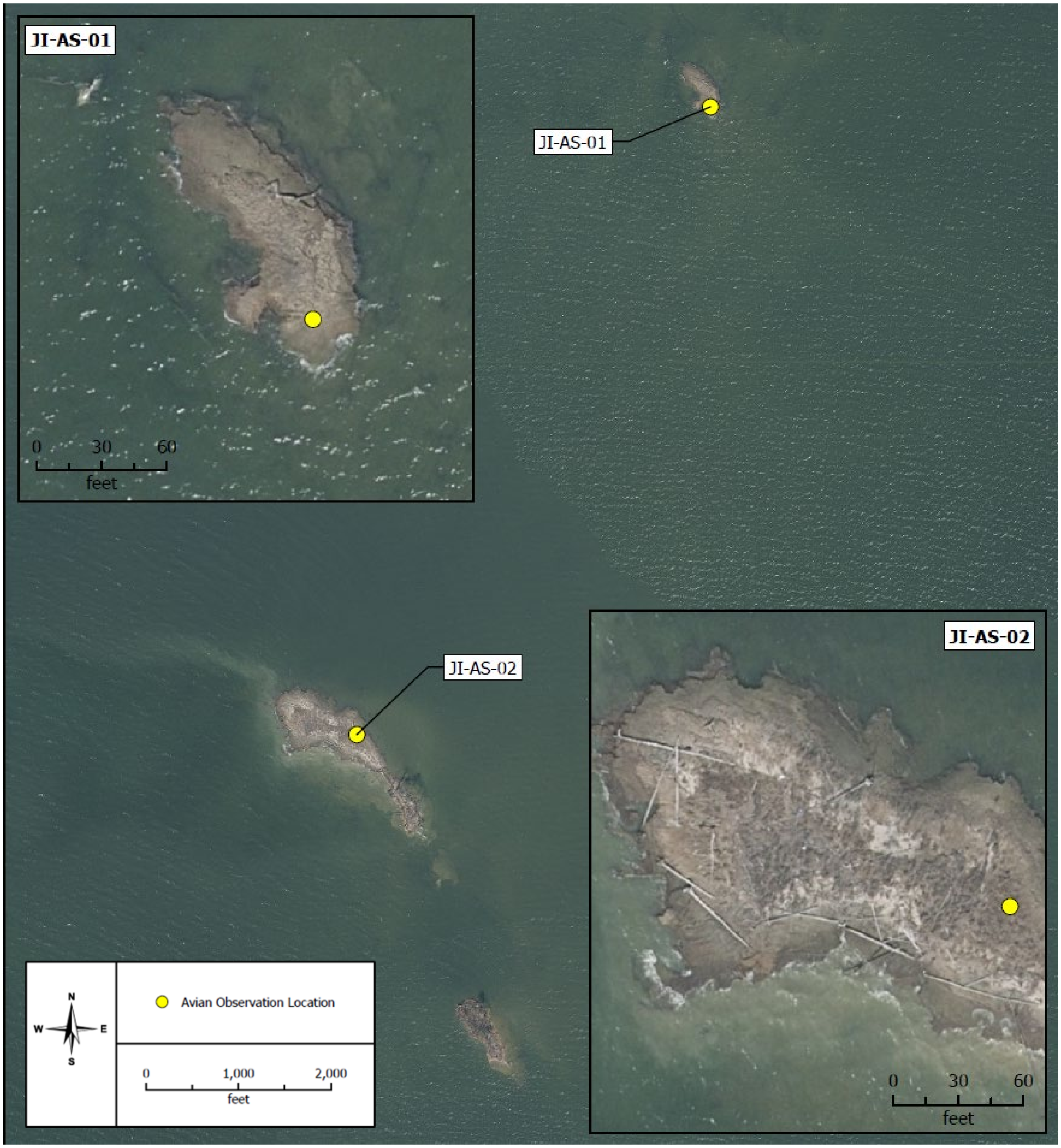
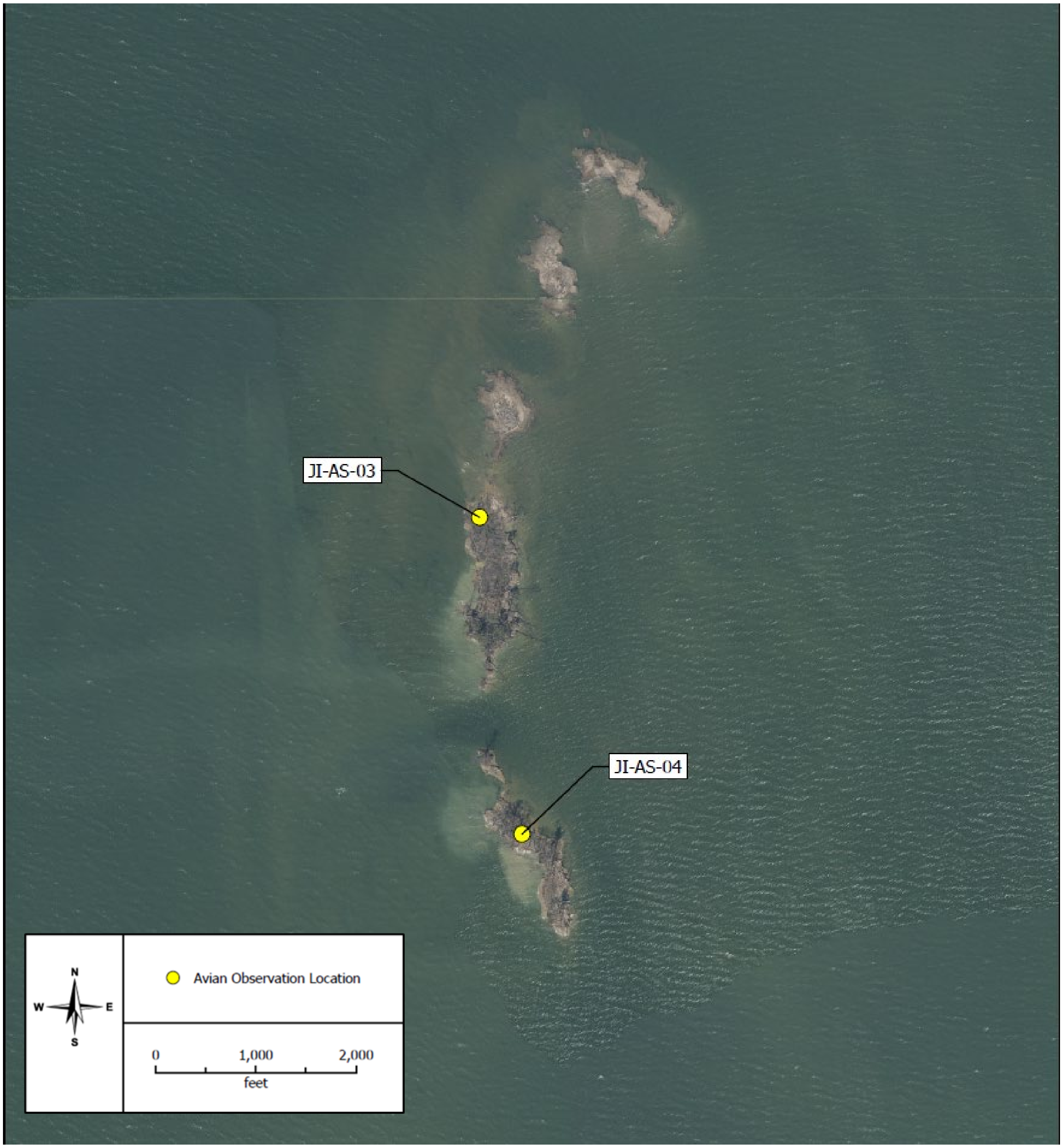


Figure 2-14
James Island Avian Observations Locations (Southern Remnants)



For brevity, Section 3 Barren Island results (and supporting Appendices 1 and 2) have been removed from this document since this report is focused on James Island analyses. The Barren Island results are available in the Mid-Chesapeake Bay Island Ecosystem Restoration Project: Barren Island supplemental Environmental Assessment (sEA) Appendix C – March 2022 at: www.nab.usace.army.mil/Mid-Bay/.

4 James Island Results

This section presents the results for all environmental surveys conducted at James Island during all seasons of sampling.

4.1 Water Quality

Quarterly water quality sampling was conducted in the vicinity of James Island in the summer 2020, fall 2020, winter 2021, and spring 2021. A complete description of sampling locations, sample dates, and in situ water quality parameters (including temperature, DO, salinity, pH, and turbidity) are provided in Table 4-1. Water temperatures exhibited typical seasonal trends. The warmer water temperatures were generally recorded during the summer (ranging from 26.1°C to 26.5°C) and coolest water temperatures were recorded during the winter (4.6°C to 5.4°C).

Overall, the DO concentrations varied seasonally. Because warm water has less ability to hold DO than cold water, DO concentrations tend to be lower in the summer compared to the winter. The lowest DO levels were measured during the summer season (ranging from 6.5 to 7.6 mg/L) and maximum DO levels were measured in the winter (12.5 to 12.7 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.

The highest salinities were measured during the fall (ranging from 16.0 to 16.4 ppt) and the lowest salinities occurred during the spring (ranging from 11.2 to 11.7 ppt), which is consistent with typical weather patterns in the area. During spring rains, the salinity is usually lower compared to the drier fall months, when the salinity is usually higher.

In general, the pH measurements at James Island were very similar to each other, both between locations and seasons. The range of pH measurements from all locations and for all seasons was 7.9 to 8.3.

Turbidity values were recorded in NTU. Generally, turbidity levels were lower in the spring (range of 0 to 1.7 NTU); however, turbidity levels were generally low during all seasons for all locations. The maximum turbidity reading was 6.7 NTU, which was measured during the summer sampling event (from JI-WQ-10). Secchi depth was also recorded during the spring 2021 sampling event. The maximum Secchi depth reading was 5.7 feet.

Results for the chemical constituents and nutrient parameters measured in James Island surface water samples are provided in Table 4-2. Orthophosphate was not detected in most surface water samples during each sampling event, and ammonium was detected in less than one-third of the samples during the summer, fall, and winter sampling events. Both were detected at low concentrations in most samples during the spring sampling event. All remaining nutrients were generally detected in low concentrations. Generally, highest concentrations of chlorophyll, phaeophytin, organic phosphorus, particulate carbon, particulate nitrogen, particulate phosphorus, total dissolved phosphorus, and total phosphorus were measured during the summer 2020 season. Highest concentrations of nitrite+nitrate, total nitrogen, and total dissolved nitrogen were measured during the winter 2021 season. Nitrite and total suspended solids were measured in the greatest concentrations in the spring 2021 surface water samples.

MDNR has a CBWQM that has routinely sampled year-round in the Chesapeake Bay since 1985 and in the Coastal Bays since 1999. Five years of water quality data (2015 to 2020) from the CBWQM were summarized for the fixed monitoring stations closest to James Island (stations EE2.2; MDNR 2021). Station EE2.2 is located in approximately 12.5 meters (41 feet) of water, near the mouth of the Little Choptank River approximately 1 mile northeast of James Island. The most recent five years of surface (14 feet) water quality data at stations EE2.2 were chosen as a representative comparison to existing seasonal conditions because these samples most closely resemble the conditions of the sampling locations conducted at James Island. Means and ranges for physical water quality parameters and nutrients are presented in Tables 4-3 and 4-4, respectively, and are used for comparisons to the existing conditions.

Overall, the seasonal physical in situ water quality and nutrient parameters measured at the islands were similar to and typical of conditions in shallow, mesohaline areas of the middle portion of the Chesapeake Bay. Seasonal patterns of water quality and nutrient parameters measured at James Island were similar to seasonal distributions at CBWQM Station EE2.2. Additionally, the range in values for both the water quality parameters and nutrient concentrations were similar to the ranges measured at CBWQM Station EE2.2 from 2016 to 2020. Turbidity measurements were not collected at EE2.2 during the dates that coincide with the quarterly sampling at the islands, so comparisons to this data are not possible.

Table 4-1
James Island Water Quality Sample Locations and Water Quality Parameters

Season	Sample ID	Date	Time	Northing	Easting	Water Depth (feet)	Temp (°C)	DO (mg/L)	Salinity (ppt)	pH	Turbidity (NTU)
Summer	JI-WQ-01	8/31/2020	9:30	306620.99	1495951.99	9.0	26.2	7.4	13.4	8.3	3.8
	JI-WQ-02	8/31/2020	10:05	304226.65	1499644.99	7.0	26.2	7.5	13.2	8.3	5.6
	JI-WQ-03	8/31/2020	9:10	310221.64	1498541.50	8.0	26.1	7.2	13.2	8.2	4.3
	JI-WQ-04	8/31/2020	8:18	317348.69	1494645.773	11.0	26.5	6.5	13.6	8.2	2.4
	JI-WQ-05	8/31/2020	8:02	317283.65	1496764.276	8.5	26.4	6.9	13.4	8.2	2.1
	JI-WQ-06	8/31/2020	8:35	313107.53	1499020.163	8.0	26.3	7.6	13.4	8.3	2.8
	JI-WQ-07	8/31/2020	7:42	316178.11	1504175.971	9.5	26.6	7.0	13.4	8.2	2.3
	JI-WQ-08	8/31/2020	7:30	313848.94	1503823.152	8.0	26.2	7.0	13.2	8.2	3.8
	JI-WQ-09	8/31/2020	8:52	310872.55	1501695.801	5.0	26.2	7.0	13.2	8.2	5.9
	JI-WQ-10	8/31/2020	9:46	307629.99	1501284.987	9.0	26.2	7.3	13.2	8.2	6.7
	JI-WQ-REF	8/31/2020	10:35	228030.14	1531605.267	8.0	26.2	7.3	13.6	8.3	4.2
Fall	JI-WQ-01	10/21/2020	11:34	306654.08	1495968.451	9.7	18.8	8.9	16.4	8.2	1.8
	JI-WQ-02	10/21/2020	11:53	304148.15	1499603.176	6.3	19.0	8.7	16.2	8.1	3.1
	JI-WQ-03	10/21/2020	10:53	310210.18	1498522.902	8.6	18.6	8.7	16.1	8.1	1.7
	JI-WQ-04	10/21/2020	10:02	317343.09	1494698.573	12.7	18.7	8.5	16.4	8.1	1.7
	JI-WQ-05	10/21/2020	9:42	317276.59	1496781.648	10.0	18.6	8.4	16.4	8.1	1.7
	JI-WQ-06	10/21/2020	10:27	313112.24	1499013.295	9.1	18.7	8.6	16.3	8.1	2.1
	JI-WQ-07	10/21/2020	9:17	316141.14	1504224.476	10.5	18.3	8.4	16.1	8.1	1.5
	JI-WQ-08	10/21/2020	8:46	313799.57	1503918.639	10.1	18.3	8.8	16.0	8.1	1.5
	JI-WQ-09	10/21/2020	7:47	310875.17	1501708.181	6.8	18.6	8.8	16.3	8.0	2.3
	JI-WQ-10	10/21/2020	11:15	307648.67	1501251.387	9.2	18.6	8.6	16.2	8.1	2.1
	JI-WQ-REF	10/21/2020	12:12	296538.85	1499356.889	7.5	19.0	8.9	16.4	8.2	2.7

Season	Sample ID	Date	Time	Northing	Easting	Water Depth (feet)	Temp (°C)	DO (mg/L)	Salinity (ppt)	pH	Turbidity (NTU)
Winter	JI-WQ-01	3/9/2021	8:24	306687.90	1496101.36	9.8	4.6	12.5	13.0	8.0	2.1
	JI-WQ-02	3/9/2021	12:04	304136.84	1499619.95	7.5	5.0	12.6	12.9	8.1	1.6
	JI-WQ-03	3/9/2021	11:28	310235.83	1498686.85	9.5	4.9	12.6	12.9	8.1	1.7
	JI-WQ-04	3/9/2021	9:05	317271.25	1494796.89	12.7	5.0	12.6	12.7	8.1	2.4
	JI-WQ-05	3/9/2021	9:31	317275.83	1496831.63	9.8	5.1	12.7	12.7	8.1	2.4
	JI-WQ-06	3/9/2021	10:51	313180.82	1499011.53	9.6	4.9	12.6	13.0	8.1	1.8
	JI-WQ-07	3/9/2021	9:58	316171.91	1504267.56	10.0	4.7	12.7	12.6	8.1	2.6
	JI-WQ-08	3/9/2021	10:00	313814.47	1503950.64	10.0	5.0	12.7	12.7	8.1	2.9
	JI-WQ-09	3/9/2021	11:10	310244.47	1501743.59	6.2	5.0	12.6	13.0	8.1	1.9
	JI-WQ-10	3/9/2021	11:46	307606.42	1501312.50	9.8	5.1	12.6	12.9	8.1	1.7
	JI-WQ-REF	3/9/2021	12:24	296536.29	1499381.48	8.2	5.4	12.6	13.6	8.1	2.0
Spring	JI-WQ-01	5/25/2021	10:15	306680.11	1495958.09	9.3	20.7	7.8	11.3	8.0	0.2
	JI-WQ-02	5/25/2021	10:50	304174.31	1499625.33	6.5	20.6	7.1	11.6	7.9	1.7
	JI-WQ-03	5/25/2021	9:57	310248.25	1498527.88	8.0	20.3	8.2	11.2	8.1	0.0
	JI-WQ-04	5/25/2021	8:55	317366.91	1494661.70	11.8	19.7	7.5	11.7	8.0	0.0
	JI-WQ-05	5/25/2021	8:35	317300.75	1496721.72	9.5	19.7	7.5	11.6	8.0	1.2
	JI-WQ-06	5/25/2021	9:18	313110.63	1499028.49	8.3	19.8	7.6	11.4	8.0	0.0
	JI-WQ-07	5/25/2021	8:18	316142.92	1504191.33	9.7	19.8	7.5	11.4	8.0	1.2
	JI-WQ-08	5/25/2021	8:00	313832.51	1503886.69	9.0	20.2	7.9	11.2	8.1	1.5
	JI-WQ-09	5/25/2021	9:37	310913.43	1501724.44	5.3	20.1	7.9	11.3	8.1	0.1
	JI-WQ-10	5/25/2021	10:33	307702.09	1501322.30	8.5	20.6	7.9	11.3	8.0	1.0
	JI-WQ-REF	5/25/2021	11:07	296546.58	1499347.85	7.0	20.6	8.1	11.4	8.1	0.7

Table 4-2
James Island Surface Water Quality Sample Results

Analyte	Units	JI-WQ-REF				JI-WQ-01				JI-WQ-02			
		Summer 2020	Fall 2020	Winter 2021	Spring 2021	Summer 2020	Fall 2020	Winter 2021	Spring 2021	Summer 2020	Fall 2020	Winter 2021	Spring 2021
Chlorophyll, active	µg/L	**13.1**	**4.6**	**9.97**	**9.4**	**9.0**	**2.9**	**9.2**	**9.2**	**12.8**	**5.5**	**7.8**	**8.5**
Phaeophytin *a*	µg/L	**3.2**	**1.7**	**1.78**	**2.13**	**3.4**	**1.0**	**1.8**	**1.8**	**4.0**	**1.8**	**1.4**	**2.1**
Chlorophyll *a*	µg/L	**14.9**	**5.6**	**11.0**	**10.6**	**10.9**	**3.5**	**10.2**	**10.2**	**15.0**	**6.6**	**8.6**	**9.6**
Dissolved organic carbon	mg/L	**3.37**	**3.79**	**1.28**	**3.37**	**3.31**	**3.22**	**3.06**	**3.61**	**3.7**	**3.5**	**2.74**	**3.51**
Organic nitrogen	mg/L	**0.35**	**0.31**	**0.38**	**0.28**	**0.34**	**0.32**	**0.26**	**0.27**	**0.22**	**0.27**	**0.30**	**0.28**
Organic phosphorus	mg/L	**0.018**	**0.012**	**0.0045**	**0.013**	**0.018**	**0.015**	**0.006**	**0.011**	**0.016**	**0.011**	**0.004**	**0.013**
Ammonium	mg/L	0.009 U	0.009 U	0.009 U	**0.01**	0.009 U	0.009 U	**0.009**	**0.028**	0.009 U	0.009 U	**0.014**	**0.033**
Nitrite	mg/L	**0.001**	**0.003**	**0.0012**	**0.0062**	**0.001**	**0.002**	**0.004**	**0.006**	**0.002**	**0.003**	**0.004**	**0.006**
Nitrite + nitrate	mg/L	**0.026**	**0.017**	**0.055**	**0.084**	**0.006**	**0.015**	**0.259**	**0.095**	**0.132**	**0.028**	**0.244**	**0.084**
Particulate carbon	mg/L	**1.55**	**0.747**	**1.2**	**1.21**	**1.31**	**0.786**	**1.17**	**1.03**	**1.57**	**0.82**	**1.09**	**1.19**
Particulate nitrogen	mg/L	**0.28**	**0.131**	**0.168**	**0.205**	**0.23**	**0.13**	**0.17**	**0.21**	**0.28**	**0.15**	**0.15**	**0.21**
Orthophosphate	mg/L	0.0034 U	0.0034 U	0.0034 U	**0.0055**	0.0034 U	0.0034 U	0.0034 U	**0.0048**	0.0034 U	**0.0075**	0.0034 U	**0.0053**
Particulate phosphorus	mg/L	**0.027**	**0.010**	**0.012**	**0.021**	**0.023**	**0.011**	**0.012**	**0.021**	**0.028**	**0.012**	**0.011**	**0.021**
Total dissolved nitrogen	mg/L	**0.39**	**0.34**	**0.44**	**0.37**	**0.35**	**0.34**	**0.53**	**0.39**	**0.36**	**0.31**	**0.56**	**0.40**
Total dissolved phosphorus	mg/L	**0.021**	**0.016**	**0.0079**	**0.018**	**0.021**	**0.019**	**0.009**	**0.016**	**0.019**	**0.018**	**0.007**	**0.018**
Total nitrogen	mg/L	**0.56**	**0.390**	**0.61**	**0.52**	**0.55**	**0.41**	**0.63**	**0.53**	**0.59**	**0.42**	**0.71**	**0.56**
Total phosphorus	mg/L	**0.043**	**0.030**	**0.0195**	**0.032**	**0.041**	**0.026**	**0.017**	**0.030**	**0.046**	**0.026**	**0.023**	**0.029**

Analyte	Units	JI-WQ-REF				JI-WQ-01				JI-WQ-02			
		Summer 2020	Fall 2020	Winter 2021	Spring 2021	Summer 2020	Fall 2020	Winter 2021	Spring 2021	Summer 2020	Fall 2020	Winter 2021	Spring 2021
Total suspended solids	mg/L	**16.0**	**10.0**	**8.5**	**26.3**	**11.4**	**6.3**	**7.0**	**24.0**	**15.5**	**12.3**	**7.5**	**28.0**

Analyte	Units	JI-WQ-03				JI-WQ-04				JI-WQ-05			
		Summer 2020	Fall 2020	Winter 2021	Spring 2021	Summer 2020	Fall 2020	Winter 2021	Spring 2021	Summer 2020	Fall 2020	Winter 2021	Spring 2021
Chlorophyll, active	µg/L	**12.3**	**5.3**	**9.3**	**9.0**	**11.4**	**6.1**	**12.0**	**9.1**	**10.2**	**6.4**	**12.8**	**10.0**
Phaeophytin *a*	µg/L	**4.5**	**1.9**	**1.6**	**2.2**	**4.5**	**2.1**	**1.8**	**2.3**	**4.1**	**2.3**	**2.0**	**2.6**
Chlorophyll *a*	µg/L	**14.8**	**6.4**	**10.2**	**10.2**	**13.9**	**7.3**	**13.0**	**10.4**	**12.5**	**7.7**	**14.0**	**11.5**
Dissolved organic carbon	mg/L	**3.39**	**3.5**	**2.4**	**3.29**	**3.05**	**3.41**	**3.23**	**3.52**	**3.17**	**3.46**	**2.98**	**3.12**
Organic nitrogen	mg/L	**0.36**	**0.31**	**0.20**	**0.27**	**0.32**	**0.29**	**0.28**	**0.27**	**0.34**	**0.30**	**0.21**	**0.26**
Organic phosphorus	mg/L	**0.020**	**0.015**	**0.003**	**0.015**	**0.017**	**0.011**	**0.004**	**0.012**	**0.016**	**0.014**	**0.003**	**0.009**
Ammonium	mg/L	**0.014**	0.009 U	0.009 U	**0.017**	0.009 U	**0.01**	0.009 U	**0.031**	0.009 U	0.009 U	0.009 U	**0.029**
Nitrite	mg/L	**0.002**	**0.003**	**0.003**	**0.004**	**0.006**	**0.002**	**0.004**	**0.006**	**0.004**	**0.003**	**0.003**	**0.004**
Nitrite + nitrate	mg/L	**0.008**	**0.012**	**0.200**	**0.076**	**0.031**	**0.013**	**0.218**	**0.096**	**0.014**	**0.019**	**0.176**	**0.088**
Particulate carbon	mg/L	**1.43**	**0.78**	**1.09**	**1.1**	**1.21**	**0.824**	**1.56**	**1.08**	**1.24**	**0.806**	**1.61**	**1.08**
Particulate nitrogen	mg/L	**0.28**	**0.14**	**0.16**	**0.21**	**0.23**	**0.15**	**0.21**	**0.21**	**0.23**	**0.16**	**0.22**	**0.21**
Orthophosphate	mg/L	0.0034 U	0.0034 U	0.0034 U	**0.004**	**0.0035**	**0.0062**	0.0034 U	**0.0068**	0.0034 U	**0.005**	0.0034 U	**0.0044**
Particulate phosphorus	mg/L	**0.031**	**0.011**	**0.013**	**0.019**	**0.026**	**0.013**	**0.012**	**0.019**	**0.025**	**0.015**	**0.016**	**0.020**
Total dissolved nitrogen	mg/L	**0.38**	**0.33**	**0.41**	**0.36**	**0.36**	**0.31**	**0.51**	**0.40**	**0.36**	**0.33**	**0.39**	**0.38**

Analyte	Units	JI-WQ-03				JI-WQ-04				JI-WQ-05			
		Summer 2020	**Fall 2020**	**Winter 2021**	**Spring 2021**	**Summer 2020**	**Fall 2020**	**Winter 2021**	**Spring 2021**	**Summer 2020**	**Fall 2020**	**Winter 2021**	**Spring 2021**
Total dissolved phosphorus	mg/L	**0.023**	**0.018**	**0.006**	**0.019**	**0.021**	**0.017**	**0.007**	**0.019**	**0.019**	**0.019**	**0.006**	**0.013**
Total nitrogen	mg/L	**0.60**	**0.41**	**0.63**	**0.51**	**0.55**	**0.39**	**0.62**	**0.54**	**0.55**	**0.42**	**0.68**	**0.56**
Total phosphorus	mg/L	**0.045**	**0.026**	**0.015**	**0.026**	**0.045**	**0.029**	**0.017**	**0.027**	**0.045**	**0.025**	**0.021**	**0.031**
Total suspended solids	mg/L	**23.0**	**9.1**	**7.8**	**23.3**	**12.7**	**34.3**	**8.0**	**24.0**	**12.6**	**35.7**	**--**	**23.5**

Analyte	Units	JI-WQ-06				JI-WQ-07				JI-WQ-08			
		Summer 2020	**Fall 2020**	**Winter 2021**	**Spring 2021**	**Summer 2020**	**Fall 2020**	**Winter 2021**	**Spring 2021**	**Summer 2020**	**Fall 2020**	**Winter 2021**	**Spring 2021**
Chlorophyll, active	µg/L	**10.1**	**6.0**	**9.92**	**8.53**	**11.2**	**6.1**	**17.2**	**8.5**	**10.3**	**6.4**	**13.5**	**9.4**
Phaeophytin *a*	µg/L	**3.9**	**2.0**	**1.74**	**1.99**	**4.1**	**2.0**	**2.0**	**2.1**	**4.7**	**1.9**	**2.4**	**2.3**
Chlorophyll *a*	µg/L	**12.3**	**7.1**	**10.89**	**9.63**	**13.5**	**7.2**	**18.3**	**9.6**	**12.9**	**7.4**	**14.8**	**10.6**
Dissolved organic carbon	mg/L	**3.31**	**3.66**	**2.94**	**2.96**	**3.33**	**3.44**	**3.49**	**3.18**	**4.35**	**3.45**	**2.77**	**3.12**
Organic nitrogen	mg/L	**0.38**	**0.28**	**0.30**	**0.24**	**0.33**	**0.28**	**0.28**	**0.24**	**0.42**	**0.29**	**0.64**	**0.25**
Organic phosphorus	mg/L	**0.015**	**0.016**	**0.0036**	**0.0066**	**0.014**	**0.014**	**0.007**	**0.007**	**0.020**	**0.012**	**0.018**	**0.002**
Ammonium	mg/L	**0.01**	0.009 U	**0.009**	**0.029**	0.009 U	0.009 U	0.009 U	**0.028**	**0.016**	0.009 U	0.009 U	**0.021**
Nitrite	mg/L	**0.002**	**0.003**	**0.0042**	**0.0042**	**0.003**	**0.003**	**0.004**	**0.006**	**0.004**	**0.002**	**0.002**	**0.004**
Nitrite + nitrate	mg/L	**0.012**	**0.026**	**0.257**	**0.088**	**0.013**	**0.013**	**0.227**	**0.098**	**0.014**	**0.018**	**0.125**	**0.100**
Particulate carbon	mg/L	**1.29**	**0.737**	**1.05**	**1.02**	**1.17**	**0.699**	**1.83**	**0.991**	**1.31**	**0.738**	**1.79**	**1.1**
Particulate nitrogen	mg/L	**0.24**	**0.14**	**0.153**	**0.197**	**0.24**	**0.14**	**0.25**	**0.19**	**0.26**	**0.14**	**0.25**	**0.22**

Analyte	Units	JI-WQ-06				JI-WQ-07				JI-WQ-08			
		Summer 2020	Fall 2020	Winter 2021	Spring 2021	Summer 2020	Fall 2020	Winter 2021	Spring 2021	Summer 2020	Fall 2020	Winter 2021	Spring 2021
Orthophosphate	mg/L	0.0034 U	0.0034 U	0.0034 U	0.0034 U	0.0034 U	0.0034 U	**0.0036**	**0.0035**	0.0034 U	0.0034 U	0.0034 U	**0.0088**
Particulate phosphorus	mg/L	**0.028**	**0.011**	**0.012**	**0.019**	**0.026**	**0.011**	**0.016**	**0.019**	**0.028**	**0.012**	**0.019**	**0.020**
Total dissolved nitrogen	mg/L	**0.40**	**0.31**	**0.57**	**0.36**	**0.35**	**0.30**	**0.52**	**0.37**	**0.45**	**0.32**	**0.77**	**0.37**
Total dissolved phosphorus	mg/L	**0.018**	**0.020**	**0.007**	**0.01**	**0.017**	**0.017**	**0.010**	**0.010**	**0.024**	**0.016**	**0.021**	**0.011**
Total nitrogen	mg/L	**0.53**	**0.39**	**0.64**	**0.54**	**0.53**	**0.45**	**0.73**	**0.55**	**0.60**	**0.42**	**0.67**	**0.54**
Total phosphorus	mg/L	**0.042**	**0.032**	**0.017**	**0.032**	**0.043**	**0.031**	**0.026**	**0.029**	**0.047**	**0.035**	**0.023**	**0.028**
Total suspended solids	mg/L	**39.0**	**9.4**	**7.5**	**23.3**	**12.5**	**6.5**	**9.5**	**22.5**	**17.3**	**7.2**	**10.5**	**23.5**

Analyte	Units	JI-WQ-09				JI-WQ-10			
		Summer 2020	Fall 2020	Winter 2021	Spring 2021	Summer 2020	Fall 2020	Winter 2021	Spring 2021
Chlorophyll, active	µg/L	**11.1**	**5.3**	**10.1**	**10.3**	**13.5**	**6.0**	**7.6**	**9.2**
Phaeophytin *a*	µg/L	**5.1**	**2.0**	**2.0**	**2.2**	**4.8**	**2.3**	**1.3**	**1.9**
Chlorophyll *a*	µg/L	**13.9**	**6.4**	**11.2**	**11.6**	**16.2**	**7.3**	**8.3**	**10.2**
Dissolved organic carbon	mg/L	**3.57**	**3.34**	**2.04**	**3.03**	**3.51**	**3.27**	**2.74**	**3.16**
Organic nitrogen	mg/L	**0.36**	**0.30**	**0.43**	**0.14**	**0.32**	**0.29**	**0.33**	**0.26**
Organic phosphorus	mg/L	**0.016**	**0.013**	**0.005**	**0.007**	**0.016**	**0.011**	**0.004**	**0.009**
Ammonium	mg/L	**0.015**	0.009 U	0.009 U	**0.022**	0.009 U	0.009 U	0.009 U	**0.019**
Nitrite	mg/L	**0.004**	**0.003**	**0.002**	**0.005**	**0.001**	**0.003**	**0.003**	**0.005**
Nitrite + nitrate	mg/L	**0.010**	**0.014**	**0.153**	**0.192**	**0.049**	**0.010**	**0.222**	**0.081**

Analyte	Units	JI-WQ-09				JI-WQ-10			
		Summer 2020	**Fall 2020**	**Winter 2021**	**Spring 2021**	**Summer 2020**	**Fall 2020**	**Winter 2021**	**Spring 2021**
Particulate carbon	mg/L	**1.38**	**0.689**	**1.1**	**1.17**	**1.54**	**0.766**	**1.05**	**1.08**
Particulate nitrogen	mg/L	**0.28**	**0.13**	**0.16**	**0.23**	**0.30**	**0.14**	**0.15**	**0.20**
Orthophosphate	mg/L	0.0034 U	0.0034 U	0.0034 U	**0.0036**	0.0034 U	0.0034 U	0.0034 U	**0.0036**
Particulate phosphorus	mg/L	**0.033**	**0.011**	**0.012**	**0.022**	**0.031**	**0.011**	**0.011**	**0.021**
Total dissolved nitrogen	mg/L	**0.39**	**0.32**	**0.59**	**0.35**	**0.38**	**0.31**	**0.56**	**0.36**
Total dissolved phosphorus	mg/L	**0.020**	**0.016**	**0.009**	**0.011**	**0.020**	**0.015**	**0.008**	**0.013**
Total nitrogen	mg/L	**0.59**	**0.43**	**0.67**	**0.53**	**0.63**	**0.42**	**0.63**	**0.53**
Total phosphorus	mg/L	**0.048**	**0.029**	**0.019**	**0.029**	**0.048**	**0.031**	**0.018**	**0.029**
Total suspended solids	mg/L	**44.3**	**10.3**	**8.0**	**24.5**	**22.0**	**8.8**	**7.2**	**25.0**

Notes:
Bold cells are detected constituents.
R: Poor replication between pads; sample rejected because the difference is greater than 50%.
U: compound not detected

Table 4-3
Average and Range of Water Quality Variables at CBWQM Station EE2.2 (2016–2020)

Analyte	Units	Sample Season[a]			
		Summer (August)	Fall (October)	Winter (March)	Spring (May)
Temperature	°C	27.5 (25.4–29.4)	19.3 (18.8–19.8)	6.5 (5.2–9.2)	17.5 (15.2–21.6)
DO	mg/L	6.9 (5.4–8.3)	8.4 (7.9–9.6)	12.0 (10.4–13)	8.0 (3.8–9.1)
Salinity	ppt	11.6 (7.6–15.3)	14.4 (8–17.7)	11.2 (8.4–13.3)	10.4 (6.9–13.7)
pH	su	8.1 (7.8–8.5)	8.1 (8–8.2)	8.2 (7.7–8.8)	7.9 (7.3–8.2)
Secchi depth	ft	2.6 (2–4.3)	4.6 (2.3–8.2)	4.6 (3.6–6.6)	5.2 (3.3–6.6)

Note:
a. The value provided is the calculated average. The full range of results is provided in parentheses.

Table 4-4
Average and Range of Nutrient Concentrations at CBWQM Station EE2.2 (2016–2020)

Analyte	Units	Sample Season[a]			
		Summer (August)	Fall (October)	Winter (March)	Spring (May)
Phaeophytin *a*	µg/L	2 (1.65–2.2)	3.1 (0.74–6.3)	0.95 (0.74–1.3)	0.74 (0.74–0.74)
Chlorophyll *a*	µg/L	11 (6.4–17.9)	7.4 (3.6–10.9)	10.5 (6.2–13.9)	5.1 (3–9.6)
Particulate carbon	mg/L	1.4 (1.1–2)	0.89 (0.56–1.3)	1.7 (1–2.4)	0.9 (0.61–1.6)
Organic nitrogen	mg/L	0.64 (0.56–0.73)	0.54 (0.49–0.63)	0.61 (0.53–0.69)	0.45 (0.38–0.49)
Organic phosphorus	mg/L	0.013 (0.003–0.023)	0.012 (0.006–0.015)	0.005 (0.003–0.007)	0.005 (0.0008–0.007)
Ammonium	mg/L	0.017 (0.007–0.035)	0.02 (0.011–0.036)	0.019 (0.007–0.046)	0.036 (0.018–0.054)
Nitrite	mg/L	0.001 (0.0007–0.003)	0.015 (0.0009–0.048)	0.005 (0.004–0.005)	0.0064 (0.005–0.008)
Nitrite + nitrate	mg/L	0.01 (0.002–0.02)	0.08 (0.002–0.33)	0.34 (0.11–0.67)	0.29 (0.14–0.65)
Particulate nitrogen	mg/L	0.27 (0.18–0.36)	0.17 (0.1–0.24)	0.27 (0.17–0.34)	0.15 (0.1–0.25)
Orthophosphate	mg/L	0.004 (0.002–0.007)	0.005 (0.004–0.006)	0.003 (0.002–0.004)	0.004 (0.002–0.005)

Analyte	Units	Sample Season[a]			
		Summer (August)	Fall (October)	Winter (March)	Spring (May)
Particulate phosphorus	mg/L	0.022 (0.018–0.025)	0.014 (0.008–0.028)	0.016 (0.009–0.028)	0.009 (0.006–0.015)
Total dissolved nitrogen	mg/L	0.39 (0.35–0.43)	0.51 (0.35–0.75)	0.71 (0.51–1)	0.63 (0.47–0.88)
Total dissolved phosphorus	mg/L	0.015 (0.01–0.025)	0.017 (0.011–0.02)	0.008 (0.006–0.01)	0.008 (0.005–0.011)
Total nitrogen	mg/L	0.66 (0.57–0.78)	0.67 (0.53–0.99)	0.97 (0.8–1.3)	0.77 (0.57–1.13)
Total phosphorus	mg/L	0.037 (0.031–0.048)	0.031 (0.026–0.039)	0.024 (0.018–0.0355)	0.017 (0.012–0.024)
Total suspended solids	mg/L	7 (4.8–9.4)	7.4 (2.4–15.6)	4.9 (3.2–7.7)	3.2 (2.4–4)

Note:
a. The value provided is the calculated average. The full range of results is provided in parentheses.

4.2 Benthic Community

Benthic sampling was conducted in summer 2020, fall 2020, and spring 2021 at 10 locations in the vicinity of James Island and at one reference location (Figure 2-5). A complete description of benthic sampling locations, sample dates, and measured water quality parameters is provided in Table 4-5.

4.2.1 Habitat Classification

Sediment was also collected during the summer 2020 sampling event for grain size and total organic carbon content determination. Results of the grain size and total organic carbon analyses are provided in Table 4-6. With the exception of location of JI-BC-09, all James Island locations and the James Island reference location were composed of more than 90% sand. Location JI-BC-09 was still composed of 51% and 49% silts and clays (Table 4-6).

The bottom salinities measured at all James Island benthic sampling locations during the summer and fall sampling events were greater than 12 ppt (Table 4-5); therefore, each of the James Island benthic sampling locations were classified as high mesohaline during these sampling seasons. The bottom salinities in the spring sampling event ranged from 11.1 to 11.5 ppt; therefore, the spring James Island benthic samples were classified as low mesohaline.

Table 4-5
James Island Benthic Community Sample Locations and Water Quality Parameters

Season	Sample ID	Date	Time	Northing	Easting	Water Depth (feet)	Temp (°C)	DO (mg/L)	Salinity (ppt)	pH	Turbidity (NTU)
Summer	JI-BC-01	8/25/2020	1246	306649.60	1496020.71	9.8	27.7	8.1	13	8.6	4.4
	JI-BC-02	8/26/2020	858	304097.23	1499583.90	6.7	26.6	6.8	13.3	8.2	14.7
	JI-BC-03	8/25/2020	1021	310274.30	1498548.04	9.0	27.4	7.8	13	8.5	1.9
	JI-BC-04	8/24/2020	1239	317277.25	1494613.30	12.5	27.4	7.9	13.3	8	2.6
	JI-BC-05	8/24/2020	1353	317326.62	1496702.71	9.2	27.5	7.9	13.5	8.3	2.5
	JI-BC-06	8/25/2020	820	313079.64	1499123.36	10.7	27.2	7.4	12.9	8.4	4.7
	JI-BC-07	8/24/2020	1515	316161.98	1504252.06	9.5	27	7.5	13.6	8.3	9.4
	JI-BC-08	8/24/2020	1610	313777.18	1503956.23	9.6	27.5	7.5	13.5	8.3	6.7
	JI-BC-09	8/25/2020	918	310867.80	1501765.62	6.5	27.2	7.4	13	8.4	7.8
	JI-BC-10	8/25/2020	1124	307622.92	1501313.97	9.2	27.3	7.6	13	8.5	7.8
	JI-BC-REF	8/25/2020	1522	296522.36	1499384.92	6.8	28.2	8.3	13	8.6	7.5
Fall	JI-BC-01	10/19/2020	1235	306682.33	1495971.432	9.0	17.8	8.9	15.8	8.1	1.6
	JI-BC-02	10/19/2020	1005	304130.94	1499601.311	6.0	17.3	8.8	15.9	7.9	2.7
	JI-BC-03	10/19/2020	1530	310218.77	1498535.160	8.5	18.1	8.9	16.5	8.1	1.6
	JI-BC-04	10/20/2020	1338	317349.37	1494684.227	11.0	18.6	8.7	16.7	8.1	1.5
	JI-BC-05	10/20/2020	1156	317274.13	1496748.213	8.0	18.5	8.5	16.6	8.1	1.6
	JI-BC-06	10/20/2020	1508	313126.03	1499031.952	9.0	18.8	9.6	14.2	8.2	1.4
	JI-BC-07	10/20/2020	1047	316120.50	1504238.057	9.0	18.3	8.1	16.5	8.1	1.3
	JI-BC-08	10/20/2020	845	313789.41	1503913.072	9.0	18	8.4	16	7.9	1.4
	JI-BC-09	10/21/2020	747	310875.17	1501708.181	6.0	18.6	8.7	16.3	8	2.4
	JI-BC-10	10/19/2020	1355	307648.24	1501275.634	8.0	18	9.3	15.9	8.2	2
	JI-BC-REF	10/19/2020	1140	296538.36	1499302.500	7.0	17.4	9.0	16.0	8.2	2.1

Season	Sample ID	Date	Time	Northing	Easting	Water Depth (feet)	Temp (°C)	DO (mg/L)	Salinity (ppt)	pH	Turbidity (NTU)
Spring	JI-BC-01	5/27/2021	9:58	306626.08	1495942.42	9.4	21.6	9.0	11.3	8.0	0.1
	JI-BC-02	5/27/2021	8:40	304121.02	1499586.596	6.8	21.5	8.4	11.4	8.2	3.4
	JI-BC-03	5/27/2021	1115	310193.03	1498529.462	8.1	21.8	9.0	11.3	8.3	1.9
	JI-BC-04	5/27/2021	1255	317334.09	1494655.728	12.8	21.5	8.9	11.1	8.3	1.6
	JI-BC-05	5/27/2021	1430	317341.25	1496812.577	9.4	21.9	9.5	11.1	8.7	1.6
	JI-BC-06	5/28/2021	755	677373.89	1496346.201	9.3	22.7	8.7	11.4	8.2	3.5
	JI-BC-07	5/28/2021	825	316198.21	1504130.133	10.0	21.1	9.3	11.2	8.4	1.6
	JI-BC-08	5/28/2021	855	313919.59	1503814.608	10.3	22.2	9.4	11.2	8.4	1.6
	JI-BC-09	5/27/2021	1555	310890.21	1501730.803	5.6	23.1	9.5	11.5	8.3	2.8
	JI-BC-10	5/25/2021	1537	307720.41	1501253.094	10.4	20.6	8.8	11.4	8.2	1
	JI-BC-REF	5/27/2021	743	296506.50	1499360.302	7.3	22.0	8.2	11.3	8.1	4.2

Table 4-6
James Island Sediment Sample Results

Analyte	Units	James Island										
		JI-BC-REF	JI-BC-01	JI-BC-02	JI-BC-03	JI-BC-04	JI-BC-05	JI-BC-06	JI-BC-07	JI-BC-08	JI-BC-09	JI-BC-10
Gravel	%	0	0	0	0	0	0	0.1	0	1.7	0.4	1.3
Sand	%	91.4	97.9	94.5	92.9	96.2	93.9	96.7	97.6	95	50.6	95.8
Silt	%	6	0.2	4	5.2	2.3	4.8	1.8	1	1.9	29.6	1.1
Clay	%	2.6	1.9	1.5	2	1.5	1.3	1.4	1.5	1.4	19.4	1.8
Percent moisture	%	29.3	22.6	26.6	23.7	26.5	26.6	22.8	26.4	25.2	41.1	23.1
Total organic carbon	mg/kg	1,400	2,600	1,400	1,300	2,300	1,400	1,300	5,900	1,300	12,000	1,300

4.2.2 Benthic Community Metrics

A taxonomic list and abundance (number per m^2) of the benthic fauna collected at the James Island benthic sampling locations during the summer 2020, fall 2020, and spring 2021 sampling events are provided in Tables 4-7 through 4-9, respectively. A list of the benthic fauna collected in individual replicates collected at each location is provided in Appendix C.

A total of 32 unique benthic taxa were collected during the summer sampling event (Table 4-7), 36 unique taxa were collected during the fall sampling event (Table 4-8), and 40 unique taxa were collected during spring sampling event (Table 4-9). Bivalves (specifically mollusk and amethyst gem clam) and polychaetes (specifically pile worm and ram's horn worm [*Streblospio benedicti*]) were the dominant taxa during the summer sampling event (Table 4-7). During the fall sampling event, the bivalve mollusk was the dominant taxon at four of the 10 benthic community locations and the reference location. The dominant taxa at four of the remaining benthic community locations were also bivalves (amethyst gem clam and stout razor clam [*Tagelus plebeius*]), and the polychaete bristle worm (*Heteromastus filiformis*) was the dominant taxon at one benthic location (Table 4-8). The most dominant species identified during both the summer and fall sampling events was the clam mollusk, representing 25% and 46% of the total count of benthic invertebrate taxa, respectively. Bivalves (specifically amethyst gem clam, dwarf surf clam, and stout razor clam) and polychaetes (bristle worm) were also the dominant taxa during the spring sampling event (Table 4-9).

Six metrics were used to describe the overall characteristics of the benthic community at the James Island—total abundance, unique taxa collected, species richness, evenness, Simpson's Dominance Index, and the Shannon-Wiener Diversity Index. These results are presented in Table 4-10 for all sampling events.

Abundance ranged from 1,091 to 6,206 organisms per m^2 in the summer, from 1,595 to 26,726 organisms per m^2 in the fall, and from 746 to 12,732 organisms per m^2 in the spring sampling event. The total abundance at the reference site was 1,690, 3,177, and 2,513 organisms per m^2 in the summer, fall, and spring sampling events, respectively (Table 4-10).

The number of unique taxa at each benthic sample locations ranged from 8 to 15 taxa during the summer sampling event, from 12 to 17 taxa during the fall sampling event, and from 14 to 28 taxa during the spring sampling event. At all locations, the number of taxa between the summer and fall events either increased or stayed the same, and higher numbers of unique taxa were documented during the spring sampling event. There were 12, 13, and 20 unique taxa at the reference site during the summer, fall, and spring sampling events, respectively.

Species richness is a comparison of how many taxa are in a sample compared to how many individuals are in a sample (Equation 2-3). Lower values indicate that the total benthic abundance at a location is dominated by a few taxa and does not represent a diverse benthic community. Species richness values ranged from 1.6 to 3.1 during the summer sampling event, from 2.0 to 2.8 during the fall sampling event, and from 2.2 to 3.6 during the spring sampling event. Of the 10 sampling locations, seven had the greatest species richness values during the spring sampling event (JI-BC-03, JI-BC-04, JI-BC-05, JI-BC-06, JI-BC-08, JI-BC-09, and JI-BC-10). The reference location also had the highest species richness values during the spring sampling event. Generally, the reference site species richness values were similar to species richness values measured at the James Island locations (Table 4-10).

Evenness is a measure of how evenly the individuals collected at a location are distributed among the taxa collected at that location (Equation 2-4), with a maximum value of 1 indicating that the individuals are distributed as evenly as possible. Evenness values ranged from 0.6 to 0.8 during the summer sampling event and from 0.3 to 0.8 during the fall and spring sampling events. The lowest evenness value was reported in the JI-BC-06 sample during the fall and spring sampling events and is likely the result of the high number of amethyst gem clam in the sample (22,835 individuals during the fall sampling event and 10,378 individuals in the spring sampling event). Evenness values were consistent between all sampling events at most locations. Results decreased at two locations, JI-BC-06 and JI-BC-09, likely due to the high abundance of amethyst gem clam in the samples. Evenness values at the reference site were 0.8, 0.7, and 0.8 for summer, fall, and spring, respectively.

The Shannon-Wiener Species Diversity Index considers species richness and species evenness (Equation 2-1), with greater values indicating a more diverse benthic community. Shannon-Wiener Species Diversity Indices ranged from 1.3 to 2.1 during the summer sampling event, from 0.7 to 2.0 during the fall sampling event, and from 0.9 to 2.4 during the spring sampling event. Shannon-Wiener Species Diversity Indices at the reference site were 2.0, 1.9, and 2.0 for summer, fall, and spring, respectively.

Simpson’s Dominance Index measures the diversity of a sample (Equation 2-2), with a lower value indicating a more diverse community. Simpson’s Dominance Indices ranged from 0.1 to 0.4 during the summer sampling event, from 0.2 to 0.7 during the fall sampling event, and from 0.1 to 0.7 during the spring sampling event. Shannon-Wiener Species Diversity Indices were generally consistent for all sampling events at most locations. Results increased at two locations, JI-BC-06 and JI-BC-09, likely due to the high abundance of amethyst gem clam in the samples. The Simpson’s Dominance Index at the reference site was 0.2 during all sampling events.

Results for all benthic community metrics measured at the James Island benthic community sampling locations were within the range of metrics measured at the James Island reference site for both the summer and fall sampling events. Additionally, with the exception of fall and spring sample from JI-BC-06 and the spring sample from JI-BC-09, the high evenness and Shannon-Wiener Species Diversity Indices and low Simpson’s Dominance Indices indicate that the benthic community surrounding James Island is a diverse community. As discussed, the exceptionally high abundance of amethyst gem clam at JI-BC-06 and JI-BC-09 affected the species diversity and dominance in the sample.

Table 4-7
James Island Benthic Community Data: Summer 2020

Species Collected		Abundance (Organisms/m²)										
Scientific Name	**Common Name**	**JI-BC-REF**	**JI-BC-01**	**JI-BC-02**	**JI-BC-03**	**JI-BC-04**	**JI-BC-05**	**JI-BC-06**	**JI-BC-07**	**JI-BC-08**	**JI-BC-09**	**JI-BC-10**
Alitta succinea	Pile worm	281	83	217	370	89	83	13	96	395	**638**	32
Americamysis almyra	Mysid shrimp	6	19	26	19	13	13	13	0	19	19	19
Ameritella mitchelli	Mollusk	**485**	179	529	861	198	268	255	262	217	485	376
Ameroculodes spp. complex	Amphipod	0	6	0	0	0	0	6	0	0	6	0
Amphibalanus improvisus	Bay barnacle	0	0	0	0	0	0	0	0	0	13	0
Amphiporus ochraceus	Ribbon worm	0	0	0	0	0	0	0	0	0	6	0
Boccardiella ligerica	Segmented worm	0	0	0	0	0	0	0	0	0	13	0
Carinoma tremaphoros	Round worm	6	6	0	0	0	0	0	0	13	6	0
Cyathura polita	Isopod	0	6	13	51	13	0	0	0	19	0	6
Cyclaspis varians	Copepod	6	0	0	19	0	6	0	0	0	13	0
Edwardsia elegans	Elegant burrowing anemone	0	0	0	0	0	0	0	0	0	6	0
Fragilonemertes rosea	Rose worm	70	19	32	140	51	26	6	6	38	6	32
Gemma gemma	Amethyst gem clam	210	38	**593**	**1,639**	**1,537**	**2,360**	102	587	77	230	134
Glycinde multidens	Segmented worm	57	26	26	38	6	51	6	13	0	19	19
Heteromastus filiformis	Bristle worm	434	128	466	976	676	313	121	172	236	96	293
Hypereteone foliosa	Paddle worm	0	0	0	6	0	0	0	0	0	0	6
Hypereteone heteropoda	Paddle worm	26	19	0	38	26	0	13	19	6	6	13
Leitoscoloplos fragilis	Segmented worm	0	0	0	0	0	0	0	0	0	6	0
Lepidactylus dytiscus	Amphipod	0	26	6	0	0	0	0	0	0	6	13
Marenzelleria viridis	Segmented worm	0	45	13	0	6	0	0	0	26	13	13
Mediomastus ambiseta	Segmented worm	51	6	13	6	0	6	13	32	0	6	13
Mulinia lateralis	Dwarf surf clam	38	198	300	115	242	223	45	83	89	434	242
Paraonis fulgens	Segmented worm	0	0	0	6	0	0	0	0	0	0	0
Parvilucina crenella	Many-lined lucine	0	0	0	6	0	0	0	0	0	0	0
Pectinaria gouldii	Fan worm	6	0	0	0	0	0	0	0	0	0	0
Petricolaria pholadiformis	False angel wing	0	0	0	0	0	0	0	0	0	19	0
Phoronis psammophila	Horseshoe worm	0	0	0	6	0	0	0	0	0	0	0
Polydora cornuta	Whip mudworm	0	0	0	0	0	0	0	6	0	172	0
Streblospio benedicti	Ram's horn worm	427	**242**	504	1237	383	421	**542**	**810**	**657**	255	**427**
Stylochus ellipticus	Flatworm	6	0	0	0	0	0	0	0	0	0	0
Tagelus plebeius	Stout razor clam	89	38	83	670	115	19	0	0	51	115	45
Tubificoides spp.	Segmented worms	0	6	32	0	0	6	6	32	13	6	6

Notes:
Bold values represent the dominant species at each location.

Table 4-8
James Island Benthic Community Data: Fall 2020

Species Collected		Abundance (Organisms/m²)										
Scientific Name	**Common Name**	**JI-BC-REF**	**JI-BC-01**	**JI-BC-02**	**JI-BC-03**	**JI-BC-04**	**JI-BC-05**	**JI-BC-06**	**JI-BC-07**	**JI-BC-08**	**JI-BC-09**	**JI-BC-10**
Alitta succinea	Pile worm	96	32	108	115	45	140	32	121	121	1078	57
Americamysis almyra	Mysid shrimp	0	32	0	0	0	0	6	0	6	0	26
Ameritella mitchelli	Mollusk	804	**1,231**	1,410	**1,550**	1,480	1,709	**421**	2,143	1,065	**1,365**	**1,027**
Ameroculodes spp. complex	Amphipod	13	13	13	32	108	32	6	6	19	45	6
Amphibalanus improvisus	Bay barnacle	0	0	0	0	0	0	0	0	19	0	0
Amphiporus bioculatus	Round worm	51	0	19	0	38	0	0	0	19	13	0
Carinoma tremaphoros	Round worm	19	13	70	57	19	19	26	64	6	6	13
Cyathura polita	Isopod	13	0	0	13	26	6	6	0	13	13	6
Cyclaspis varians	Copepod	6	6	0	26	13	0	0	6	6	0	0
Fragilonemertes rosea	Rose worm	121	77	70	108	77	96	13	57	26	32	70
Gemma gemma	Amethyst gem clam	128	128	1,021	395	1,505	**22,835**	255	**7,457**	**1,295**	1,250	77
Glycinde multidens	Segmented worm	262	121	134	159	153	77	262	249	0	57	447
Haminella solitaria	Gastropod	6	6	6	0	0	0	0	0	0	0	0
Heteromastus filiformis	Bristle worm	**1,052**	344	880	631	517	236	204	785	185	325	427
Hypereteone foliosa	Paddle worm	0	13	0	0	45	32	0	0	32	0	6
Hypereteone heteropoda	Paddle worm	32	6	32	0	6	0	19	26	0	26	0
Japonactaeon punctostriatus	Pitted baby-bubble	0	0	0	0	0	0	0	0	0	0	6
Leitoscoloplos fragilis	Segmented worm	32	13	64	6	45	45	13	45	6	6	19
Lepidactylus dytiscus	Amphipod	0	6	6	0	0	0	0	0	0	0	6
Limecola petalum	Bivalve	0	0	0	0	0	13	0	0	0	0	0
Marenzelleria viridis	Segmented worm	0	6	6	0	0	0	0	6	13	13	0
Mediomastus ambiseta	Segmented worm	64	0	19	19	0	0	0	0	0	0	0
Mulinia lateralis	Dwarf surf clam	19	77	45	32	38	57	32	45	13	32	45
Mya arenaria	Soft-shell clam	0	0	6	0	6	96	6	6	0	57	0
Paraonis fulgens	Segmented worm	0	0	0	13	0	0	0	0	0	6	0
Paraprionospio alata	Segmented worm	0	0	0	6	0	0	0	0	0	6	0
Pectinaria gouldii	Fan worm	0	0	0	0	0	0	6	0	0	6	0
Petricolaria pholadiformis	False angel wing	0	0	0	0	0	0	0	0	0	102	0
Phoronis psammophila	Horseshoe worm	0	0	0	32	0	0	0	0	0	0	0
Polydora cornuta	Whip mudworm	0	0	0	0	0	0	0	0	70	83	0
Siphonenteron bicolour	Worm	0	0	0	0	0	0	0	19	6	0	6
Spiochaetopterus oculatus	Segmented worm	6	0	0	0	0	0	0	0	0	0	0
Streblospio benedicti	Ram's horn worm	408	147	38	19	51	38	115	325	0	325	364
Stylochus ellipticus	Flatworm	13	0	26	83	89	38	0	13	0	6	13
Tagelus plebeius	Stout razor clam	823	848	**1,818**	1,333	**2,373**	1,244	172	1,467	580	1,257	555

Species Collected		Abundance (Organisms/m²)										
Scientific Name	**Common Name**	**JI-BC-REF**	**JI-BC-01**	**JI-BC-02**	**JI-BC-03**	**JI-BC-04**	**JI-BC-05**	**JI-BC-06**	**JI-BC-07**	**JI-BC-08**	**JI-BC-09**	**JI-BC-10**
Tubificoides spp.	Segmented worms	0	0	89	0	6	13	0	19	0	13	0

Notes:
Bold values represent the dominant species at each location.

Table 4-9
James Island Benthic Community Data: Spring 2021

Species Collected		Abundance (Organisms/m²)										
Scientific Name	**Common Name**	**JI-BC-REF**	**JI-BC-01**	**JI-BC-02**	**JI-BC-03**	**JI-BC-04**	**JI-BC-05**	**JI-BC-06**	**JI-BC-07**	**JI-BC-08**	**JI-BC-09**	**JI-BC-10**
Acteocina canaliculata	Channeled barrel-bubble	6	0	0	0	0	0	0	0	0	0	6
Alitta succinea	Pile worm	0	0	0	6	0	0	6	0	6	0	6
Ameritella mitchelli	Mollusk	191	115	51	306	115	45	64	166	172	115	593
Ameroculodes spp. complex	Amphipod	249	204	121	293	179	249	83	274	281	191	223
Amphibalanus improvisus	Bay barnacle	0	0	0	0	6	0	6	364	274	6	6
Amphiporus bioculatus	Round worm	0	0	6	38	45	38	19	6	6	13	6
Apocorophium lacustre	Scud	6	0	0	0	0	0	0	0	6	0	0
Carinoma tremaphoros	Round worm	13	0	0	26	38	13	6	26	0	0	6
Chiridotea coeca	Sand isopod	0	0	0	6	0	0	0	0	0	0	0
Cyathura polita	Isopod	0	0	0	0	6	0	0	0	0	13	6
Edotia triloba	Isopod	0	13	0	6	0	0	13	0	13		13
Fragilonemertes rosea	Rose worm	32	102	13	64	153	147	57	38	6	13	32
Gammarus mucronatus	Scud	0	6	0	0	0	0	0	26	0	0	6
Gemma gemma	Amethyst gem clam	242	0	19	612	70	466	**10,378**	**1,237**	**3,132**	**3,138**	**1,518**
Geukensia demissa	Ribbed mussel	0	0	0	0	0	0	6	0	0	0	0
Glycinde multidens	Segmented worm	13	0	0	6	0	0	0	19	0	0	26
Heteromastus filiformis	Bristle worm	**797**	**746**	121	**1,314**	**529**	485	753	1,021	606	134	453
Hypereteone foliosa	Paddle worm	51	19	0	51	19	102	38	26	26	32	45
Hypereteone heteropoda	Paddle worm	13	77	6	26	26	6	51	38	38	0	38
Leitoscoloplos fragilis	Segmented worm	13	70	0	262	108	57	128	115	77	70	13
Lepidactylus dytiscus	Amphipod	6	0	70	32	0	0	6	0	0	13	13
Leptocheirus plumulosus	Amphipod	96	6	19	0	0	0	0	70	26	0	19
Limecola petalum	Bivalve	13	0	0	6	6	0	13	0	0	6	6
Marenzelleria viridis	Segmented worm	332	153	83	185	313	274	140	306	89	242	325
Mediomastus ambiseta	Segmented worm	0	0	0	0	0	0	0	0	13	0	0
Melita nitida	Amphipod	0	0	0	0	0	0	6	0	0	0	0
Mulinia lateralis	Dwarf surf clam	313	440	**179**	351	198	440	351	683	236	45	147
Mya arenaria	Soft-shell clam	0	0	0	6	6	0	13	0	19	26	96

Species Collected		Abundance (Organisms/m²)										
Scientific Name	**Common Name**	**JI-BC-REF**	**JI-BC-01**	**JI-BC-02**	**JI-BC-03**	**JI-BC-04**	**JI-BC-05**	**JI-BC-06**	**JI-BC-07**	**JI-BC-08**	**JI-BC-09**	**JI-BC-10**
Naididae sp.	Sludge worm	0	6	0	0	19	0	0	0	0	0	6
Neomysis americana	Possum shrimp	13	6	6	6	6	6	6	6	13	0	0
Paraonis fulgens	Segmented worm	0	0	0	0	26	0	0	0	0	0	0
Phoronis psammophila	Horseshoe worm	0	0	0	0	26	6	0	0	0	0	0
Polydora cornuta	Whip mudworm	0	6	0	0	6	0	26	0	0	6	26
Sayella chesapeakea	Sea snail	0	0	0	0	6	0	0	0	13	0	0
Siphonenteron bicolour	Round worm	0	13	0	6	0	6	0	0	0	0	0
Spilocuma watlingi	Cumacea	0	13	0	32	26	70	6	0	0	13	32
Streblospio benedicti	Ram's horn worm	38	319	19	281	395	38	204	96	70	0	70
Stylochus ellipticus	Flatworm	0	0	0	13	0	6	0	0	0	0	0
Tagelus plebeius	Stout razor clam	77	128	32	472	402	**899**	287	223	102	6	172
Tubificoides spp.	Segmented worms	6	13	0	13	13	0	64	0	6	6	0

Notes:

Bold values represent the dominant species at each location.

Table 4-10
James Island Benthic Community Metrics

	James Island											
	JI-BC-REF			**JI-BC-01**			**JI-BC-02**			**JI-BC-03**		
Metric	**Summer 2020**	**Fall 2020**	**Spring 2021**	**Summer 2020**	**Fall 2020**	**Spring 2021**	**Summer 2020**	**Fall 2020**	**Spring 2021**	**Summer 2020**	**Fall 2020**	**Spring 2021**
Total abundance/m²	1,690	3,177	2,513	2,201	3,967	2,456	1,091	3,119	746	2,851	5,881	4,420
Total biomass (g/m²)	0.7	0.4	1.3	1.4	0.4	0.6	0.6	0.4	0.3	1.1	0.6	0.9
Unique infaunal taxa	12	13	20	12	15	20	13	13	14	13	16	26
Species richness (Ludwig-Reynolds)	2.5	2.3	2.6	2.3	2.7	2.4	3.1	2.3	2.2	2.4	2.7	3.2
Evenness	0.8	0.7	0.8	0.8	0.7	0.8	0.8	0.7	0.9	0.8	0.7	0.8
Shannon-Wiener H' (ln)	2.0	1.9	2.0	2.0	2.0	2.0	2.1	1.7	1.9	2.0	1.8	2.2
Simpson's dominance	0.2	0.2	0.2	0.2	0.2	0.2	0.1	0.3	0.2	0.2	0.2	0.2
Shannon-Wiener H' (log base 2)	2.8	2.7	2.9	2.9	2.9	2.9	3.1	2.5	2.7	2.9	2.6	3.2
Percent abundance pollution-indicative species	40	13	15	22	12	34	40	8.1	28	26	2.3	20
Percent biomass pollution-indicative species	27	11	26	51	13	4.2	19	30	8.8	43	22	7.2
Percent abundance pollution-sensitive species	5.0	18	17	6.4	22	13	8.9	27	17	3.7	31	15
Percent biomass pollution-sensitive species	1.3	3.8	12	1.2	1.2	20	3.7	13	29	4.2	4.6	25
Percent abundance carnivores and omnivores	5.3	16	3.2	16	10	3.6	13	5.3	0.8	11	6.6	2.1

Metric	James Island											
	JI-BC-04			JI-BC-05			JI-BC-06			JI-BC-07		
	Summer 2020	Fall 2020	Spring 2021	Summer 2020	Fall 2020	Spring 2021	Summer 2020	Fall 2020	Spring 2021	Summer 2020	Fall 2020	Spring 2021
Total abundance/m²	6,206	4,631	2,743	3,355	6,640	3,355	3,795	26,726	12,732	1,142	1,595	4,739
Total biomass (g/m²)	0.7	1.0	0.8	0.7	0.5	1.2	1.9	0.5	2.1	0.6	0.1	1.4
Unique infaunal taxa	14	15	26	10	16	19	9	15	26	8	13	19
Species richness (Ludwig-Reynolds)	2.2	2.6	3.6	1.9	2.6	2.7	1.6	2.0	2.6	1.7	2.6	2.4
Evenness	0.7	0.7	0.8	0.7	0.6	0.8	0.6	0.3	0.3	0.7	0.8	0.8
Shannon-Wiener H' (ln)	1.9	1.8	2.4	1.6	1.7	2.2	1.3	0.7	0.9	1.5	1.9	2.0
Simpson's dominance	0.2	0.2	0.1	0.3	0.2	0.2	0.4	0.7	0.7	0.3	0.2	0.2
Shannon-Wiener H' (log base 2)	2.7	2.6	3.5	2.4	2.5	3.1	1.9	1.0	1.3	2.2	2.8	2.9
Percent abundance pollution-indicative species	21	1.3	26	21	2.0	15	17	0.6	5.2	51	10	20
Percent biomass pollution-indicative species	19	31	8.6	33	27	16	18	16	1.6	34	40	8.6
Percent abundance pollution-sensitive species	11	30	28	4.0	36	36	0.6	5.1	3.7	1.3	11	12
Percent biomass pollution-sensitive species	8.6	2.7	32	11	5.3	39	1.8	0.2	8.7	0.9	0.6	13
Percent abundance carnivores and omnivores	7.6	6.1	2.4	4.0	4.1	3.3	3.6	1.4	0.7	3.3	21	1.8

Metric	James Island								
	JI-BC-08			JI-BC-09			JI-BC-10		
	Summer 2020	Fall 2020	Spring 2021	Summer 2020	Fall 2020	Spring 2021	Summer 2020	Fall 2020	Spring 2021
Total abundance/m²	2,118	12,859	3,132	1,856	3,502	3,138	2,596	6,123	1,518
Total biomass (g/m²)	1.3	0.3	1.2	1.1	1.0	1.4	2.3	0.7	1.9
Unique infaunal taxa	10	14	23	11	12	19	15	17	28
Species richness (Ludwig-Reynolds)	1.9	2.0	2.3	2.2	2.0	2.3	2.9	2.8	3.1
Evenness	0.7	0.5	0.6	0.8	0.6	0.4	0.7	0.7	0.7
Shannon-Wiener H' (ln)	1.6	1.4	1.5	1.8	1.5	1.1	2.0	1.8	2.0
Simpson's dominance	0.3	0.4	0.4	0.2	0.3	0.6	0.2	0.2	0.2
Shannon-Wiener H' (log base 2)	2.3	2.0	2.1	2.7	2.2	1.5	2.8	2.7	2.9
Percent abundance pollution-indicative species	43	3.2	7.4	39	0.6	2.5	28	4.6	6.1
Percent biomass pollution-indicative species	23	48	11	24	13	0.7	17	25	24
Percent abundance pollution-sensitive species	1.5	12	4.4	5.3	18	8.0	5.5	24	15
Percent biomass pollution-sensitive species	1.7	0.7	7.2	4.5	10	13	5.7	2.8	7.0
Percent abundance carnivores and omnivores	7.3	3.2	1.3	22	4.2	1.6	23	14	3.2

4.2.3 *Chesapeake Bay Benthic Index of Biotic Integrity*

The total B-IBI score for each location is derived by averaging individual scores for each metric. A summary of the benthic community metrics and scores used to calculate the Chesapeake Bay B-IBI are presented in Table 4-11. 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 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 James Island benthic locations for summer 2020 and fall 2020, ranging from 1.2 to 2.9, with one exception. The highest score occurred at locations JI-BC-09 during fall 2020 (total B-IBI score of 3.3), which was classified as meeting the restoration goal. During the spring sampling event, two locations (JI-BC-05 and JI-BC-10) and the reference location were classified as meeting the restoration goal. Sampling locations JI-BC-01, JI-BC-03, JI-BC-07, and JI-BC-10 from the summer sampling event and JI-BC-07, JI-BC-08, and JI-BC-09 from the spring sampling event received the classification of marginal. All remaining samples were classified as either degraded or severely degraded. The James Island reference site was also classified as degraded during the summer sampling event (total B-IBI score of 2.4), severely degraded during the fall sampling event (total B-IBI score of 1.8) and increased to meets restoration goal during the spring sampling event (total B-IBI score of 3.0; Table 4-11).

These results were compared to the B-IBI scores calculated from the benthic sampling conducted in 2002 to 2003 and presented in the FS/EIS (USACE 2009). Total B-IBI scores ranged from 1.0 to 3.8 for all locations at James Island. The total B-IBI calculated for the summer 2002 samples were all 1.8 and were classified as severely degraded. The benthic community around James Island was determined to be stressed according to the B-IBI scores. This was attributed to a number of possible factors, including the high abundance of amethyst gem clam (USACE 2009), similar to the benthic community composition determined during the 2020 and 2021 sampling events. Results of the 2020 benthic community sampling are consistent with the 2002 and 2003 sampling results presented in the FS/EIS (USACE 2009).

As discussed in Section 3.2.3, long-term benthic monitoring has also been part of Maryland's Water Quality Monitoring Program for the Chesapeake Bay since 1984. The same long-term benthic monitoring locations described in Section 3.2.3 for comparison the Barren Island B-IBI results are also used for comparison to James Island B-IBI results. B-IBI calculations for these long-term monitoring locations for 2015 through 2019 are presented in Table 3-12.

The 5-year averages for the B-IBI for the high mesohaline mud monitoring location (024) and two of the high mesohaline mud monitoring locations (001 and 006) all exceed 3.0, meaning they are classified as meets restoration goals. The 5-year average for one high mesohaline mud location (015) is 2.4, resulting in a classification of degraded. Results of the James Island B-IBI calculation were generally consistent with long-term monitoring location 015; however, they were less than the results of the remaining Chesapeake Bay long-term benthic monitoring locations.

Table 4-11
Chesapeake Bay B-IBI Scoring for James Island Benthic Locations

Metric	James Island											
	JI-BC-REF			JI-BC-01			JI-BC-02			JI-BC-03		
	Summer 2020	Fall 2020	Spring 2021	Summer 2020	Fall 2020	Spring 2021	Summer 2020	Fall 2020	Spring 2021	Summer 2020	Fall 2020	Spring 2021
Salinity regime	High mesohaline (sand)	High mesohaline (sand)	Low mesohaline	High mesohaline (sand)	High mesohaline (sand)	Low mesohaline	High mesohaline (sand)	High mesohaline (sand)	Low mesohaline	High mesohaline (sand)	High mesohaline (sand)	Low mesohaline
Shannon-Wiener H' (log base 2)	3.0	3.0	5.0	3.0	3.0	50	1.7	3.7	5.0	3.0	3.0	5.0
Total abundance/m²	3.7	3.7	4.3	3.0	5.0	3.7	4.3	2.3	2.3	1.7	3.0	3.0
Biomass/m²	1.0	1.0	2.3	3.0	1.0	1.0	1.0	1.0	1.0	2.3	1.0	1.7
Percent abundance pollution-indicative species	3.0	1.0	2.3	3.0	2.3	1.0	4.3	1.0	1.7	5.0	1.7	1.7
Percent biomass pollution-indicative species	--	--	--	--	--	--	--	--	--	--	--	--
Percent abundance pollution-sensitive species	3.0	1.0	--	3.0	1.0	--	3.0	1.7	--	3.0	1.0	--
Percent biomass pollution-sensitive species	--	--	--	--	--	--	--	--	--	--	--	--
Percent abundance carnivores and omnivores	1.0	1.0	--	1.0	1.7	--	1.0	1.0	--	1.0	1.0	--
B-IBI	2.4	1.8	3.0	2.7	2.3	2.3	2.6	1.8	2.2	2.7	1.8	2.5
Restoration goal	Degraded	Severely degraded	Meets Restoration Goals	Marginal	Degraded	Degraded	Degraded	Severely degraded	Degraded	Marginal	Severely degraded	Degraded

Metric	James Island											
	JI-BC-04			JI-BC-05			JI-BC-06			JI-BC-07		
	Summer 2020	Fall 2020	Spring 2021	Summer 2020	Fall 2020	Spring 2021	Summer 2020	Fall 2020	Spring 2021	Summer 2020	Fall 2020	Spring 2021
Salinity regime	High mesohaline (sand)	High mesohaline (sand)	Low mesohaline	High mesohaline (sand)	High mesohaline (sand)	Low mesohaline	High mesohaline (sand)	High mesohaline (sand)	Low mesohaline	High mesohaline (sand)	High mesohaline (sand)	Low mesohaline
Shannon-Wiener H' (log base 2)	2.3	3.0	5.0	1.7	1.0	5.0	1.0	1.0	1.0	3.0	1.0	5.0
Total abundance/m²	2.3	1.7	3.0	1.0	3.0	3.7	1.0	3.0	1.0	3.7	2.3	3.0
Biomass/m²	1.7	1.7	1.0	1.0	1.0	1.7	3.0	1.0	3.0	1.0	1.0	3.0
Percent abundance pollution-indicative species	5.0	2.3	1.0	5.0	2.3	3.7	5.0	3.0	5.0	4.3	1.0	1.7
Percent biomass pollution-indicative species	--	--	--	--	--	--	--	--	--	--	--	--
Percent abundance pollution-sensitive species	3.0	1.7	--	3.0	1.0	--	1.0	1.0	--	2.3	1.0	--
Percent biomass pollution-sensitive species	--	--	--	--	--	--	--	--	--	--	--	--
Percent abundance carnivores and omnivores	1.0	1.0	--	1.0	1.0	--	1.0	1.0	--	2.3	1.0	--
B-IBI	2.6	1.9	2.2	2.1	1.6	3.3	2.0	1.7	2.2	2.8	1.2	2.7

Metric	James Island											
	JI-BC-04			JI-BC-05			JI-BC-06			JI-BC-07		
	Summer 2020	Fall 2020	Spring 2021	Summer 2020	Fall 2020	Spring 2021	Summer 2020	Fall 2020	Spring 2021	Summer 2020	Fall 2020	Spring 2021
Restoration goal	Degraded	Severely degraded	Degraded	Degraded	Severely degraded	Meets Restoration Goals	Severely degraded	Severely degraded	Degraded	Marginal	Severely degraded	Marginal

Metric	James Island								
	JI-BC-08			JI-BC-09			JI-BC-10		
	Summer 2020	Fall 2020	Spring 2021	Summer 2020	Fall 2020	Spring 2021	Summer 2020	Fall 2020	Spring 2021
Salinity regime	High mesohaline (sand)	High mesohaline (sand)	Low mesohaline	High mesohaline (mud)	High mesohaline (mud)	Low mesohaline	High mesohaline (sand)	High mesohaline (sand)	Low mesohaline
Shannon-Wiener H' (log base 2)	1.0	1.7	3.0	3.0	3.7	1.7	2.3	3.0	5.0
Total abundance/m²	1.0	5.0	3.0	3.0	4.3	3.7	2.3	4.3	3.0
Biomass/m²	3.0	1.0	2.3	3.0	3.0	2.3	3.0	1.7	3.0
Percent abundance pollution-indicative species	5.0	1.0	4.3	--	--	5.0	5.0	1.7	5.0
Percent biomass pollution-indicative species	--	--	--	3.0	3.7	--	--	--	--
Percent abundance pollution-sensitive species	3.0	1.0	--	--	--	--	3.0	1.0	--
Percent biomass pollution-sensitive species	--	--	--	1.0	1.0	--	--	--	--
Percent abundance carnivores and omnivores	1.0	1.0	--	1.0	4.3	--	1.7	2.3	--
B-IBI	2.3	1.8	2.7	2.3	3.3	2.7	2.9	2.3	3.4
Restoration goal	Degraded	Severely degraded	Marginal	Degraded	Meets restoration goals	Marginal	Marginal	Degraded	Meets restoration goals

Notes:
B-IBI Scores: ≥ 3.0 = meets restoration goals; 2.7-2.9 = marginal; 2.1-2.6 = degraded; ≤ 2.0 = severely degraded
--: Metric was not used for this habitat classification

4.3 Fisheries Surveys

To identify the fish species using the area around James Island, a four-season sampling program was implemented including surveys in summer 2020, fall 2020, winter 2021, and spring 2021. Survey sampling techniques include bottom trawling, beach seining, gillnetting, and pop netting. Bottom trawl, beach seine, and gillnet surveys were conducted during all four seasons. The bottom trawl is used to collect data on the benthic fish assemblages, and the beach seine provides data on the nearshore fish assemblages and blue crab assemblages. The gillnet surveys were used to collect data on fish assemblages in the offshore water column. Pop netting, which targets fish that use the SAV beds in the vicinity of James Island as habitat, was conducted in summer 2020 and spring 2021.

As expected, sampling data indicated that beach seine surveys detected juvenile fish, while bottom trawl and gillnet surveys detected larger subadult to adult fish, mainly due to juveniles and smaller fish remaining closer to the shore where they are more likely to be captured in a seine net, while larger fish tend to be in deeper water where they are more likely to be captured in a trawl or gillnet. In addition, beach seine surveys generally collected more species than other sampling gear.

4.3.1 Beach Seine Survey Results

A summary of species collected, number of each species collected, and range of sizes collected in beach seines for each sampling season is provided in Table 4-12. Individual lengths for all fish and crab collected are provided in Appendix D. Overall, eight different species of fish and one invertebrate were collected throughout all four sampling seasons. The summer survey resulted in the greatest number of fish collected. No fish were collected during the winter 2021 beach seine survey.

At James Island, the summer 2020 beach seine sampling produced six different species of fish and one species of invertebrate, blue crab. Striped anchovy and Atlantic silverside were present in the greatest abundance. Five or less of each of the following species were also collected during the summer 2020 event (in order of abundance): bay anchovy, Atlantic menhaden, Atlantic needlefish (*Strongylura marina*), and Atlantic threadfin (*Polydactylus octonemus*).

The fall 2020 beach seine sampling produced two different species of fish. Atlantic silverside was present in the highest numbers (232 fish) and one red drum was collected. Two species were also collected during the spring 2021 survey: 137 Atlantic silverside and eight spot.

The beach seine surveys conducted at James Island in 2002 to 2003 and presented in the FS/EIS (USACE 2009) found that bay anchovy and Atlantic silverside were generally present in the greatest abundances, similar to the results from the 2020 and 2021 beach seine surveys. Additionally, the list of species collected during the 2002 and 2003 surveys is similar to the species list from the 2020 and 2021 surveys. In the winter 2003 beach seine survey, there were no organisms collected (USACE 2009), again similar to the winter 2021 survey.

Table 4-12
James Island Beach Seine Collection Data

Species Collected		Summer Collection				Fall Collection			
Scientific Name	Common Name	Total Count	Minimum Length (mm)	Maximum Length (mm)	Average Length (mm)	Total Count	Minimum Length (mm)	Maximum Length (mm)	Average Length (mm)
Fish									
Brevoortia tyrannus	Atlantic menhaden	4	83	99	89	--	--	--	--
Strongylura marina	Atlantic needlefish	4	252	380	305	--	--	--	--
Menidia menidia	Atlantic silverside	93	56	100	81	232	64	129	92
Polydactylus octonemus	Atlantic threadfin	2	65	72	69	--	--	--	--
Anchoa mitchilli	Bay anchovy	5	51	54	52	--	--	--	--
Sciaenops ocellatus	Red drum	--	--	--	--	1	39	39	39
Anchoa hepsetus	Striped anchovy	259	54	91	70	--	--	--	--
Leiostomus xanthurus	Spot	--	--	--	--	--	--	--	--
Invertebrate									
Callinectes sapidus	Blue crab	2	60	62	61	--	--	--	--

Species Collected		Spring Collection						
Scientific Name	Common Name	Total Count	Minimum Length (mm)	Maximum Length (mm)	Average Length (mm)	Minimum Weight (g)	Maximum Weight (g)	Average Weight (g)
Fish								
Brevoortia tyrannus	Atlantic menhaden	--	--	--	--	--	--	--
Strongylura marina	Atlantic needlefish	--	--	--	--	--	--	--
Menidia menidia	Atlantic silverside	137	60	136	109	0.7	17.0	8.3
Polydactylus octonemus	Atlantic threadfin	--	--	--	--	--	--	--
Anchoa mitchilli	Bay anchovy	--	--	--	--	--	--	--

Species Collected		Spring Collection						
Scientific Name	**Common Name**	**Total Count**	**Minimum Length (mm)**	**Maximum Length (mm)**	**Average Length (mm)**	**Minimum Weight (g)**	**Maximum Weight (g)**	**Average Weight (g)**
Sciaenops ocellatus	Red drum	--	--	--	--	--	--	--
Anchoa hepsetus	Striped anchovy	--	--	--	--	--	--	--
Leiostomus xanthurus	Spot	8	34	45	38.25	0.2	0.6	0.4
Invertebrate								
Callinectes sapidus	Blue crab	--	--	--	--	--	--	--

Notes:

a. No fish were collected in seine nets during the winter collection.

--: no data

4.3.2 Bottom Trawl Survey Results

A summary of species collected, number of each species collected, and range of sizes collected in bottom trawls for each sampling season is provided in Table 4-13. Individual lengths for all fish and crab collected are provided in Appendix D. Overall, five different species of fish and one invertebrate were collected throughout all four sampling seasons. The spring survey resulted in the greatest number of fish collected. No fish were collected during the winter bottom trawl survey.

During the summer 2020 bottom trawl survey, one hogchoker (*Trinectes maculatus*) and three blue crabs were collected. During the fall 2020 bottom trawl survey, one skilletfish (*Gobiesox strumosus*) and four blue crabs were collected. The spring 2021 bottom trawl survey yielded both the highest number of species and the greatest abundance collected. Thirteen bay anchovy, one American shad (*Alosa sapidissima*), and one Atlantic menhaden were collected.

The bottom trawl surveys conducted at James Island in 2002 and 2003 and presented in the FS/EIS (USACE 2009) yielded similar results to those presented in this SAR. Bottom trawling yielded few species, and the most dominant finfish in the bottom trawl was the bay anchovy and the dominant shellfish was the blue crab (USACE 2009).

Table 4-13
James Island Bottom Trawl Collection Data

Species Collected		Summer Collection				Fall Collection			
Scientific Name	Common Name	Total Count	Minimum Length (mm)	Maximum Length (mm)	Average Length (mm)	Total Count	Minimum Length (mm)	Maximum Length (mm)	Average Length (mm)
Fish									
Alosa sapidissima	Amercian shad	--	--	--	--	--	--	--	--
Brevoortia tyrannus	Atlantic menhaden	--	--	--	--	--	--	--	--
Anchoa mitchilli	Bay anchovy	--	--	--	--	--	--	--	--
Trinectes maculatus	Hogchoker	1	165	165	165	--	--	--	--
Gobiesox strumosus	Skilletfish	--	--	--	--	1	66	66	66
Invertebrate									
Callinectes sapidus	Blue crab	3	127	164	142	8	129	175	143.75

Species Collected		Spring Collection						
Scientific Name	Common Name	Total Count	Minimum Length (mm)	Maximum Length (mm)	Average Length (mm)	Minimum Weight (g)	Maximum Weight (g)	Average Weight (g)
Fish								
Alosa sapidissima	Amercian shad	1	130	130	130	17.8	17.8	17.8
Brevoortia tyrannus	Atlantic menhaden	1	39	39	39	0.4	0.4	0.4
Anchoa mitchilli	Bay anchovy	13	42	67	57	0.4	1.9	1.1
Trinectes maculatus	Hogchoker	--	--	--	--	--	--	--
Gobiesox strumosus	Skilletfish	--	--	--	--	--	--	--

Species Collected		Spring Collection						
Scientific Name	Common Name	Total Count	Minimum Length (mm)	Maximum Length (mm)	Average Length (mm)	Minimum Weight (g)	Maximum Weight (g)	Average Weight (g)
Invertebrate								
Callinectes sapidus	Blue crab	1	145	145	145	--	--	--

Notes:

b. No fish were collected in bottom trawls during the winter collection.

--: no data

4.3.3 Gillnet Survey Results

A summary of species collected, number of each species collected, and range of sizes collected in gill nets for each sampling season is provided in Table 4-14. Individual lengths for all fish and crab collected are provided in Appendix D. Overall, nine different species of fish and one invertebrate were collected throughout all four sampling seasons. The summer 2020 survey resulted in the greatest number species number of species and greatest abundance of fish collected.

The summer 2020 gill net surveys produced eight different species of fish and one species of invertebrate, the blue crab. Spot and Spanish mackerel were present in the greatest abundances. Five or less of each of the following species were also collected during the summer 2020 survey (in order of abundance): Atlantic menhaden, gizzard shad, bluefish, weakfish, striped bass, and summer flounder (*Paralichthys dentatus*).

Only two fish species were collected during the fall 2020 gill net survey: two striped bass and one gizzard shad were collected. The winter 2021 gill net survey also yielded only one alewife. Three striped bass were collected in the spring 2021 survey.

The number of species collected and fish abundance presented in the FS/EIS for the 2002/2003 exceeds the number of species and abundance collected as part of the 2020/2021 gillnetting survey (USACE 2009).

Table 4-14
James Island Gill Net Collection Data

Species Collected		Summer Collection				Fall Collection				Winter Collection			
Scientific Name	**Common Name**	**Total Count**	**Minimum Length (mm)**	**Maximum Length (mm)**	**Average Length (mm)**	**Total Count**	**Minimum Length (mm)**	**Maximum Length (mm)**	**Average Length (mm)**	**Total Count**	**Minimum Length (mm)**	**Maximum Length (mm)**	**Average Length (mm)**
Fish													
Alosa pseudoharengus	Alewife	--	--	--	--	--	--	--	--	1	280	280	280
Brevoortia tyrannus	Atlantic menhaden	5	280	340	323	--	--	--	--	--	--	--	--
Pomatomus saltatrix	Bluefish	3	266	363	311	--	--	--	--	--	--	--	--
Dorosoma cepedianum	Gizzard shad	4	415	467	438	1	490	490	490	--	--	--	--
Scomberomorus maculatus	Spanish mackerel	6	232	395	301	--	--	--	--	--	--	--	--
Leiostomus xanthurus	Spot	9	122	155	135	--	--	--	--	--	--	--	--
Morone saxatilis	Striped bass	1[a]	--	--	--	2	337	471	404	--	--	--	--
Paralichthys dentatus	Summer flounder	1	208	208	208	--	--	--	--	--	--	--	--
Cynoscion regalis	Weakfish	2[a]	--	--	--	--	--	--	--	--	--	--	--
Invertebrate													
Callinectes sapidus	Blue crab	3	127	132	130	--	--	--	--	--	--	--	--

Species Collected		Spring Collection						
Scientific Name	**Common Name**	**Total Count**	**Minimum Length (mm)**	**Maximum Length (mm)**	**Average Length (mm)**	**Minimum Weight (g)**	**Maximum Weight (g)**	**Average Weight (g)**
Fish								
Alosa pseudoharengus	Alewife	--	--	--	--	--	--	--
Brevoortia tyrannus	Atlantic menhaden	--	--	--	--	--	--	--
Pomatomus saltatrix	Bluefish	--	--	--	--	--	--	--
Dorosoma cepedianum	Gizzard shad	--	--	--	--	--	--	--
Scomberomorus maculatus	Spanish mackerel	--	--	--	--	--	--	--
Leiostomus xanthurus	Spot	--	--	--	--	--	--	--
Morone saxatilis	Striped bass	3	360	475	405	488	1145	711
Paralichthys dentatus	Summer flounder	--	--	--	--	--	--	--
Cynoscion regalis	Weakfish	--	--	--	--	--	--	--
Invertebrate								
Callinectes sapidus	Blue crab	--	--	--	--	--	--	--

Notes:

c. Parts of fish were missing upon net retrieval; total lengths could not be measured.

--: no data

4.3.4 Pop Net Survey Results

A summary of species collected, number of each species collected, and range of sizes collected in pop nets for the summer 2020 and spring 2021 surveys is provided in Table 4-15. Individual lengths for all fish and crab collected are provided in Appendix D. Overall, four different species of fish were collected over both sampling seasons. The summer 2020 survey resulted in the greatest number species number of species and greatest abundance of fish collected.

During the summer 2020 pop net survey, 499 bay anchovies, 76 striped anchovy, and six Atlantic silverside were collected. Four spot were collected during the spring 2021 pop net survey.

The most common finfish species collected during the 2002/2003 pop net surveys was the bay anchovy (USACE 2009), similar to the results of the pop net surveys conducted as part of this field investigation. Additionally, the number of species collected was similar between the 2002/2003 and 2020/2021 surveys. However, the total number of fish collected substantially greater in the 2020/2021 surveys. A total of 14 fish were collected in the 2002/2003 pop nets as compared to 585 fish collected in the 2020/2021 surveys.

4.3.5 Summary of Fish Survey Results

The species caught in the fisheries surveys were typical of mesohaline areas of the Mid-Chesapeake Bay Region. Based on the fisheries survey results, the area around James Island is attracting fish in the juvenile and adult life stages. As evident from the beach seine and pop net 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 FS/EIS (USACE 2009). Whereas results were similar to those reported in the SAR, the 2002/2003 fisheries surveys reported greater diversity in species collected for all sample gear types. However, bay anchovy, Atlantic menhaden, and Atlantic silverside continue to be present in the greatest numbers.

Table 4-15
James Island Pop Net Collection Data

Species Collected		Summer Collection				Spring Collection						
Scientific Name	Common Name	Total Count	Minimum Length (mm)	Maximum Length (mm)	Average Length (mm)	Total Count	Minimum Length (mm)	Maximum Length (mm)	Average Length (mm)	Minimum Weight (g)	Maximum Weight (g)	Average Weight (g)
Fish												
Menidia menidia	Atlantic silverside	6	76	85	81	--	--	--	--	--	--	--
Anchoa mitchilli	Bay anchovy	499	36	62	49	--	--	--	--	--	--	--
Leiostomus xanthurus	Spot	--	--	--	--	4	23	25	24	0.1	0.2	0.1
Anchoa hepsetus	Striped anchovy	76	42	68	53	--	--	--	--	--	--	--

Notes:
--: no data

4.4 Bivalve Surveys

Two commercially important clams are found in the vicinity of James Island and include soft-shell and razor clams. Soft-shell and razor clam surveys identified razor clams as more prevalent than soft-shell clams. Bivalve surveys were conducted at five locations around James Island on December 19, 2020. Water quality parameters, including temperature, DO, salinity, and pH, were measured at each transect and are provided in Table 4-16.

Only one legal, harvestable soft-shell clam was collected from all James Island transects; no sublegal soft-shell clams were collected. The bivalve survey at James Island transect JI-CS-05 yielded the greatest number of bivalves: 817 razor clams and one soft-shell clam. The number of bivalves collected at the remaining James Island transects ranged from 35 to 129 bivalves (Table 4-16).

In summary, James Island surveys identified one legal soft-shell clam (no soft-shell clams less than 2 inches in length were identified), 1,175 razor clams, and one oyster (Table 4-16). There were no locations in the James Island survey with a productive natural clam bar ranking as defined by the 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).

Table 4-16
James Island Bivalve Survey Results

Sample Area	Survey Transect	Date	Time	Water Depth (feet)	Temp (°C)	DO (mg/L)	Salinity (ppt)	pH	Bivalve Counts		
									Soft-Shell Clams	Razor Clams	Oysters
James Island	JI-CS-01	12/19/2020	10:18	6.2	5.8	11.4	14.3	8.2	--	128	1
	JI-CS-02	12/19/2020	9:38	6.1	8	10.9	15	8.1	--	91	--
	JI-CS-03	12/19/2020	8:53	5.9	8	10.9	14.8	8	--	35	--
	JI-CS-04	12/19/2020	11:03	8.5	5.5	11.44	14.1	8.1	--	104	--

Notes:
a. Soft-shell clams greater than 2 inches only.
--: no data

4.5 Crab Pot Surveys

Crab pot surveys in the vicinity of James Island were conducted in August 2020, September 2020, May 2021, June 2021, and July 2021. The location and number of crab pots observed are provided in Figures 4-1 through 4-5 for August 2020, September 2020, May 2021, June 2021, and July 2021, respectively. Sampling points along each transect were used to identify relative crab pot density within subareas. For several of the surveys, areas where crab pots were visibly clustered were noted in the field and are represented on the applicable figures. On each figure, the blue boxes represent the area in which the crab pots were observed. The numbers within the boxes are the number of crab pots counted within the area of the blue box.

The August 2020 survey was conducted on August 30, 2020. One thousand one hundred and twenty-three crab pots were observed surrounding James Island. Crab pots were present in the highest densities in the areas immediately north and immediately south of the island. Crab pots were present within the footprint north and west of the northern remnant and south and west of the southern remnant. Very few crab pots were observed east of the island. The number of crab pots observed and the general vicinity in which the crab pots were located are provided in Figure 4-1.

During the September 2020 survey conducted on September 29, 2020, 971 crab pots were observed. During this survey, most of the crab pots were observed to the north and northwest of the northern remnant. No crab pots were observed south or east of James Island. The number of crab pots observed and the general vicinity in which the crab pots were located for the September 2020 survey are provided in Figure 4-2.

A total of 50 crab pots were counted during the May 2021 survey, conducted on May 18, 2021. The majority of the crab pots were all located northeast of James Island. The number of crab pots observed and the general vicinity in which the crab pots were located for the May 2021 survey are provided in Figure 4-3.

The June 2021 survey was conducted on June 23, 2021. A total of 1,106 crab pots were observed during this survey. The distribution of crab pots was split relatively evenly between the north and south sides of the island. There were no crab pots placed east of James Island. The number of crab pots observed and the general vicinity in which the crab pots were located for the June 2021 survey are provided in Figure 4-4.

The July 2021 survey was conducted on July 22, 2021. A total of 598 crab pots were observed during this survey. A dense cluster of crab pots was observed south and west of the southern remnant of James Island and another cluster was observed immediately north of the island. There were no crab pots placed east of James Island. The number of crab pots observed and the general vicinity in which the crab pots were located for the July 2021 survey are provided in Figure 4-5.

Table 4-17 presents the relative crab pot numbers observed during each sampling event. The estimated density of crab pots (number of crab pots per acre of area surveyed) ranged from 0.01 to 0.29 pot per acre. The greatest crab pot densities were measured during the August 202 and June 2021 surveys.

Table 4-17
Crab Pot Estimates Surrounding James Island

Survey Month	Total Number of Crab Pots Observed	Harvest Area (acres)	Estimated Density (pots/acre)
August 2020	1,123	3,846	0.29
September 2020	971	3,846	0.25
May 2021	50	3,846	0.01
June 2021	1,106	3,846	0.29
July 2021	598	3,846	0.16

Figure 4-1
James Island Crab Pot Survey Transects – August 2020

LEGEND:

- James Island Remnants
- Proposed James Island Access Channel
- Proposed James Island Alignment
- Crab Pot Survey Footprint
- Crab Pot Survey Transect
- Crab Pot Count Area

Existing SAV Bed

- Moderate 40-70% cover
- Sparse 10-20% cover

NOTES:
1. Basemaps obtained from Esri aerial imagery and NOAA raster nautical charts streaming services.
2. Crabpot survey boundary includes the area within 0.25 mile of the proposed restoration footprint and James Island remnants.
3. The numbers provided in the figure represent the number of crab pots observed within in the crab pot survey footprint. See Section 4.5 for additional information.

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Meters

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Figure 4-2
F James Island Crab Pot Survey Transects – September 2020

LEGEND:

- James Island Remnants
- Proposed James Island Access Channel
- Proposed James Island Alignment
- Crab Pot Survey Footprint
- Crab Pot Survey Transect
- Crab Pot Count Area

Existing SAV Bed

- Moderate 40-70% cover
- Sparse 10-20% cover

NOTES:
1. Basemaps obtained from Esri aerial imagery and NOAA raster nautical charts streaming services.
2. Crabpot survey boundary includes the area within 0.25 mile of the proposed restoration footprint and James Island remnants.
3. The numbers provided in the figure represent the number of crab pots observed within in the crab pot survey footprint. See Section 4.5 for additional information.

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Figure 4-3
James Island Crab Pot Survey Transects – May 2021

LEGEND:

- James Island Remnants
- Proposed James Island Access Channel
- Proposed James Island Alignment
- Crab Pot Survey Footprint
- Crab Pot Survey Transect
- Crab Pot Count Area

Existing SAV Bed

- Moderate 40-70% cover
- Sparse 10-20% cover

NOTES:
1. Basemaps obtained from Esri aerial imagery and NOAA raster nautical charts streaming services.
2. Crabpot survey boundary includes the area within 0.25 mile of the proposed restoration footprint and James Island remnants.
3. The numbers provided in the figure represent the number of crab pots observed within in the crab pot survey footprint. See Section 4.5 for additional information.

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Figure 4-4
James Island Crab Pot Survey Transects – June 2021

LEGEND:

James Island Remnants
Proposed James Island Access Channel
Proposed James Island Alignment
Crab Pot Survey Footprint
Crab Pot Survey Transect
Crab Pot Count Area
Existing SAV Bed
Moderate 40-70% cover
Sparse 10-20% cover

NOTES:
1. Basemaps obtained from Esri aerial imagery and NOAA raster nautical charts streaming services.
2. Crabpot survey boundary includes the area within 0.25 mile of the proposed restoration footprint and James Island remnants.
3. The numbers provided in the figure represent the number of crab pots observed within in the crab pot survey footprint. See Section 4.5 for additional information.

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Figure 4-5
James Island Crab Pot Survey Transects – July 2021

LEGEND:

- James Island Remnants
- Proposed James Island Access Channel
- Proposed James Island Alignment
- Crab Pot Survey Footprint
- Crab Pot Survey Transect
- Crab Pot Count Area

Existing SAV Bed

- Moderate 40-70% cover
- Sparse 10-20% cover

0 2,000
Meters

NOTES:
1. Basemaps obtained from Esri aerial imagery and NOAA raster nautical charts streaming services.
2. Crabpot survey boundary includes the area within 0.25 mile of the proposed restoration footprint and James Island remnants.
3. The numbers provided in the figure represent the number of crab pots observed within in the crab pot survey footprint. See Section 4.5 for additional information.

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4.6 Avian Surveys

Avian surveys were performed in summer 2020 and spring 2021. The surveys covered a representative range of habitats on the island, including forest, saltmarsh, open water, scrub-shrub, and shoreline.

4.6.1 Summer Survey Results

Four locations at James Island were included in the summer avian survey conducted on September 2, 2020. On James Island, each survey point occurred on a separate fragment of the island and covered the range of habitats available, including salt marsh, open water, mudflat, and shoreline. Survey points JI-AS-03 and JI-AS-04 had some remaining pine trees and snags that were not present near the other two survey points. Survey locations are shown in Figure 2-13 and 2-14. A summary of the survey results is provided in Table 4-18.

A total of 24 species and 469 individuals were observed on or from James Island during the summer 2020 surveys. Laughing gull (*Leucophaeus atricilla*), Forster's tern (*Sterna forsteri*), and double-crested cormorant were the most abundant species observed from the island fragments during the surveys and represented more than 70% of all observations. Most observations of these species were of individuals flying past the island fragments; however, a few Forester's terns were observed perched along the shoreline.

Several migrating shorebirds were observed feeding on the shoreline and exposed mudflats, including semipalmated plover, ruddy turnstone (*Arenaria interpres*), sanderling, least sandpiper (*Calidris minutilla*), spotted sandpiper, and semipalmated sandpiper (*Calidris pusilla*).

Three raptor species, osprey, bald eagle, and peregrine falcon (*Falco peregrinus*), were observed perching on the remnant trees of the two southernmost fragments of James Island, near survey points JI-AS-03 and JI-AS-04. An intact osprey nest, as well as two partial nests were present in the trees near JI-AS-04. Two unhatched brown pelican eggs were also observed in the sand as well as remnant nests in the shrubs near survey point JI-AS-03.

No terrestrial habitat remains on any of the James Island fragments. Therefore, no typical land birds were observed during the timed surveys or incidental observations.

A wide variety of both resident and migratory bird species were observed using all habitats available at James Island during the September 2020 avian survey. The late summer survey period did not provide direct evidence of the presence of breeding birds because of the late date of the surveys in early September. However, the surveys did document the presence of likely resident species and species that use the islands as stopover sites for resting and foraging during migration.

James Island has eroded from approximately 100 acres to less than 5 acres in less than 20 years. It currently has no remaining upland habitat and is limited to salt marsh, shoreline, and mudflats. These habitats provide only limited opportunities for nesting by a few species.

An avian survey was conducted on James Island in 2002 as part of the FS/EIS (USACE 2009). During the summer 2002 survey, a total of 40 birds were observed at James 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 laughing gulls, Forster's terns, and double-crested cormorants observed during the 2020 survey (totaling 345 individuals). Additionally, 24 species were observed in the 2020 survey, as compared to 18 bird species in the 2002 survey (USACE 2009).

Table 4-18
James Island Avian Summer Survey Results

Species Observed				
Scientific Name	Common Name	Status[a]	Habitat[b]	Number Observed Summer 2020
Haliaeetus leucocephalus	Bald eagle	R, M	O, FO	28
Hirundo rustica	Barn swallow	M	FO	1
Pelecanus occidentalis	Brown pelican	S	O, FO	32
Branta canadensis	Canada goose	R	FO	3
Hydroprogne caspia	Caspian tern	M	FO	1
Chaetura pelagica	Chimney swift	M	FO	1
Phalacrocorax auritus	Double-crested cormorant	S, M	O, FO	82
Sterna forsteri	Forster's tern	S, M	S, O, FO, MF, SH	99
Larus marinus	Great black-backed gull	R, M	O, FO	2
Ardea Herodias	Great blue heron	R	FO	1
Larus argentatus	Herring gull	R, M	O	7
Leucophaeus atricilla	Laughing gull	S, M	S, O, FO, MF	164
Calidris minutilla	Least sandpiper	M	MF, SH	8
Pandion haliaetus	Osprey	S, M	O, FO, SH	15
Falco peregrinus	Peregrine falcon	M	SH	1
Larus delawarensis	Ring-Billed gull	M, W	O	1
Archilochus colubris	Ruby-throated hummingbird	M	S	1
Arenaria interpres	Ruddy turnstone	M	FO, MF	4
Calidris alba	Sanderling	M	FO, MF	4
Charadrius semipalmatus	Semipalmated plover	M	FO, MF, SH	4
Actitis macularius	Spotted Sandpiper	M	MF, SH	3
Cathartes aura	Turkey vulture	R, M	FO	5
Corvus sp.	Unidentified crow	R	FO	1

Species Observed				Number Observed
Scientific Name	Common Name	Status[a]	Habitat[b]	Summer 2020
Calidris sp.	Unidentified peep	M	FO	1

Notes:

a. Status:
- M: migrant
- R: year-round resident
- S: summer resident
- W: winter resident

b. Habitat:
- F: Forest
- S: saltmarsh
- O: open water
- FO: flyover
- MF: mud flat
- SH: shore
- S/S: scrub-shrub

4.6.2 Spring Survey Results

Four locations at James Island were included in the spring avian survey conducted on May 27, 2021. The surveys were conducted from the same locations as the summer 2020 avian survey, with the exception of location JI-AS-03. Actively nesting birds were observed at this location, so the survey was conducted from kayaks approximately 200 feet west of the original location to limit disturbance to the nesting birds. Each survey point was located on a separate fragment of the island and covered the range of habitats available, including salt marsh, open water, mudflat, and shoreline. Survey points JI-AS-03 and JI-AS-04 had some remaining pine trees and snags that were not present near the other two survey points. Survey locations are shown in Figure 2-13 and 2-14. A summary of the survey results is provided in Table 4-19.

A total of 309 individual birds representing 18 species were observed during the spring survey. Terns, including common tern (*Sterna hirundo*) and Forster's tern, were observed in the greatest abundance, making up 57% (178 individuals) of the total number of birds surveyed. Most observations of these two species were of individuals courting and nesting on the island fragment just north of JI-AS-03.

Canada goose (*Branta canadensis*), great blue heron, and common grackle were also observed nesting on the southern remnants of James Island near JI-AS-03. A pair of ospreys were also observed nesting in a pine tree near JI-AS-04. Two pairs of American oystercatchers (*Haematopus palliates*), each with two recently fledged young, were also observed on fragments of James Island.

Typical land birds were not observed during the timed surveys or incidental observations due to the lack of remaining terrestrial habitat on the island. One exception was the common grackle, which were observed carrying food from the mainland, southeast of the islands, back to the southern fragments of James Island to feed nestlings. The purple martin (*Progne subis*) and barn swallow (*Hirundo rustica*) were observed flying past the survey locations.

James Island has eroded from approximately 100 acres to less than 5 acres in less than 20 years. It currently has no remaining upland habitat, and is limited to salt marsh, shoreline, and mudflats. These habitats provide only limited opportunities for nesting by a few species. Despite this, seven avian species were confirmed to be breeding on the island remnants.

Avian surveys were conducted in 2002 and 2003 as part of the FS/EIS (USACE 2009). During the spring 2003 survey, a total of 47 birds were observed at James Island. The number of birds observed during the spring 2021 survey is approximately an order of magnitude greater than the 2003 survey. Most of this is likely due to the high numbers of terns observed during the 2021 survey (totaling 178 individuals). Despite the difference in bird abundance, the number of species observed were similar. Eighteen species were observed in the 2021 survey, as compared to 12 bird species in the 2003 survey (USACE 2009).

Table 4-19
James Island Avian Spring Survey Results

Species Observed				Number Observed[c]	
Scientific Name	Common Name	Status[a]	Habitat[b]	Morning Survey	Afternoon Survey
Haematopus palliatus	American oystercatcher[d]	S, M	SH, MF	2	3
Haliaeetus leucocephalus	Bald eagle	R, M	FO	1	2
Hirundo rustica	Barn swallow	M	FO	3	4
Branta canadensis	Canada goose[d]	R	O, SH	6	1
Quiscalus quiscula	Common grackle[d]	R	SH	5	5
Sterna spp.	Common/Forster's tern[d, e]	S, M	O, FO, SH	82	96
Phalacrocorax auritus	Double-crested cormorant	S, M	O, FO	10	16
Larus marinus	Great black-backed gull	R, M	FO, SH	3	6
Ardea herodias	Great blue heron[d]	R	FO, SH	5	6
Larus argentatus	Herring gull	R, M	FO, SH	2	5
Leucophaeus atricilla	Laughing gull	S, M	FO	0	7
Sternula antillarum	Least tern	S, M	FO	1	0
Pandion haliaetus	Osprey[d]	S, M	O, FO, SH	7	7
Progne subis	Purple martin	M	FO	1	0
Larus delawarensis	Ring-billed gull	M, W	O, FO	2	1

Species Observed				Number Observed[c]	
Scientific Name	Common Name	Status[a]	Habitat[b]	Morning Survey	Afternoon Survey
Calidris pusilla	Semipalmated sandpiper	M	SH, MF	2	2
Cathartes aura	Turkey vulture	R, M	FO	0	16

Notes:

a. Status:
- M: migrant
- R: year-round resident
- S: summer resident
- W: winter resident

b. Habitat:
- F: Forest
- S: saltmarsh
- O: open water
- FO: flyover
- MF: mud flat
- SH: shore
- S/S: scrub-shrub

c. Individual birds may have been observed during both surveys

d. Confirmed breeding

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Appendix A
Barren Island Benthic Community
Replicate Sample Results

Appendix B
Barren Island Fish Collection Data

Appendix C
James Island Benthic Community Replicate Sample Results

Table C-1a
James Island Summer Benthic Community Counts and Biomass – JI-BC-01

Species List	JI-BC-01 Abundance			JI-BC-01 Biomass (g; AFDW)		
	Replicate A	Replicate B	Replicate C	Replicate A	Replicate B	Replicate C
Stylochus ellipticus		1			0.00010	
Carinoma tremaphoros		1			0.00010	
Fragilonemertes rosea	3	2	6	0.00100	0.00350	0.00500
Hypereteone heteropoda	2	2		0.00005	0.00005	
Alitta succinea	20	22	2	0.00120	0.00260	0.00010
Glycinde multidens	1	1	7	0.00030	0.00005	0.00040
Streblospio benedicti	17	24	26	0.00040	0.00090	0.00120
Heteromastus filiformis	19	29	20	0.00510	0.00390	0.00530
Mediomastus ambiseta	3	2	3	0.00005	0.00005	0.00020
Pectinaria gouldii		1			0.00010	
Acteocina canaliculata			1			0.00010
Mulinia lateralis	3	3		0.00005	0.00730	
Ameritella mitchelli	27	31	18	0.00080	0.01070	0.00040
Tagelus plebeius	4	7	3	0.00010	0.00010	0.00005
Gemma gemma	7	17	9	0.00050	0.00190	0.00200
Americamysis almyra	1			0.00005		
Cyclaspis varians		1			0.00010	
Apocorophium lacustre	1			0.00005		

Notes:
AFDW: ash free dry weight
g: gram

Table C-1b
James Island Summer Benthic Community Counts and Biomass – JI-BC-02

Species List	JI-BC-02 Abundance			JI-BC-02 Biomass (g; AFDW)		
	Replicate A	Replicate B	Replicate C	Replicate A	Replicate B	Replicate C
Carinoma tremaphoros	1			0.00005		
Fragilonemertes rosea	1	1	1	0.00170	0.00070	0.00090
Hypereteone heteropoda	1		2	0.00020		0.00010
Alitta succinea	8	1	4	0.00160	0.00010	0.00190
Glycinde multidens	3	1		0.00020	0.00060	
Marenzelleria viridis	1	5	1	0.00140	0.00330	0.00100
Streblospio benedicti	18	10	10	0.00100	0.00030	0.00050
Heteromastus filiformis	2	10	8	0.00010	0.00160	0.00040
Mediomastus ambiseta		1			0.00020	
Tubificoides spp.			1			0.00010
Mulinia lateralis	15	10	6	0.00150	0.00670	0.00820
Ameritella mitchelli	14	8	6	0.00590	0.00490	0.00840
Tagelus plebeius	2	3	1	0.00060	0.00010	0.00060
Gemma gemma	4	2		0.00010	0.00005	
Americamysis almyra	2	1		0.00020	0.00020	
Cyathura polita		1			0.00030	
Lepidactylus dytiscus	1	2	1	0.00020	0.00070	0.00040
Ameroculodes spp. complex	1			0.00010		

Notes:
AFDW: ash free dry weight
g: gram

Table C-1c
James Island Summer Benthic Community Counts and Biomass – JI-BC-03

Species List	JI-BC-03 Abundance			JI-BC-03 Biomass (g; AFDW)		
	Replicate A	Replicate B	Replicate C	Replicate A	Replicate B	Replicate C
Fragilonemertes rosea	2	1	2	0.00250	0.00020	0.00940
Alitta succinea	15	13	6	0.00340	0.00190	0.00150
Glycinde multidens	1	2	1	0.00020	0.00050	0.00020
Marenzelleria viridis	1	1		0.00140	0.00120	
Streblospio benedicti	43	28	8	0.00230	0.00170	0.00050
Heteromastus filiformis	31	25	17	0.00590	0.00510	0.00880
Mediomastus ambiseta	2			0.00005		
Tubificoides spp.	1	2	2	0.00005	0.00020	0.00050
Mulinia lateralis	20	21	6	0.01970	0.00090	0.00030
Ameritella mitchelli	36	34	13	0.00100	0.00140	0.00060
Tagelus plebeius	5	8		0.00020	0.00010	
Gemma gemma	27	46	20	0.00780	0.00380	0.00150
Americamysis almyra	1	1	2	0.00040	0.00020	0.00050
Cyathura polita	1		1	0.00030		0.00050
Lepidactylus dytiscus	1			0.0003		

Notes:
AFDW: ash free dry weight
g: gram

Table C-1d
James Island Summer Benthic Community Counts and Biomass – JI-BC-04

Species List	JI-BC-04 Abundance			JI-BC-04 Biomass (g; AFDW)		
	Replicate A	Replicate B	Replicate C	Replicate A	Replicate B	Replicate C
Fragilonemertes rosea	7	7	8	0.01110	0.00450	0.01160
Hypereteone heteropoda	3	2	1	0.00030	0.00010	0.00030
Hypereteone foliosa	1			0.00040		
Alitta succinea	27	24	7	0.00340	0.00270	0.00090
Glycinde multidens	2	3	1	0.00080	0.00090	0.00040
Paraonis fulgens	1			0.00010		
Streblospio benedicti	105	65	24	0.00440	0.00330	0.00100
Heteromastus filiformis	68	61	24	0.00680	0.01620	0.00420
Mediomastus ambiseta		1			0.00010	
Acteocina canaliculata		1			0.00010	
Parvilucina crenella		1			0.00010	
Mulinia lateralis	4	8	6	0.00680	0.02060	0.01170
Ameritella mitchelli	29	62	44	0.00110	0.00130	0.00120
Tagelus plebeius	30	54	21	0.00040	0.00070	0.00060
Gemma gemma	80	68	109	0.00910	0.01790	0.00500
Americamysis almyra		2	1		0.00100	0.00050
Cyclaspis varians	1		2	0.00005		0.00030
Cyathura polita	4	4		0.00080	0.00160	
Phoronis psammophila		1			0.00040	

Notes:
AFDW: ash free dry weight
g: gram

Table C-1e

James Island Summer Benthic Community Counts and Biomass – JI-BC-05

Species List	JI-BC-05 Abundance			JI-BC-05 Biomass (g; AFDW)		
	Replicate A	Replicate B	Replicate C	Replicate A	Replicate B	Replicate C
Fragilonemertes rosea	2	2	4	0.00220	0.00330	0.00290
Hypereteone heteropoda	2	2		0.00030	0.00030	
Alitta succinea	9	4	1	0.00180	0.00090	0.00030
Glycinde multidens		1			0.00010	
Marenzelleria viridis		1			0.00160	
Streblospio benedicti	23	22	15	0.00110	0.00120	0.00050
Heteromastus filiformis	42	54	10	0.00380	0.01120	0.00050
Mulinia lateralis	18	14	6	0.00470	0.00450	0.00350
Ameritella mitchelli	14	14	3	0.00060	0.00150	0.00010
Tagelus plebeius	7	10	1	0.00030	0.00020	0.00005
Gemma gemma	112	96	33	0.01070	0.01140	0.00080
Americamysis almyra		1	1		0.00060	0.00005
Cyathura polita			2			0.00090

Notes:

AFDW: ash free dry weight

g: gram

Table C-1f
James Island Summer Benthic Community Counts and Biomass – JI-BC-06

Species List	JI-BC-06 Abundance			JI-BC-06 Biomass (g; AFDW)		
	Replicate A	Replicate B	Replicate C	Replicate A	Replicate B	Replicate C
Fragilonemertes rosea	2	2		0.00110	0.00170	
Alitta succinea	5	4	4	0.00190	0.00190	0.00010
Glycinde multidens	3	5		0.00040	0.00060	
Streblospio benedicti	24	30	12	0.00140	0.00190	0.00040
Heteromastus filiformis	15	27	7	0.00310	0.01220	0.00150
Mediomastus ambiseta	1			0.00010		
Tubificoides spp.		1			0.00005	
Acteocina canaliculata		1			0.00005	
Mulinia lateralis	19	7	9	0.00970	0.00120	0.00040
Ameritella mitchelli	15	19	8	0.00030	0.00340	0.00020
Tagelus plebeius	1	2		0.00005	0.00010	
Gemma gemma	143	106	121	0.01410	0.01360	0.01280
Americamysis almyra	2			0.00020		
Cyclaspis varians		1			0.00020	
Edotia triloba	2			0.00030		

Notes:
AFDW: ash free dry weight
g: gram

Table C-1g
James Island Summer Benthic Community Counts and Biomass – JI-BC-07

Species List	JI-BC-07 Abundance			JI-BC-07 Biomass (g; AFDW)		
	Replicate A	Replicate B	Replicate C	Replicate A	Replicate B	Replicate C
Fragilonemertes rosea			1			0.00370
Hypereteone heteropoda	1	1		0.00020	0.00020	
Alitta succinea			2			0.00005
Glycinde multidens		1			0.00010	
Streblospio benedicti	16	43	26	0.00060	0.00190	0.00100
Heteromastus filiformis	6	8	5	0.00070	0.00210	0.00020
Mediomastus ambiseta			2			0.00010
Tubificoides spp.		1			0.00005	
Mulinia lateralis	4	3		0.00440	0.00110	
Ameritella mitchelli	11	18	11	0.00140	0.00200	0.00050
Gemma gemma	3	10	3	0.00020	0.00060	0.00005
Americamysis almyra		1	1		0.00005	0.00040
Ameroculodes spp. complex	1			0.00005		

Notes:

AFDW: ash free dry weight

g: gram

Table C-1h
James Island Summer Benthic Community Counts and Biomass – JI-BC-08

Species List	JI-BC-08 Abundance			JI-BC-08 Biomass (g; AFDW)		
	Replicate A	Replicate B	Replicate C	Replicate A	Replicate B	Replicate C
Fragilonemertes rosea		1			0.00060	
Hypereteone heteropoda	1	1	1	0.00010	0.00005	0.00010
Alitta succinea	1	8	6	0.00005	0.00200	0.00050
Glycinde multidens		1	1		0.00010	0.00010
Polydora cornuta		1			0.00020	
Streblospio benedicti	49	37	41	0.00190	0.00180	0.00190
Heteromastus filiformis	11	10	6	0.00230	0.00190	0.00120
Mediomastus ambiseta	2	2	1	0.00010	0.00010	0.00005
Tubificoides spp.		1	4		0.00005	0.00020
Mulinia lateralis	3	5	5	0.00030	0.00390	0.01250
Ameritella mitchelli	13	17	11	0.00320	0.00130	0.00030
Gemma gemma	17	46	29	0.00040	0.00240	0.00160

Notes:

AFDW: ash free dry weight

g: gram

Table C-1i

James Island Summer Benthic Community Counts and Biomass – JI-BC-09

Species List	JI-BC-09 Abundance			JI-BC-09 Biomass (g; AFDW)		
	Replicate A	Replicate B	Replicate C	Replicate A	Replicate B	Replicate C
Carinoma tremaphoros	1		1	0.00020		0.00060
Fragilonemertes rosea	3	3		0.01010	0.00300	
Hypereteone heteropoda			1			0.00040
Alitta succinea	6	23	33	0.00690	0.02780	0.03370
Marenzelleria viridis	1		3	0.00250		0.00950
Streblospio benedicti	18	32	53	0.00110	0.00230	0.00280
Heteromastus filiformis	14	9	14	0.00730	0.00350	0.01020
Tubificoides spp.		1	1		0.00010	0.00020
Mulinia lateralis	3	4	7	0.00040	0.00170	0.01730
Ameritella mitchelli	13	13	8	0.00110	0.00120	0.00080
Tagelus plebeius	2	4	2	0.00120	0.00180	0.00080
Gemma gemma	8	3	1	0.00200	0.00160	0.00030
Americamysis almyra	3			0.00030		
Cyathura polita	2		1	0.00060		0.00030
Edotia triloba	1	1		0.00020	0.00030	

Notes:

AFDW: ash free dry weight

g: gram

Table C-1j
James Island Summer Benthic Community Counts and Biomass – JI-BC-10

Species List	JI-BC-10 Abundance			JI-BC-10 Biomass (g; AFDW)		
	Replicate A	Replicate B	Replicate C	Replicate A	Replicate B	Replicate C
Edwardsia elegans	1			0.00005		
Carinoma tremaphoros			1			0.00070
Fragilonemertes rosea	1		frag.	0.00110		0.00080
Amphiporus ochraceus	1			0.00030		
Hypereteone heteropoda			1			0.00040
Alitta succinea	76	20	4	0.04450	0.01000	0.00190
Glycinde multidens	1		2	0.00060		0.00010
Leitoscoloplos fragilis			1			0.00005
Boccardiella ligerica	2			0.00030		
Polydora cornuta	20	6	1	0.00070	0.00030	0.00005
Marenzelleria viridis	1	1		0.00100	0.00120	
Streblospio benedicti	12	22	6	0.00040	0.00070	0.00040
Heteromastus filiformis	5	8	2	0.00120	0.00120	0.00040
Mediomastus ambiseta	1			0.00020		
Tubificoides spp.	1			0.00010		
Geukensia demissa	1	1		0.00005	0.00005	
Mulinia lateralis	14	18	36	0.00660	0.01380	0.00170
Ameritella mitchelli	13	26	37	0.00090	0.00210	0.00690
Tagelus plebeius	2	7	9	0.00010	0.00030	0.00020
Gemma gemma	7	19	10	0.00020	0.00060	0.00020
Petricolaria pholadiformis	3			0.00070		
Amphibalanus improvisus	2			0.00010		
Americamysis almyra	1	2		0.00005	0.00020	
Cyclaspis varians		1	1		0.00005	0.00005
Edotia triloba	1			0.00005		
Melita nitida		1			0.00005	
Lepidactylus dytiscus			1			0.00040
Ameroculodes spp. complex			1			0.00010

Notes:
AFDW: ash free dry weight
frag.: fragment
g: gram

Table C-1k
James Island Summer Benthic Community Counts and Biomass – JI-BC-REF

Species List	JI-BC-REF Abundance			JI-BC-REF Biomass (g; AFDW)		
	Replicate A	Replicate B	Replicate C	Replicate A	Replicate B	Replicate C
Fragilonemertes rosea	2	2	1	0.00560	0.00560	0.00240
Hypereteone heteropoda	2			0.00010		
Hypereteone foliosa	1			0.00010		
Alitta succinea	3	1	1	0.00310	0.00020	0.00030
Glycinde multidens		1	2		0.00070	0.00005
Marenzelleria viridis	1	1		0.00110	0.00060	
Streblospio benedicti	25	30	12	0.00080	0.00170	0.00060
Heteromastus filiformis	22	17	7	0.00730	0.00650	0.00200
Mediomastus ambiseta	1	1		0.00005	0.00010	
Tubificoides spp.		1			0.00005	
Eulimastoma engonium	1			0.00005		
Acteocina canaliculata	1			0.00005		
Mulinia lateralis	11	20	7	0.00050	0.00170	0.00050
Ameritella mitchelli	23	28	8	0.00710	0.00250	0.00280
Tagelus plebeius	3	1	3	0.00005	0.00005	0.00020
Gemma gemma	7	10	4	0.00130	0.00080	0.00030
Americamysis almyra		3			0.00050	
Cyathura polita	1			0.00040		
Lepidactylus dytiscus	2			0.00050		

Notes:
AFDW: ash free dry weight
g: gram

Table C-2a
James Island Fall Benthic Community Counts and Biomass – JI-BC-01

Species List	JI-BC-01 Abundance			JI-BC-01 Biomass (g; AFDW)		
	Replicate A	Replicate B	Replicate C	Replicate A	Replicate B	Replicate C
Stylochus ellipticus		2			0.00010	
Carinoma tremaphoros	2	1		0.00060	0.00010	
Fragilonemertes rosea	3	9	7	0.00830	0.01660	0.01160
Amphiporus bioculatus		5	3		0.00150	0.00180
Hypereteone heteropoda	1	4		0.00010	0.00020	
Alitta succinea	6	4	5	0.00160	0.00130	0.00360
Glycinde multidens	15	12	14	0.00170	0.00180	0.00220
Leitoscoloplos fragilis	3	1	1	0.00770	0.00030	0.00010
Streblospio benedicti	22	19	23	0.00100	0.00100	0.00130
Spiochaetopterus oculatus			1			0.00005
Heteromastus filiformis	60	53	52	0.01390	0.00890	0.00610
Mediomastus ambiseta	6	4		0.00020	0.00010	
Acteocina canaliculata		2			0.00005	
Haminella solitaria		1			0.00010	
Mulinia lateralis	frag.	1	2	0.00830	0.02890	0.06850
Ameritella mitchelli	48	42	36	0.00040	0.00040	0.00070
Tagelus plebeius	61	40	28	0.00080	0.00020	0.00030
Gemma gemma	4	8	8	0.00850	0.00010	0.00010
Cyclaspis varians		1			0.00005	
Cyathura polita	1		1	0.00030		0.00050
Edotia triloba		1			0.00005	
Apocorophium lacustre		1			0.00005	
Ameroculodes spp. complex		1	1		0.00005	0.00040

Notes:
AFDW: ash free dry weight
frag.: fragment
g: gram

Table C-2b
James Island Fall Benthic Community Counts and Biomass – JI-BC-02

Species List	JI-BC-02 Abundance			JI-BC-02 Biomass (g; AFDW)		
	Replicate A	Replicate B	Replicate C	Replicate A	Replicate B	Replicate C
Carinoma tremaphoros		2			0.00120	
Fragilonemertes rosea	6	4	2	0.02100	0.01550	0.00340
Hypereteone heteropoda		1			0.00005	
Hypereteone foliosa	1	1		0.00020	0.00040	
Alitta succinea	3		2	0.00080		0.00100
Glycinde multidens	10	2	7	0.00110	0.00010	0.00070
Leitoscoloplos fragilis		1	1		0.00010	0.00005
Marenzelleria viridis			1			0.00180
Streblospio benedicti	8	8	7	0.00050	0.00040	0.00050
Heteromastus filiformis	13	24	17	0.00360	0.00510	0.00470
Acteocina canaliculata	1			0.00010		
Haminella solitaria	1			0.00005		
Mulinia lateralis	2	7	3	0.00040	0.00100	0.01530
Ameritella mitchelli	88	60	45	0.00220	0.00100	0.00390
Tagelus plebeius	61	24	48	0.00100	0.00030	0.00060
Gemma gemma	17		3	0.00360		0.00110
Americamysis almyra	3	2		0.00140	0.00090	
Cyclaspis varians	1			0.00040		
Edotia triloba			1			0.00005
Lepidactylus dytiscus		1			0.00050	
Ameroculodes spp. complex	2			0.00030		

Notes:
AFDW: ash free dry weight
g: gram

Table C-2c
James Island Fall Benthic Community Counts and Biomass – JI-BC-03

	JI-BC-03 Abundance			JI-BC-03 Biomass (g; AFDW)		
Species List	**Replicate A**	**Replicate B**	**Replicate C**	**Replicate A**	**Replicate B**	**Replicate C**
Stylochus ellipticus	1	1	2	0.00050	0.00050	0.00040
Carinoma tremaphoros	3	3	5	0.00090	0.00020	0.00005
Fragilonemertes rosea	4	4	3	0.01610	0.00790	0.00280
Amphiporus bioculatus	2		1	0.00010		0.00005
Hypereteone heteropoda	1		4	0.00005		0.00010
Alitta succinea	2	6	9	0.01420	0.01110	0.00510
Glycinde multidens	9	4	8	0.00040	0.00030	0.00060
Leitoscoloplos fragilis	2	1	7	0.00950	0.00090	0.00060
Marenzelleria viridis	1			0.00270		
Streblospio benedicti		2	4		0.00010	0.00020
Heteromastus filiformis	61	34	43	0.00810	0.00520	0.00700
Mediomastus ambiseta	1		2	0.00010		0.00010
Tubificoides spp.	10	4		0.00020	0.00005	
Haminella solitaria			1			0.00010
Mulinia lateralis	1	1	5	0.00005	0.01880	0.05090
Ameritella mitchelli	74	48	99	0.00120	0.00090	0.00180
Tagelus plebeius	77	59	149	0.00120	0.00100	0.00240
Gemma gemma	36	18	106	0.00040	0.00010	0.00140
Mya arenaria			1			0.00010
Edotia triloba			1			0.00010
Lepidactylus dytiscus			1			0.00040
Ameroculodes spp. complex	1		1	0.00040		0.00040

Notes:
AFDW: ash free dry weight
g: gram

Table C-2d

James Island Fall Benthic Community Counts and Biomass – JI-BC-04

Species List	JI-BC-04 Abundance			JI-BC-04 Biomass (g; AFDW)		
	Replicate A	Replicate B	Replicate C	Replicate A	Replicate B	Replicate C
Stylochus ellipticus	8	3	2	0.00140	0.00040	0.00020
Carinoma tremaphoros	3	4	2	0.00010	0.00010	0.00010
Fragilonemertes rosea	6	7	4	0.01000	0.00570	0.00300
Alitta succinea	7	4	7	0.00270	0.00260	0.00150
Glycinde multidens	14	4	7	0.00130	0.00040	0.00030
Leitoscoloplos fragilis		1			0.00020	
Paraonis fulgens	1	1		0.00010	0.00020	
Paraprionospio alata		1			0.00160	
Streblospio benedicti		2	1		0.00020	0.00010
Heteromastus filiformis	36	30	33	0.00770	0.00560	0.00580
Mediomastus ambiseta	2		1	0.00020		0.00005
Acteocina canaliculata		1	1		0.00005	0.00030
Mulinia lateralis	1	1	3	0.03620	0.00005	0.00010
Ameritella mitchelli	83	67	93	0.00120	0.00090	0.00240
Tagelus plebeius	63	60	86	0.00130	0.00110	0.00170
Gemma gemma	16	19	27	0.00280	0.00030	0.00030
Cyclaspis varians	2	2		0.00010	0.00005	
Cyathura polita	1	1		0.00040	0.00080	
Ameroculodes spp. complex	4		1	0.00050		0.00005
Phoronis psammophila	2		3	0.00010		0.00040
Ascidiacea sp.		2	2		0.00010	0.00010

Notes:

AFDW: ash free dry weight

g: gram

Table C-2e

James Island Fall Benthic Community Counts and Biomass – JI-BC-05

Species List	JI-BC-05 Abundance			JI-BC-05 Biomass (g; AFDW)		
	Replicate A	Replicate B	Replicate C	Replicate A	Replicate B	Replicate C
Stylochus ellipticus	5	4	5	0.00110	0.00150	0.00100
Carinoma tremaphoros	2		1	0.00010		0.00040
Fragilonemertes rosea	2	7	3	0.00330	0.01600	0.00360
Amphiporus bioculatus	3	3		0.00030	0.00070	
Hypereteone heteropoda	1			0.00005		
Hypereteone foliosa	2	2	3	0.00020	0.00020	0.00020
Alitta succinea	4		3	0.00040		0.00130
Glycinde multidens	13	3	8	0.00090	0.00040	0.00070
Leitoscoloplos fragilis	4		3	0.00020		0.00010
Streblospio benedicti	3	4	1	0.00010	0.00010	0.00005
Heteromastus filiformis	33	22	26	0.00510	0.00290	0.00440
Tubificoides spp.		1			0.00005	
Acteocina canaliculata			1			0.00010
Mulinia lateralis	1	3	2	0.00005	0.01610	0.03030
Ameritella mitchelli	72	83	77	0.00120	0.00390	0.00090
Tagelus plebeius	136	117	119	0.00260	0.00250	0.00230
Gemma gemma	87	59	90	0.00160	0.00080	0.00130
Mya arenaria		1			0.00005	
Cyclaspis varians		2			0.00010	
Cyathura polita	2	1	1	0.00130	0.00040	0.00040
Ameroculodes spp. complex	7	4	6	0.00130	0.00070	0.00140

Notes:

AFDW: ash free dry weight

g: gram

Table C-2f

James Island Fall Benthic Community Counts and Biomass – JI-BC-06

Species List	JI-BC-06 Abundance			JI-BC-06 Biomass (g; AFDW)		
	Replicate A	Replicate B	Replicate C	Replicate A	Replicate B	Replicate C
Stylochus ellipticus		4	2		0.00080	0.00030
Carinoma tremaphoros	1		2	0.00010		0.00010
Fragilonemertes rosea	6	2	7	0.01340	0.00440	0.01080
Hypereteone foliosa	2	1	2	0.00030	0.00020	0.00040
Alitta succinea	6	8	8	0.01090	0.00430	0.00880
Glycinde multidens	8	1	3	0.00060	0.00010	0.00050
Leitoscoloplos fragilis	2	3	2	0.00130	0.00570	0.00150
Streblospio benedicti	1	2	3	0.00005	0.00010	0.00010
Heteromastus filiformis	13	15	9	0.00350	0.00230	0.00150
Tubificoides spp.	2			0.00010		
Eulimastoma engonium			1			0.00005
Geukensia demissa			1			0.00010
Mulinia lateralis	2	4	3	0.01380	0.02830	0.00020
Ameritella mitchelli	69	88	111	0.00680	0.00280	0.01320
Limecola petalum	2			0.01420		
Tagelus plebeius	36	101	58	0.00070	0.00220	0.00130
Gemma gemma	500	1,693	1,387	0.02180	0.04230	0.07020
Mya arenaria	1	4	10	0.00005	0.00005	0.00030
Cyathura polita			1			0.00070
Edotia triloba			1			0.00005
Ameroculodes spp. complex	1	1	3	0.00040	0.00020	0.00020
Ascidiacea sp.	1		1	0.00005		0.00005

Notes:

AFDW: ash free dry weight

g: gram

Table C-2g
James Island Fall Benthic Community Counts and Biomass – JI-BC-07

Species List	JI-BC-07 Abundance			JI-BC-07 Biomass (g; AFDW)		
	Replicate A	Replicate B	Replicate C	Replicate A	Replicate B	Replicate C
Carinoma tremaphoros	2		2	0.00080		0.00060
Fragilonemertes rosea		1	1		0.01910	0.00220
Hypereteone heteropoda	1	1	1	0.00005	0.00020	0.00010
Alitta succinea	2	1	2	0.00140	0.00150	0.00300
Glycinde multidens	17	14	10	0.00180	0.00270	0.00170
Leitoscoloplos fragilis	1	1		0.00005	0.00005	
Streblospio benedicti	3	7	8	0.00010	0.00040	0.00050
Heteromastus filiformis	19	11	2	0.00770	0.00640	0.00040
Pectinaria gouldii			1			0.00010
Acteocina canaliculata	1		1	0.00040		0.00010
Mulinia lateralis	1	2	2	0.01260	0.00005	0.01540
Ameritella mitchelli	23	16	27	0.00390	0.00850	0.00260
Tagelus plebeius	4	8	15	0.00010	0.00005	0.00030
Gemma gemma	4	2	34	0.00010	0.00005	0.00090
Mya arenaria			1			0.00005
Americamysis almyra			1			0.00020
Cyathura polita	1			0.00030		
Edotia triloba		1	1		0.00010	0.00005
Ameroculodes spp. complex			1			0.00010

Notes:
AFDW: ash free dry weight
g: gram

Table C-2h

James Island Fall Benthic Community Counts and Biomass – JI-BC-08

Species List	JI-BC-08 Abundance			JI-BC-08 Biomass (g; AFDW)		
	Replicate A	Replicate B	Replicate C	Replicate A	Replicate B	Replicate C
Stylochus ellipticus	1		1	0.00005		0.00010
Carinoma tremaphoros	1	6	3	0.00005	0.00110	0.00080
Siphonenteron bicolour		1	2		0.00030	0.00130
Fragilonemertes rosea	3	2	4	0.03030	0.00050	0.04170
Hypereteone heteropoda		4			0.00020	
Alitta succinea	1	13	5	0.00260	0.01110	0.00220
Glycinde multidens	20	11	8	0.00200	0.00110	0.00110
Leitoscoloplos fragilis	3	1	3	0.00020	0.00010	0.00030
Marenzelleria viridis		1			0.00010	
Streblospio benedicti	14	19	18	0.00070	0.00080	0.00090
Heteromastus filiformis	59	39	25	0.00530	0.00460	0.00360
Tubificoides spp.		3			0.00005	
Acteocina canaliculata			1			0.00010
Geukensia demissa		1			0.00010	
Mulinia lateralis	1	3	3	0.00010	0.02130	0.02570
Ameritella mitchelli	89	126	121	0.00820	0.00290	0.00630
Tagelus plebeius	73	81	76	0.00100	0.00120	0.00100
Gemma gemma	300	474	395	0.00380	0.01570	0.00600
Mya arenaria	1			0.00010		
Cyclaspis varians		1			0.00005	
Edotia triloba	1	1	1	0.00005	0.00010	0.00005
Ameroculodes spp. complex		1			0.00010	

Notes:

AFDW: ash free dry weight

g: gram

Table C-2i
James Island Fall Benthic Community Counts and Biomass – JI-BC-09

Species List	JI-BC-09 Abundance			JI-BC-09 Biomass (g; AFDW)		
	Replicate A	Replicate B	Replicate C	Replicate A	Replicate B	Replicate C
Carinoma tremaphoros		1			0.00005	
Siphonenteron bicolour			1			0.00080
Fragilonemertes rosea		1	3		0.00110	0.00660
Amphiporus bioculatus	2	1		0.00030	0.00005	
Hypereteone foliosa		5			0.00060	
Alitta succinea	2	12	5	0.00380	0.00590	0.00780
Leitoscoloplos fragilis		1			0.00180	
Polydora cornuta		11			0.00020	
Polydora websteri		35			0.00120	
Marenzelleria viridis		1	1		0.00170	0.00370
Heteromastus filiformis	8	14	7	0.00190	0.00470	0.00350
Corambe obscura		2			0.00100	
Geukensia demissa		7			0.00200	
Mulinia lateralis	1		1	0.02500		0.00980
Ameritella mitchelli	50	48	69	0.01480	0.01250	0.01400
Tagelus plebeius	16	41	34	0.00020	0.00070	0.00060
Gemma gemma	25	131	47	0.00240	0.01060	0.00790
Amphibalanus improvisus		3			0.02720	
Americamysis almyra		1			0.00050	
Cyclaspis varians		1			0.00010	
Cyathura polita	1		1	0.00030		0.00060
Edotia triloba		1			0.00010	
Apocorophium lacustre		7			0.00020	
Melita nitida		1			0.00010	
Ameroculodes spp. complex	2	1		0.00070	0.00030	

Notes:
AFDW: ash free dry weight
g: gram

Table C-2j
James Island Fall Benthic Community Counts and Biomass – JI-BC-10

Species List	JI-BC-10 Abundance			JI-BC-10 Biomass (g; AFDW)		
	Replicate A	Replicate B	Replicate C	Replicate A	Replicate B	Replicate C
Diadumene leucolena	1		8	0.00380		0.01380
Stylochus ellipticus			1			0.00010
Carinoma tremaphoros			1			0.00010
Fragilonemertes rosea	3	1	1	0.00810	0.01420	0.01270
Amphiporus bioculatus			2			0.00010
Hypereteone heteropoda	1		3	0.00010		0.00010
Alitta succinea	3	16	150	0.00250	0.02650	0.14240
Glycinde multidens	6	1	2	0.00090	0.00010	0.00030
Leitoscoloplos fragilis			1			0.00050
Paraonis fulgens			1			0.00005
Polydora cornuta	3		10	0.00005		0.00040
Marenzelleria viridis	frag.	frag.	2	0.00010	0.00190	0.01080
Paraprionospio alata			1			0.00140
Streblospio benedicti	4	4	43	0.00010	0.00030	0.00120
Heteromastus filiformis	7	15	29	0.00070	0.00400	0.00370
Pectinaria gouldii			1			0.00010
Tubificoides spp.			2			0.00005
Gyroscala rupicola	2		1	0.00080		0.00010
Acteocina canaliculata	1			0.00010		
Geukensia demissa	2		8	0.00050		0.00280
Mulinia lateralis	2	1	2	0.00010	0.02240	0.05350
Ameritella mitchelli	81	45	88	0.00420	0.00670	0.00190
Tagelus plebeius	63	46	88	0.00110	0.00080	0.00140
Gemma gemma	53	52	91	0.00130	0.00270	0.00140
Petricolaria pholadiformis	1	2	13	0.00020	0.00010	0.01660
Mya arenaria	4	1	4	0.00010	0.00005	0.00010
Cyathura polita			2			0.00580
Paracerceis caudata		1			0.00010	
Edotia triloba	1		2	0.00005		0.00020
Apocorophium lacustre			2			0.00005
Ameroculodes spp. complex	3	3	1	0.00020	0.00020	0.00070

Notes:
AFDW: ash free dry weight
frag.: fragment
g: gram

Table C-2k
James Island Fall Benthic Community Counts and Biomass – JI-BC-REF

Species List	JI-BC-REF Abundance			JI-BC-REF Biomass (g; AFDW)		
	Replicate A	Replicate B	Replicate C	Replicate A	Replicate B	Replicate C
Stylochus ellipticus		2			0.00040	
Carinoma tremaphoros		2			0.00020	
Siphonenteron bicolour	1			0.00060		
Fragilonemertes rosea	6	2	3	0.01960	0.00580	0.00710
Hypereteone foliosa			1			0.00030
Alitta succinea	2		7	0.00110		0.00330
Glycinde multidens	23	25	22	0.00210	0.00250	0.00200
Leitoscoloplos fragilis	2		1	0.00420		0.00005
Streblospio benedicti	26	13	18	0.00120	0.00100	0.00090
Heteromastus filiformis	20	13	34	0.00420	0.00280	0.00610
Japonactaeon punctostriatus			1			0.00010
Acteocina canaliculata	1			0.00005		
Mulinia lateralis	1	4	2	0.00010	0.02540	0.00040
Ameritella mitchelli	55	49	57	0.00170	0.00200	0.00460
Tagelus plebeius	27	23	37	0.00030	0.00030	0.00040
Gemma gemma	2	6	4	0.00005	0.00160	0.00005
Americamysis almyra	1	2	1	0.00050	0.00080	0.00010
Cyathura polita		1			0.00030	
Lepidactylus dytiscus			1			0.00030
Ameroculodes spp. complex			1			0.00060

Notes:
AFDW: ash free dry weight
g: gram

Table C-3a
James Island Spring Benthic Community Counts and Biomass – JI-BC-01

Species List	JI-BC-01 Abundance			JI-BC-01 Biomass (g; AFDW)		
	Replicate A	Replicate B	Replicate C	Replicate A	Replicate B	Replicate C
Siphonenteron bicolour	2			0.00020		
Fragilonemertes rosea	8	5	3	0.02800	0.00140	0.00900
Hypereteone heteropoda	9	3		0.00005	0.00005	
Hypereteone foliosa		2	1		0.00150	0.00140
Leitoscoloplos fragilis	11			0.00060		
Polydora cornuta	1			0.00030		
Marenzelleria viridis	10	7	7	0.00470	0.00230	0.00340
Streblospio benedicti	23	12	15	0.00040	0.00020	0.00030
Heteromastus filiformis	73	25	19	0.00780	0.00320	0.00200
Tubificoides spp.	1	1		0.00005	0.00005	
Naididae sp.	1			0.00005		
Mulinia lateralis	40	13	16	0.00050	0.00110	0.00020
Ameritella mitchelli	5	12	1	0.00390	0.00570	0.00070
Tagelus plebeius	9	5	6	0.00080	0.00170	0.00210
Neomysis americana	frag.			0.00005		
Spilocuma watlingi	1		1	ND		ND
Edotia triloba	1	1		0.00010	0.00005	
Leptocheirus plumulosus	1			0.00060		
Gammarus mucronatus	1			0.00050		
Ameroculodes spp. complex	13	15	4	0.00080	0.00120	0.00080

Notes:
AFDW: ash free dry weight
frag.: fragment
g: gram
ND: no data; Specimens were vouchered so there is no AFDW measurement.

Table C-3b
James Island Spring Benthic Community Counts and Biomass – JI-BC-02

Species List	JI-BC-02 Abundance			JI-BC-02 Biomass (g; AFDW)		
	Replicate A	Replicate B	Replicate C	Replicate A	Replicate B	Replicate C
Fragilonemertes rosea		2			0.00930	
Amphiporus bioculatus	1			0.00010		
Hypereteone heteropoda	1			0.00060		
Marenzelleria viridis	3	6	4	0.00150	0.00790	0.00120
Streblospio benedicti	1	1	1	0.00010	0.00300	0.00005
Heteromastus filiformis	7	3	9	0.00080	0.00030	0.00170
Mulinia lateralis	5	7	16	0.00005	0.00060	0.00080
Ameritella mitchelli	3		5	0.00140		0.00450
Tagelus plebeius			5			0.00190
Gemma gemma		1	2		0.00005	0.00040
Neomysis americana		1			0.00020	
Leptocheirus plumulosus	1		2	0.00005		0.00050
Lepidactylus dytiscus	6	1	4	0.00010	0.00010	0.00050
Ameroculodes spp. complex	15	2	2	0.00150	0.00040	0.00040

Notes:
AFDW: ash free dry weight
g: gram

Table C-3c

James Island Spring Benthic Community Counts and Biomass – JI-BC-03

Species List	JI-BC-03 Abundance			JI-BC-03 Biomass (g; AFDW)		
	Replicate A	Replicate B	Replicate C	Replicate A	Replicate B	Replicate C
Stylochus ellipticus	1	1		0.00170	0.00150	
Carinoma tremaphoros	1	1	2	0.00010	0.00020	0.00050
Siphonenteron bicolour			1			0.00010
Fragilonemertes rosea	3	2	5	0.00240	0.00720	0.00320
Amphiporus bioculatus	3		3	0.00060		0.00100
Hypereteone heteropoda	4			0.00020		
Hypereteone foliosa	2	1	5	0.00110	0.00060	0.00170
Alitta succinea			1			0.00010
Glycinde multidens		1			0.00040	
Leitoscoloplos fragilis	16	9	16	0.00740	0.00050	0.00080
Marenzelleria viridis	11	12	6	0.00280	0.00400	0.00140
Streblospio benedicti	15	15	14	0.00030	0.00030	0.00020
Heteromastus filiformis	81	55	70	0.00540	0.00370	0.00710
Tubificoides spp.	1	1		0.00005	0.00020	
Mulinia lateralis	22	16	17	0.00040	0.00110	0.00010
Ameritella mitchelli	19	12	17	0.01920	0.01100	0.01450
Limecola petalum	1			0.00020		
Tagelus plebeius	33	16	25	0.01120	0.00500	0.01100
Gemma gemma	26	10	60	0.00180	0.00040	0.00300
Mya arenaria			1			0.00005
Neomysis americana		1			0.00005	
Spilocuma watlingi	3	2		ND	ND	
Chiridotea coeca		1			0.00100	
Edotia triloba		1			0.00010	
Lepidactylus dytiscus	2	2	1	0.00005	0.00030	0.00005
Ameroculodes spp. complex	13	21	12	0.00130	0.00220	0.00150

Notes:

AFDW: ash free dry weight

g: gram

ND: no data; Specimens were vouchered so there is no AFDW measurement.

Table C-3d
James Island Spring Benthic Community Counts and Biomass – JI-BC-04

Species List	JI-BC-04 Abundance			JI-BC-04 Biomass (g; AFDW)		
	Replicate A	Replicate B	Replicate C	Replicate A	Replicate B	Replicate C
Carinoma tremaphoros	3	2	1	0.00070	0.00070	0.00040
Fragilonemertes rosea	14	5	5	0.02340	0.00560	0.00450
Amphiporus bioculatus	2	2	3	0.00020	0.00090	0.00050
Hypereteone heteropoda	1	1	2	0.00005	0.00010	0.00040
Hypereteone foliosa	1	2		0.00050	0.00050	
Leitoscoloplos fragilis	5	7	5	0.00010	0.00410	0.00150
Paraonis fulgens	2	2		0.00005	0.00005	
Polydora cornuta		1			0.00005	
Marenzelleria viridis	18	22	9	0.00680	0.00650	0.00160
Streblospio benedicti	16	33	13	0.00010	0.00060	0.00010
Heteromastus filiformis	33	40	10	0.00650	0.00610	0.00220
Tubificoides spp.	1	1		0.00005	0.00005	
Naididae sp.		3			0.00005	
Sayella chesapeakea			1			0.00060
Mulinia lateralis	11	18	2	0.00010	0.00300	0.00010
Ameritella mitchelli	8	8	2	0.00690	0.00460	0.00030
Limecola petalum		1			0.00040	
Tagelus plebeius	19	32	12	0.00410	0.01160	0.00390
Gemma gemma	9	1	1	0.00050	0.00010	0.00020
Mya arenaria	1			0.00005		
Amphibalanus improvisus	1			0.00005		
Neomysis americana			1			0.00150
Spilocuma watlingi	2	2		ND	ND	
Cyathura polita			1			0.00160
Ameroculodes spp. complex	9	18	1	0.00050	0.00200	0.00020
Phoronis psammophila	3	1		0.00090	0.00040	

Notes:
AFDW: ash free dry weight
g: gram
ND: no data; Specimens were vouchered so there is no AFDW measurement.

Table C-3e
James Island Spring Benthic Community Counts and Biomass – JI-BC-05

Species List	JI-BC-05 Abundance			JI-BC-05 Biomass (g; AFDW)		
	Replicate A	Replicate B	Replicate C	Replicate A	Replicate B	Replicate C
Stylochus ellipticus		1			0.00130	
Carinoma tremaphoros	1		1	0.00020		0.00020
Siphonenteron bicolour		1			0.00040	
Fragilonemertes rosea	6	9	8	0.00800	0.02070	0.01580
Amphiporus bioculatus	1	2	3	0.00060	0.00100	0.00070
Hypereteone heteropoda	1			0.00010		
Hypereteone foliosa	8	3	5	0.00140	0.00060	0.00070
Leitoscoloplos fragilis	1	6	2	0.00170	0.00050	0.00010
Marenzelleria viridis	15	14	14	0.00620	0.00520	0.00530
Streblospio benedicti	2	4		0.00010	0.00010	
Heteromastus filiformis	28	32	16	0.00410	0.00560	0.00280
Mulinia lateralis	36	25	8	0.00060	0.03890	0.00020
Ameritella mitchelli	3	2	2	0.00110	0.00010	0.00350
Tagelus plebeius	57	43	41	0.02140	0.01600	0.01460
Gemma gemma	36	22	15	0.00490	0.00220	0.00150
Neomysis americana		1			0.00060	
Spilocuma watlingi	2	5	4	ND	ND	ND
Ameroculodes spp. complex	17	16	6	0.00150	0.00170	0.00080
Phoronis psammophila			1			0.00030

Notes:

AFDW: ash free dry weight

g: gram

ND: no data; Specimens were vouchered so there is no AFDW measurement.

Table C-3f
James Island Spring Benthic Community Counts and Biomass – JI-BC-06

Species List	JI-BC-06 Abundance			JI-BC-06 Biomass (g; AFDW)		
	Replicate A	Replicate B	Replicate C	Replicate A	Replicate B	Replicate C
Carinoma tremaphoros			1			0.00020
Fragilonemertes rosea	5	2	2	0.03350	0.00170	0.00170
Amphiporus bioculatus	2		1	0.00010		0.00030
Hypereteone heteropoda	5	1	2	0.00010	0.00005	0.00005
Hypereteone foliosa	2	1	3	0.00030	0.00110	0.00180
Alitta succinea			1			0.00005
Leitoscoloplos fragilis	7	6	7	0.00050	0.00240	0.00030
Polydora cornuta	1	1	2	0.00010	0.00005	0.00005
Marenzelleria viridis	4	10	8	0.00080	0.00260	0.00320
Streblospio benedicti	13	2	17	0.00020	0.00005	0.00040
Heteromastus filiformis	52	33	33	0.00600	0.00390	0.00260
Tubificoides spp.	4	2	4	0.00010	0.00005	0.00005
Geukensia demissa	1			0.00005		
Mulinia lateralis	22	7	26	0.00020	0.00010	0.00040
Ameritella mitchelli	1	4	5	0.00040	0.00720	0.00640
Limecola petalum		2			0.00040	
Tagelus plebeius	17	13	15	0.00680	0.00640	0.00630
Gemma gemma	696	383	548	0.10830	0.05040	0.06900
Mya arenaria	1	1		0.00005	0.00005	
Amphibalanus improvisus		1			0.00460	
Neomysis americana			1			0.00020
Spilocuma watlingi	1			0.00005		
Edotia triloba	1	1		0.00005	0.00005	
Melita nitida			1			0.00040
Lepidactylus dytiscus	1			0.00005		
Ameroculodes spp. complex	7	2	4	0.00070	0.00040	0.00020

Notes:
AFDW: ash free dry weight
g: gram

Table C-3g
James Island Spring Benthic Community Counts and Biomass – JI-BC-07

Species List	JI-BC-07 Abundance			JI-BC-07 Biomass (g; AFDW)		
	Replicate A	Replicate B	Replicate C	Replicate A	Replicate B	Replicate C
Carinoma tremaphoros	1	1	2	0.00005	0.00060	0.00020
Fragilonemertes rosea	2	3	1	0.00290	0.01030	0.00020
Amphiporus bioculatus	1			0.00010		
Hypereteone heteropoda	3		3	0.00020		0.00005
Hypereteone foliosa	1		3	0.00090		0.00270
Glycinde multidens	1	1	1	0.00080	0.00040	0.00010
Leitoscoloplos fragilis	1	7	10	0.00030	0.00380	0.00530
Marenzelleria viridis	22	12	14	0.00860	0.00510	0.00320
Streblospio benedicti	5	6	4	0.00030	0.00040	0.00005
Heteromastus filiformis	77	32	51	0.00990	0.00460	0.00390
Mulinia lateralis	35	37	35	0.00120	0.00580	0.00070
Ameritella mitchelli	9	8	9	0.04750	0.02980	0.03380
Tagelus plebeius	10	16	9	0.00320	0.00580	0.00300
Gemma gemma	64	74	56	0.00570	0.00640	0.00500
Amphibalanus improvisus	57			0.00340		
Neomysis americana	1			0.00020		
Leptocheirus plumulosus	4	3	4	0.00050	0.00220	0.00020
Gammarus mucronatus	4			0.00270		
Ameroculodes spp. complex	18	7	18	0.00210	0.00100	0.00110

Notes:

AFDW: ash free dry weight

g: gram

Table C-3h
James Island Spring Benthic Community Counts and Biomass – JI-BC-08

Species List	JI-BC-08 Abundance			JI-BC-08 Biomass (g; AFDW)		
	Replicate A	Replicate B	Replicate C	Replicate A	Replicate B	Replicate C
Fragilonemertes rosea			1			0.01110
Amphiporus bioculatus		1			0.00060	
Hypereteone heteropoda	4		2	0.00030		0.00050
Hypereteone foliosa	1		3	0.00210		0.00390
Alitta succinea	1			0.02100		
Leitoscoloplos fragilis	9		3	0.00040		0.00020
Marenzelleria viridis	3	7	4	0.00160	0.00210	0.00230
Streblospio benedicti	7	2	2	0.00560	0.00060	0.00010
Heteromastus filiformis	31	39	25	0.00270	0.00500	0.00260
Mediomastus ambiseta		2			0.00030	
Tubificoides spp.			1			0.00005
Sayella chesapeakea	2			0.00030		
Mulinia lateralis	10	8	19	0.00020	0.00030	0.01590
Ameritella mitchelli	5	11	11	0.00700	0.02100	0.01930
Tagelus plebeius	4	5	7	0.00120	0.00150	0.00370
Gemma gemma	136	173	182	0.01380	0.01040	0.01740
Mya arenaria	1	2		0.00005	0.00010	
Amphibalanus improvisus	21	1	21	0.00030	0.00005	0.00050
Neomysis americana	2			0.00080		
Edotia triloba	2			0.00030		
Leptocheirus plumulosus	1	1	2	0.00020	0.00020	0.00040
Apocorophium lacustre			1			0.00020
Ameroculodes spp. complex	17	4	23	0.00130	0.00040	0.00340

Notes:
AFDW: ash free dry weight
g: gram

Table C-3i
James Island Spring Benthic Community Counts and Biomass – JI-BC-09

Species List	JI-BC-09 Abundance			JI-BC-09 Biomass (g; AFDW)		
	Replicate A	Replicate B	Replicate C	Replicate A	Replicate B	Replicate C
Fragilonemertes rosea		1	1		0.00060	0.00440
Amphiporus bioculatus		1	1		0.00100	0.00050
Hypereteone foliosa	3	1	1	0.00140	0.00050	0.00130
Leitoscoloplos fragilis	1	6	4	0.00010	0.00060	0.00080
Polydora cornuta			1			0.00005
Marenzelleria viridis	10	11	17	0.00470	0.00480	0.00840
Heteromastus filiformis	6	5	10	0.00140	0.00180	0.00260
Tubificoides spp.	1			0.00020		
Mulinia lateralis		3	4		0.00005	0.00020
Ameritella mitchelli	4	6	8	0.00720	0.02430	0.08060
Limecola petalum	1			0.00030		
Tagelus plebeius			1			0.00030
Gemma gemma	58	201	233	0.00590	0.03140	0.03140
Mya arenaria		1	3		0.00005	0.00020
Amphibalanus improvisus	1			0.00070		
Spilocuma watlingi		1	1		0.00005	0.00010
Cyathura polita			2			0.00390
Lepidactylus dytiscus		1	1		0.00005	0.00005
Ameroculodes spp. complex	2	15	13	0.00020	0.00240	0.00240

Notes:
AFDW: ash free dry weight
g: gram

Table C-3j

James Island Spring Benthic Community Counts and Biomass – JI-BC-10

Species List	JI-BC-10 Abundance			JI-BC-10 Biomass (g; AFDW)		
	Replicate A	Replicate B	Replicate C	Replicate A	Replicate B	Replicate C
Carinoma tremaphoros		1			0.00020	
Fragilonemertes rosea	1	2	2	0.00560	0.00200	0.00820
Amphiporus bioculatus		1			0.00005	
Hypereteone heteropoda		3	3		0.00005	0.00020
Hypereteone foliosa	2	4	1	0.00130	0.00110	0.00060
Alitta succinea	1			0.00270		
Glycinde multidens	1	2	1	0.00020	0.00070	0.00050
Leitoscoloplos fragilis		1	1		0.00005	0.00005
Polydora cornuta		1	3		0.00005	0.00010
Marenzelleria viridis	10	22	19	0.00220	0.00500	0.00390
Streblospio benedicti	3	1	7	0.00010	0.00005	0.00020
Heteromastus filiformis	21	24	26	0.00340	0.00210	0.00410
Naididae sp.			1			0.00040
Acteocina canaliculata	1			0.00060		
Mulinia lateralis	8	10	5	0.02580	0.05460	0.00005
Ameritella mitchelli	28	31	34	0.04580	0.04290	0.04710
Limecola petalum		1			0.00020	
Tagelus plebeius	10	5	12	0.00270	0.00170	0.00190
Gemma gemma	52	98	88	0.00920	0.00790	0.00600
Mya arenaria	2	6	7	0.00005	0.00010	0.00010
Amphibalanus improvisus	1			0.00005		
Spilocuma watlingi	1	1	3	0.00010	0.00005	0.00030
Cyathura polita	1			0.00290		
Edotia triloba			2			0.00050
Leptocheirus plumulosus			3			0.00020
Gammarus mucronatus		1			0.00005	
Lepidactylus dytiscus			2			0.00020
Ameroculodes spp. complex	9	13	13	0.00140	0.00180	0.00180

Notes:

AFDW: ash free dry weight

g: gram

Table C-3k
James Island Spring Benthic Community Counts and Biomass – JI-BC-REF

Species List	JI-BC-REF Abundance			JI-BC-REF Biomass (g; AFDW)		
	Replicate A	Replicate B	Replicate C	Replicate A	Replicate B	Replicate C
Carinoma tremaphoros			2			0.00060
Fragilonemertes rosea	2	1	2	0.00160	0.00110	0.00200
Hypereteone heteropoda	1	1		0.00010	0.00060	
Hypereteone foliosa	3	3	2	0.00200	0.00170	0.00230
Glycinde multidens		1	1		0.00040	0.00020
Leitoscoloplos fragilis	1	frag.		0.00110	0.00070	
Marenzelleria viridis	21	23	8	0.00810	0.00960	0.00260
Streblospio benedicti	3	2	1	0.00005	0.00010	0.00005
Heteromastus filiformis	29	51	45	0.00410	0.01060	0.00530
Acteocina canaliculata	1			0.00030		
Mulinia lateralis	12	11	26	0.04120	0.01320	0.00470
Ameritella mitchelli	13	8	9	0.03050	0.02390	0.01640
Limecola petalum	1	1		0.00050	0.00190	
Tagelus plebeius	7	1	4	0.00220	0.00040	0.00120
Gemma gemma	16	10	12	0.00090	0.00100	0.00100
Neomysis americana			2			0.00020
Leptocheirus plumulosus	4	7	4	0.00020	0.00060	0.00050
Apocorophium lacustre	1			0.00030		
Lepidactylus dytiscus		1			0.00080	
Ameroculodes spp. complex	12	8	19	0.00140	0.00070	0.00160

Notes:
AFDW: ash free dry weight
frag.: fragment
g: gram

Appendix D
James Island Fish Collection Data

Table D-1a

James Island Seine Net Collection Results – Summer

Sample ID	Species	Length (mm)	Notes
JI-BN-01a	Striped anchovy	68	
JI-BN-01a	Striped anchovy	65	
JI-BN-01a	Striped anchovy	76	
JI-BN-01a	Striped anchovy	73	
JI-BN-01a	Striped anchovy	80	
JI-BN-01a	Striped anchovy	67	
JI-BN-01a	Striped anchovy	66	
JI-BN-01a	Striped anchovy	66	
JI-BN-01a	Striped anchovy	61	
JI-BN-01a	Striped anchovy	72	
JI-BN-01a	Striped anchovy	70	
JI-BN-01a	Striped anchovy	80	
JI-BN-01a	Striped anchovy	65	
JI-BN-01a	Striped anchovy	83	
JI-BN-01a	Striped anchovy	72	
JI-BN-01a	Striped anchovy	67	
JI-BN-01a	Striped anchovy	68	
JI-BN-01a	Striped anchovy	75	
JI-BN-01a	Striped anchovy	68	
JI-BN-01a	Striped anchovy	76	
JI-BN-01a	Striped anchovy	72	
JI-BN-01a	Striped anchovy	63	
JI-BN-01a	Striped anchovy	69	
JI-BN-01a	Striped anchovy	70	
JI-BN-01a	Striped anchovy	76	
JI-BN-01a	Striped anchovy	80	
JI-BN-01a	Striped anchovy	70	
JI-BN-01a	Striped anchovy	76	
JI-BN-01a	Striped anchovy	71	
JI-BN-01a	Striped anchovy	70	
JI-BN-01a	Striped anchovy	66	
JI-BN-01a	Striped anchovy	70	
JI-BN-01a	Striped anchovy	70	
JI-BN-01a	Striped anchovy	73	
JI-BN-01a	Striped anchovy	69	
JI-BN-01a	Striped anchovy	76	
JI-BN-01a	Striped anchovy	76	
JI-BN-01a	Striped anchovy	74	
JI-BN-01a	Striped anchovy	67	
JI-BN-01a	Striped anchovy	77	
JI-BN-01a	Striped anchovy	70	
JI-BN-01a	Striped anchovy	76	
JI-BN-01a	Striped anchovy	68	
JI-BN-01a	Striped anchovy	72	

Table D-1a

James Island Seine Net Collection Results – Summer

Sample ID	Species	Length (mm)	Notes
JI-BN-01a	Striped anchovy	70	
JI-BN-01a	Striped anchovy	75	
JI-BN-01a	Striped anchovy	69	
JI-BN-01a	Striped anchovy	77	
JI-BN-01a	Striped anchovy	69	
JI-BN-01a	Striped anchovy	70	
JI-BN-01a	Atlantic needlefish	252	
JI-BN-01b	Striped anchovy	80	
JI-BN-01b	Striped anchovy	67	
JI-BN-01b	Striped anchovy	66	
JI-BN-01b	Striped anchovy	77	
JI-BN-01b	Striped anchovy	75	
JI-BN-01b	Striped anchovy	70	
JI-BN-01b	Striped anchovy	77	
JI-BN-01b	Striped anchovy	80	
JI-BN-01b	Striped anchovy	71	
JI-BN-01b	Striped anchovy	73	
JI-BN-01b	Striped anchovy	79	
JI-BN-01b	Striped anchovy	74	
JI-BN-01b	Striped anchovy	81	
JI-BN-01b	Striped anchovy	69	
JI-BN-01b	Striped anchovy	77	
JI-BN-01b	Striped anchovy	55	
JI-BN-01b	Striped anchovy	80	
JI-BN-01b	Striped anchovy	78	
JI-BN-01b	Striped anchovy	70	
JI-BN-01b	Striped anchovy	70	
JI-BN-01b	Striped anchovy	72	
JI-BN-01b	Striped anchovy	78	
JI-BN-02a	Atlantic silverside	90	
JI-BN-02a	Striped anchovy	69	
JI-BN-02a	Striped anchovy	71	
JI-BN-02a	Atlantic silverside	98	
JI-BN-02a	Atlantic silverside	86	
JI-BN-02a	Atlantic silverside	80	
JI-BN-02a	Atlantic silverside	75	
JI-BN-02a	Atlantic silverside	83	
JI-BN-02a	Striped anchovy	72	
JI-BN-02a	Atlantic silverside	68	
JI-BN-02a	Striped anchovy	69	
JI-BN-02a	Striped anchovy	70	
JI-BN-02a	Atlantic silverside	78	
JI-BN-02a	Striped anchovy	72	
JI-BN-02a	Striped anchovy	62	

Table D-1a

James Island Seine Net Collection Results – Summer

Sample ID	Species	Length (mm)	Notes
JI-BN-02a	Atlantic silverside	78	
JI-BN-02a	Atlantic silverside	86	
JI-BN-02a	Atlantic silverside	85	
JI-BN-02a	Atlantic silverside	92	
JI-BN-02a	Atlantic silverside	87	
JI-BN-02a	Atlantic silverside	80	
JI-BN-02a	Atlantic silverside	84	
JI-BN-02a	Atlantic silverside	71	
JI-BN-02a	Striped anchovy	61	
JI-BN-02a	Striped anchovy	67	
JI-BN-02a	Striped anchovy	70	
JI-BN-02a	Atlantic silverside	88	
JI-BN-02a	Atlantic silverside	99	
JI-BN-02a	Atlantic silverside	74	
JI-BN-02a	Striped anchovy	65	
JI-BN-02a	Atlantic silverside	82	
JI-BN-02a	Atlantic silverside	80	
JI-BN-02a	Atlantic silverside	85	
JI-BN-02a	Striped anchovy	65	
JI-BN-02a	Atlantic silverside	87	
JI-BN-02a	Atlantic silverside	69	
JI-BN-02a	Atlantic silverside	77	
JI-BN-02a	Striped anchovy	66	
JI-BN-02a	Striped anchovy	57	
JI-BN-02a	Striped anchovy	62	
JI-BN-02a	Atlantic threadfin	65	
JI-BN-02a	Atlantic threadfin	72	
JI-BN-02a	Striped anchovy	69	
JI-BN-02a	Atlantic silverside	80	
JI-BN-02a	Striped anchovy	54	
JI-BN-02a	Striped anchovy	72	
JI-BN-02a	Striped anchovy	75	
JI-BN-02a	Striped anchovy	61	
JI-BN-02a	Striped anchovy	65	
JI-BN-02a	Striped anchovy	68	
JI-BN-02a	Striped anchovy	73	
JI-BN-02a	Atlantic silverside	67	
JI-BN-02a	Striped anchovy	62	
JI-BN-02a	Striped anchovy	66	
JI-BN-02a	Striped anchovy	64	
JI-BN-02a	Atlantic silverside	85	
JI-BN-02a	Atlantic silverside	67	
JI-BN-02a	Striped anchovy	69	
JI-BN-02a	Striped anchovy	67	

Table D-1a

James Island Seine Net Collection Results – Summer

Sample ID	Species	Length (mm)	Notes
JI-BN-02a	Atlantic silverside	69	
JI-BN-02a	Striped anchovy	63	
JI-BN-02a	Striped anchovy	63	
JI-BN-02a	Striped anchovy	69	
JI-BN-02a	Striped anchovy	69	
JI-BN-02a	Striped anchovy	56	
JI-BN-02a	Striped anchovy	67	
JI-BN-02a	Striped anchovy	66	
JI-BN-02a	Striped anchovy	65	
JI-BN-02a	Striped anchovy	71	
JI-BN-02a	Atlantic silverside	76	
JI-BN-02a	Striped anchovy	62	
JI-BN-02a	Striped anchovy	64	
JI-BN-02a	Atlantic silverside	78	
JI-BN-02a	Striped anchovy	67	
JI-BN-02a	Atlantic silverside	83	
JI-BN-02a	Atlantic silverside	86	
JI-BN-02b	Blue crab	62	
JI-BN-02b	Blue crab	60	
JI-BN-02b	Striped anchovy	65	
JI-BN-02b	Atlantic silverside	84	
JI-BN-02b	Striped anchovy	60	
JI-BN-02b	Atlantic silverside	85	
JI-BN-02b	Atlantic silverside	94	
JI-BN-02b	Striped anchovy	79	
JI-BN-02b	Atlantic silverside	88	
JI-BN-02b	Atlantic silverside	80	
JI-BN-02b	Atlantic silverside	88	
JI-BN-02b	Atlantic silverside	100	
JI-BN-02b	Atlantic silverside	97	
JI-BN-02b	Atlantic silverside	96	
JI-BN-02b	Striped anchovy	74	
JI-BN-02b	Atlantic silverside	81	
JI-BN-02b	Atlantic silverside	79	
JI-BN-02b	Atlantic silverside	80	
JI-BN-02b	Atlantic silverside	76	
JI-BN-02b	Atlantic silverside	75	
JI-BN-02b	Atlantic silverside	85	
JI-BN-02b	Atlantic silverside	90	
JI-BN-02b	Atlantic silverside	89	
JI-BN-02b	Atlantic silverside	78	
JI-BN-02b	Atlantic silverside	87	
JI-BN-02b	Atlantic silverside	75	parasite
JI-BN-02b	Atlantic silverside	90	

Table D-1a
James Island Seine Net Collection Results – Summer

Sample ID	Species	Length (mm)	Notes
JI-BN-02b	Atlantic silverside	90	
JI-BN-02b	Atlantic silverside	84	
JI-BN-02b	Atlantic silverside	93	
JI-BN-02b	Atlantic silverside	67	
JI-BN-02b	Atlantic silverside	77	
JI-BN-02b	Atlantic silverside	92	
JI-BN-02b	Atlantic silverside	84	
JI-BN-02b	Atlantic silverside	86	
JI-BN-02b	Atlantic silverside	89	
JI-BN-02b	Atlantic silverside	88	
JI-BN-02b	Striped anchovy	64	
JI-BN-02b	Atlantic silverside	66	
JI-BN-02b	Atlantic silverside	81	
JI-BN-02b	Atlantic silverside	76	
JI-BN-02b	Striped anchovy	59	
JI-BN-02b	Atlantic silverside	80	
JI-BN-02b	Atlantic silverside	72	
JI-BN-02b	Atlantic silverside	63	
JI-BN-02b	Atlantic silverside	73	
JI-BN-02b	Atlantic silverside	92	
JI-BN-02b	Atlantic silverside	85	
JI-BN-02b	Atlantic silverside	63	
JI-BN-02b	Atlantic silverside	74	
JI-BN-02b	Atlantic silverside	64	
JI-BN-02b	Atlantic silverside	70	
JI-BN-02b	Atlantic silverside	67	
JI-BN-02b	Atlantic silverside	90	
JI-BN-02b	Atlantic silverside	85	
JI-BN-02b	Atlantic silverside	85	
JI-BN-02b	Atlantic silverside	82	
JI-BN-02b	Atlantic silverside	80	
JI-BN-02b	Atlantic silverside	56	
JI-BN-02b	Atlantic silverside	79	
JI-BN-02b	Atlantic silverside	77	
JI-BN-02b	Atlantic silverside	76	
JI-BN-02b	Atlantic silverside	84	
JI-BN-02b	Atlantic silverside	91	
JI-BN-02b	Striped anchovy	65	
JI-BN-02b	Atlantic silverside	73	
JI-BN-02b	Striped anchovy	55	
JI-BN-02b	Atlantic silverside	78	
JI-BN-03a	Striped anchovy	91	
JI-BN-03a	Striped anchovy	75	
JI-BN-03a	Striped anchovy	76	

Table D-1a
James Island Seine Net Collection Results – Summer

Sample ID	Species	Length (mm)	Notes
JI-BN-03a	Striped anchovy	76	
JI-BN-03a	Striped anchovy	80	
JI-BN-03a	Striped anchovy	75	
JI-BN-03a	Striped anchovy	72	
JI-BN-03a	Striped anchovy	71	
JI-BN-03a	Striped anchovy	82	
JI-BN-03a	Atlantic menhaden	99	
JI-BN-03a	Atlantic needlefish	380	
JI-BN-03a	Atlantic needlefish	306	
JI-BN-03a	Atlantic needlefish	280	
JI-BN-03b	Striped anchovy	73	
JI-BN-03b	Striped anchovy	75	
JI-BN-03b	Atlantic menhaden	83	
JI-BN-03b	Atlantic menhaden	85	
JI-BN-03b	Atlantic menhaden	90	
JI-BN-03b	Striped anchovy	62	
JI-BN-03b	Striped anchovy	76	
JI-BN-03b	Striped anchovy	60	
JI-BN-03b	Striped anchovy	64	
JI-BN-03b	Bay anchovy	51	
JI-BN-03b	Bay anchovy	53	
JI-BN-03b	Bay anchovy	52	
JI-BN-03b	Bay anchovy	54	
JI-BN-03b	Atlantic silverside	60	
JI-BN-03b	Bay anchovy	51	

Note:
mm: millimeter

Table D-1b

James Island Seine Net Collection Results – Fall

Sample ID	Species	Length (mm)	Notes
JI-BN-01a	Atlantic silverside	86	
JI-BN-01a	Atlantic silverside	94	
JI-BN-01a	Atlantic silverside	109	
JI-BN-01a	Atlantic silverside	76	
JI-BN-01a	Atlantic silverside	87	
JI-BN-01a	Atlantic silverside	84	
JI-BN-01a	Atlantic silverside	97	
JI-BN-01a	Atlantic silverside	111	
JI-BN-01a	Atlantic silverside	64	
JI-BN-01a	Atlantic silverside	98	
JI-BN-01a	Atlantic silverside	77	
JI-BN-01a	Atlantic silverside	75	
JI-BN-01a	Atlantic silverside	97	
JI-BN-01a	Atlantic silverside	89	
JI-BN-01a	Atlantic silverside	85	
JI-BN-01a	Atlantic silverside	112	
JI-BN-01a	Atlantic silverside	71	
JI-BN-01a	Atlantic silverside	101	
JI-BN-01a	Atlantic silverside	79	
JI-BN-01a	Atlantic silverside	94	
JI-BN-01a	Atlantic silverside	76	
JI-BN-01a	Atlantic silverside	83	
JI-BN-01a	Atlantic silverside	86	
JI-BN-01a	Atlantic silverside	80	
JI-BN-01a	Atlantic silverside	107	
JI-BN-01a	Atlantic silverside	92	
JI-BN-01a	Atlantic silverside	106	
JI-BN-01a	Atlantic silverside	83	
JI-BN-01a	Atlantic silverside	85	
JI-BN-01a	Atlantic silverside	102	
JI-BN-01a	Atlantic silverside	72	
JI-BN-01a	Atlantic silverside	96	
JI-BN-01a	Atlantic silverside	85	
JI-BN-01a	Atlantic silverside	76	
JI-BN-01a	Atlantic silverside	70	
JI-BN-01a	Atlantic silverside	126	
JI-BN-01a	Atlantic silverside	91	
JI-BN-01a	Atlantic silverside	72	
JI-BN-01a	Atlantic silverside	85	
JI-BN-01a	Atlantic silverside	74	
JI-BN-01a	Atlantic silverside	107	
JI-BN-01a	Atlantic silverside	75	
JI-BN-01a	Atlantic silverside	129	
JI-BN-01a	Atlantic silverside	101	

Table D-1b

James Island Seine Net Collection Results – Fall

Sample ID	Species	Length (mm)	Notes
JI-BN-01a	Atlantic silverside	114	
JI-BN-01a	Atlantic silverside	89	
JI-BN-01a	Atlantic silverside	71	
JI-BN-01a	Atlantic silverside	105	
JI-BN-01a	Atlantic silverside	86	
JI-BN-01a	Atlantic silverside	110	
JI-BN-01b	Red drum	39	
JI-BN-01b	Atlantic silverside	102	
JI-BN-01b	Atlantic silverside	114	
JI-BN-01b	Atlantic silverside	80	
JI-BN-01b	Atlantic silverside	114	
JI-BN-01b	Atlantic silverside	74	
JI-BN-01b	Atlantic silverside	106	
JI-BN-01b	Atlantic silverside	100	
JI-BN-01b	Atlantic silverside	106	
JI-BN-01b	Atlantic silverside	105	
JI-BN-01b	Atlantic silverside	94	
JI-BN-01b	Atlantic silverside	95	
JI-BN-01b	Atlantic silverside	128	
JI-BN-01b	Atlantic silverside	96	
JI-BN-01b	Atlantic silverside	113	
JI-BN-01b	Atlantic silverside	86	
JI-BN-01b	Atlantic silverside	85	
JI-BN-01b	Atlantic silverside	96	
JI-BN-01b	Atlantic silverside	72	
JI-BN-01b	Atlantic silverside	86	
JI-BN-01b	Atlantic silverside	83	
JI-BN-01b	Atlantic silverside	91	
JI-BN-01b	Atlantic silverside	69	
JI-BN-01b	Atlantic silverside	75	
JI-BN-01b	Atlantic silverside	74	
JI-BN-01b	Atlantic silverside	89	
JI-BN-01b	Atlantic silverside	72	
JI-BN-01b	Atlantic silverside	88	
JI-BN-01b	Atlantic silverside	94	
JI-BN-01b	Atlantic silverside	112	
JI-BN-01b	Atlantic silverside	91	
JI-BN-01b	Atlantic silverside	96	
JI-BN-01b	Atlantic silverside	96	
JI-BN-01b	Atlantic silverside	91	
JI-BN-01b	Atlantic silverside	86	
JI-BN-01b	Atlantic silverside	87	
JI-BN-01b	Atlantic silverside	73	
JI-BN-01b	Atlantic silverside	74	

Table D-1b
James Island Seine Net Collection Results – Fall

Sample ID	Species	Length (mm)	Notes
JI-BN-01b	Atlantic silverside	124	
JI-BN-01b	Atlantic silverside	99	
JI-BN-01b	Atlantic silverside	104	
JI-BN-01b	Atlantic silverside	88	
JI-BN-01b	Atlantic silverside	114	
JI-BN-01b	Atlantic silverside	86	
JI-BN-01b	Atlantic silverside	117	
JI-BN-01b	Atlantic silverside	78	
JI-BN-01b	Atlantic silverside	74	
JI-BN-01b	Atlantic silverside	87	
JI-BN-01b	Atlantic silverside	108	
JI-BN-01b	Atlantic silverside	116	
JI-BN-01b	Atlantic silverside	101	
JI-BN-02a	Atlantic silverside	117	
JI-BN-02a	Atlantic silverside	84	
JI-BN-03b	Atlantic silverside	76	
JI-BN-03b	Atlantic silverside	120	
JI-BN-03b	Atlantic silverside	68	
JI-BN-03b	Atlantic silverside	105	

Note:
mm: millimeter

Table D-1c
James Island Seine Net Collection Results – Spring

Sample ID	Species	Length (mm)	Weight (g)
JI-BN-01b	Atlantic silverside	115	9.3
JI-BN-01b	Atlantic silverside	96	5.3
JI-BN-01b	Atlantic silverside	118	8.9
JI-BN-01b	Atlantic silverside	107	7
JI-BN-01b	Atlantic silverside	110	7.2
JI-BN-01b	Atlantic silverside	105	6.7
JI-BN-01b	Atlantic silverside	90	4.6
JI-BN-01b	Atlantic silverside	110	9.2
JI-BN-01b	Atlantic silverside	129	11.6
JI-BN-01b	Atlantic silverside	115	10
JI-BN-01b	Atlantic silverside	100	5.5
JI-BN-01b	Atlantic silverside	117	11.4
JI-BN-01b	Atlantic silverside	100	6.5
JI-BN-01b	Atlantic silverside	117	9.5
JI-BN-01b	Atlantic silverside	123	11
JI-BN-01b	Atlantic silverside	98	5.4
JI-BN-01b	Atlantic silverside	107	8.2
JI-BN-01b	Atlantic silverside	125	12.5
JI-BN-01b	Atlantic silverside	107	4.5
JI-BN-01b	Atlantic silverside	91	5.2
JI-BN-01b	Atlantic silverside	115	9.6
JI-BN-01b	Atlantic silverside	120	11.3
JI-BN-01b	Atlantic silverside	106	6.6
JI-BN-01b	Atlantic silverside	99	6.1
JI-BN-01b	Atlantic silverside	104	6.4
JI-BN-01b	Atlantic silverside	127	12.4
JI-BN-01b	Atlantic silverside	132	13.5
JI-BN-01b	Atlantic silverside	121	10.9
JI-BN-01b	Atlantic silverside	112	8.4
JI-BN-01b	Atlantic silverside	106	7.8
JI-BN-01b	Atlantic silverside	110	8.9
JI-BN-02a	Atlantic silverside	90	4
JI-BN-02b	Atlantic silverside	66	0.7
JI-BN-02b	Atlantic silverside	1211	13
JI-BN-02b	Atlantic silverside	107	4.4
JI-BN-02b	Atlantic silverside	60	1
JI-BN-02b	Atlantic silverside	106	8.7
JI-BN-03a	Atlantic silverside	116	80
JI-BN-03a	Atlantic silverside	122	10.3
JI-BN-03a	Atlantic silverside	107	6.6
JI-BN-03a	Atlantic silverside	117	10
JI-BN-03a	Atlantic silverside	99	6.7
JI-BN-03a	Atlantic silverside	121	10.6
JI-BN-03a	Atlantic silverside	102	6.8

Table D-1c
James Island Seine Net Collection Results – Spring

Sample ID	Species	Length (mm)	Weight (g)
JI-BN-03a	Atlantic silverside	115	11.1
JI-BN-03a	Atlantic silverside	133	16
JI-BN-03a	Atlantic silverside	113	9.1
JI-BN-03a	Atlantic silverside	110	8.3
JI-BN-03a	Atlantic silverside	104	7
JI-BN-03a	Atlantic silverside	76	2.9
JI-BN-03a	Atlantic silverside	126	12.4
JI-BN-03a	Atlantic silverside	123	11.5
JI-BN-03a	Atlantic silverside	128	13.7
JI-BN-03a	Atlantic silverside	111	8.2
JI-BN-03a	Atlantic silverside	95	5.6
JI-BN-03a	Atlantic silverside	120	11.1
JI-BN-03a	Atlantic silverside	133	14.2
JI-BN-03a	Atlantic silverside	95	6.1
JI-BN-03a	Atlantic silverside	101	6.3
JI-BN-03a	Atlantic silverside	97	6.4
JI-BN-03a	Atlantic silverside	121	13.1
JI-BN-03a	Atlantic silverside	95	6
JI-BN-03a	Atlantic silverside	112	8.9
JI-BN-03a	Atlantic silverside	116	9.4
JI-BN-03a	Atlantic silverside	121	10.5
JI-BN-03a	Atlantic silverside	107	7.5
JI-BN-03a	Atlantic silverside	109	8.3
JI-BN-03a	Atlantic silverside	100	6.3
JI-BN-03a	Atlantic silverside	117	11.1
JI-BN-03a	Atlantic silverside	110	8.2
JI-BN-03a	Atlantic silverside	115	9.2
JI-BN-03a	Atlantic silverside	130	13.7
JI-BN-03a	Atlantic silverside	129	12.4
JI-BN-03a	Atlantic silverside	115	8.6
JI-BN-03a	Atlantic silverside	102	7
JI-BN-03a	Atlantic silverside	131	15
JI-BN-03a	Atlantic silverside	129	13
JI-BN-03a	Atlantic silverside	113	8.4
JI-BN-03a	Atlantic silverside	108	7.8
JI-BN-03a	Atlantic silverside	102	6.9
JI-BN-03a	Atlantic silverside	100	5.8
JI-BN-03a	Atlantic silverside	96	5.4
JI-BN-03a	Atlantic silverside	112	9.9
JI-BN-03a	Atlantic silverside	118	10.3
JI-BN-03a	Atlantic silverside	80	2.4
JI-BN-03a	Atlantic silverside	93	4.8
JI-BN-03a	Atlantic silverside	93	4.5
JI-BN-03b	Atlantic silverside	113	8.2

Table D-1c
James Island Seine Net Collection Results – Spring

Sample ID	Species	Length (mm)	Weight (g)
JI-BN-03b	Atlantic silverside	128	11.6
JI-BN-03b	Atlantic silverside	102	6.2
JI-BN-03b	Atlantic silverside	102	6.3
JI-BN-03b	Atlantic silverside	105	6.9
JI-BN-03b	Atlantic silverside	94	5
JI-BN-03b	Atlantic silverside	102	6.3
JI-BN-03b	Atlantic silverside	104	6
JI-BN-03b	Atlantic silverside	104	5.9
JI-BN-03b	Atlantic silverside	107	7.2
JI-BN-03b	Atlantic silverside	115	6.5
JI-BN-03b	Atlantic silverside	106	7.3
JI-BN-03b	Atlantic silverside	106	7.6
JI-BN-03b	Atlantic silverside	99	5.8
JI-BN-03b	Atlantic silverside	103	5.8
JI-BN-03b	Atlantic silverside	109	7.4
JI-BN-03b	Atlantic silverside	112	8.8
JI-BN-03b	Atlantic silverside	118	9.2
JI-BN-03b	Atlantic silverside	100	6.4
JI-BN-03b	Atlantic silverside	101	6.1
JI-BN-03b	Atlantic silverside	115	8.5
JI-BN-03b	Atlantic silverside	107	7.5
JI-BN-03b	Atlantic silverside	136	17
JI-BN-03b	Atlantic silverside	121	11.5
JI-BN-03b	Atlantic silverside	97	5.6
JI-BN-03b	Atlantic silverside	110	8.2
JI-BN-03b	Atlantic silverside	111	8.4
JI-BN-03b	Atlantic silverside	112	9.3
JI-BN-03b	Atlantic silverside	87	4.5
JI-BN-03b	Atlantic silverside	87	4.7
JI-BN-03b	Atlantic silverside	135	15.9
JI-BN-03b	Atlantic silverside	122	11.6
JI-BN-03b	Atlantic silverside	119	9.6
JI-BN-03b	Atlantic silverside	104	7.3
JI-BN-03b	Atlantic silverside	114	9
JI-BN-03b	Atlantic silverside	118	10.4
JI-BN-03b	Atlantic silverside	121	10.2
JI-BN-03b	Atlantic silverside	94	5.4
JI-BN-03b	Atlantic silverside	107	7.3
JI-BN-03b	Atlantic silverside	90	4.4
JI-BN-03b	Atlantic silverside	105	6.7
JI-BN-03b	Atlantic silverside	109	7.2
JI-BN-03b	Atlantic silverside	95	5.7
JI-BN-03b	Atlantic silverside	116	10.7
JI-BN-03b	Atlantic silverside	96	5.9

Table D-1c
James Island Seine Net Collection Results – Spring

Sample ID	Species	Length (mm)	Weight (g)
JI-BN-03b	Atlantic silverside	110	7.5
JI-BN-03b	Atlantic silverside	109	7.7
JI-BN-03b	Atlantic silverside	126	12.6
JI-BN-03b	Atlantic silverside	120	12
JI-BN-03b	Atlantic silverside	120	11.3
JI-BN-03b	Spot	45	0.6
JI-BN-03b	Spot	39	0.3
JI-BN-03b	Spot	36	0.3
JI-BN-03b	Spot	38	0.3
JI-BN-03b	Spot	35	0.4
JI-BN-03b	Spot	34	0.2
JI-BN-03b	Spot	39	0.5
JI-BN-03b	Spot	40	0.4

Notes:
g: gram
mm: millimeter

Table D-2
James Island Gill Net Collection Results – All Seasons

Season	Sample ID	Species	Length (mm)	Weight[a] (g)
Summer	JI-GN-01	Blue crab	127	
	JI-GN-01	Blue crab	131	
	JI-GN-01	Spot	135	
	JI-GN-01	Gizzard shad	467	
	JI-GN-01	Gizzard shad	444	
	JI-GN-01	Gizzard shad	415	
	JI-GN-01	Bluefish	363	
	JI-GN-01	Spot	136	
	JI-GN-01	Spanish mackerel	232	
	JI-GN-01	Spot	134	
	JI-GN-01	Spot	122	
	JI-GN-01	Summer flounder	208	
	JI-GN-01	Spot	130	
	JI-GN-02	Gizzard shad	424	
	JI-GN-02	Atlantic menhaden	335	
	JI-GN-02	Atlantic menhaden	338	
	JI-GN-02	Bluefish	266	
	JI-GN-02	Blue crab	132	
	JI-GN-02	Bluefish	305	
	JI-GN-02	Atlantic menhaden	340	
	JI-GN-02	Spanish mackerel	289	
	JI-GN-03	Spanish mackerel	289	
	JI-GN-03	Spanish mackerel	298	
	JI-GN-03	Spot	155	
	JI-GN-04	Atlantic menhaden	280	
	JI-GN-04	Spanish mackerel	395	
Fall	JI-GN-03	Striped bass	471	
	JI-GN-03	Striped bass	337	
	JI-GN-04	Gizzard shad	490	
Winter	JI-GN-02	Alewife	280	
Spring	JI-GN-03	Striped bass	475	1145
	JI-GN-03	Striped bass	381	488
	JI-GN-03	Striped bass	360	500

Notes:

a. Weight was measured during the spring sampling event only

g: gram

mm: millimeter

Table D-3

James Island Bottom Trawl Collection Results – All Seasons

Season	Sample ID	Species	Length (mm)	Weight[a] (g)
Summer	JI-FT-03	Blue crab	164	
	JI-FT-03	Blue crab	127	
	JI-FT-03	Blue crab	135	
	JI-FT-06	Hogchoker	165	
Fall	JI-FT-01	Skilletfish	66	
	JI-FT-04	Blue crab	139	
	JI-FT-04	Blue crab	175	
	JI-FT-05	Blue crab	145	
	JI-FT-05	Blue crab	140	
	JI-FT-05	Blue crab	151	
	JI-FT-06	Blue crab	134	
	JI-FT-06	Blue crab	137	
	JI-FT-06	Blue crab	129	
Spring	JI-FT-03a	American shad	130	17.8
	JI-FT-03a	Bay anchovy	57	1.2
	JI-FT-04a	Bay anchovy	60	1.5
	JI-FT-05a	Blue crab	145	
	JI-FT-05b	Bay anchovy	60	1.2
	JI-FT-05b	Bay anchovy	59	1.1
	JI-FT-05b	Bay anchovy	57	0.9
	JI-FT-05b	Bay anchovy	59	1.4
	JI-FT-05b	Bay anchovy	60	1.3
	JI-FT-05b	Bay anchovy	67	1.9
	JI-FT-05b	Bay anchovy	60	1.2
	JI-FT-05b	Bay anchovy	61	1.2
	JI-FT-05b	Bay anchovy	55	0.9
	JI-FT-06a	Bay anchovy	42	0.4
	JI-FT-06a	Atlantic menhaden	39	0.4
	JI-FT-06b	Bay anchovy	44	0.4

Notes:

a. Weight was measured during the spring sampling event only

g: gram

mm: millimeter

Table D-4
James Island Pop Net Collection Results – Summer/Spring

Season	Sample ID	Species	Length (mm)	Weight[a] (g)
Summer	JI-PN-01a	Bay anchovy	52	
	JI-PN-01a	Striped anchovy	62	
	JI-PN-01a	Bay anchovy	50	
	JI-PN-01a	Striped anchovy	48	
	JI-PN-01a	Striped anchovy	55	
	JI-PN-01a	Bay anchovy	53	
	JI-PN-01a	Bay anchovy	52	
	JI-PN-01a	Bay anchovy	46	
	JI-PN-01a	Striped anchovy	56	
	JI-PN-01a	Striped anchovy	50	
	JI-PN-01a	Bay anchovy	53	
	JI-PN-01a	Bay anchovy	50	
	JI-PN-01a	Striped anchovy	59	
	JI-PN-01a	Bay anchovy	53	
	JI-PN-01a	Bay anchovy	52	
	JI-PN-01a	Striped anchovy	54	
	JI-PN-01a	Bay anchovy	45	
	JI-PN-01a	Striped anchovy	60	
	JI-PN-01a	Striped anchovy	50	
	JI-PN-01a	Striped anchovy	51	
	JI-PN-01a	Bay anchovy	50	
	JI-PN-01a	Bay anchovy	51	
	JI-PN-01a	Bay anchovy	52	
	JI-PN-01a	Striped anchovy	50	
	JI-PN-01a	Bay anchovy	50	
	JI-PN-01a	Striped anchovy	53	
	JI-PN-01a	Striped anchovy	50	
	JI-PN-01a	Bay anchovy	47	
	JI-PN-01a	Striped anchovy	48	
	JI-PN-01a	Bay anchovy	46	
	JI-PN-01a	Striped anchovy	56	
	JI-PN-01a	Bay anchovy	53	
	JI-PN-01a	Striped anchovy	67	
	JI-PN-01a	Striped anchovy	54	
	JI-PN-01a	Bay anchovy	49	
	JI-PN-01a	Bay anchovy	45	
	JI-PN-01a	Bay anchovy	51	
	JI-PN-01a	Bay anchovy	55	
	JI-PN-01a	Bay anchovy	49	
	JI-PN-01a	Striped anchovy	50	
	JI-PN-01a	Bay anchovy	50	
	JI-PN-01a	Striped anchovy	52	
	JI-PN-01a	Bay anchovy	51	
	JI-PN-01a	Striped anchovy	56	

Table D-4

James Island Pop Net Collection Results – Summer/Spring

Season	Sample ID	Species	Length (mm)	Weight[a] (g)
Summer (continued)	JI-PN-01a	Striped anchovy	57	
	JI-PN-01a	Striped anchovy	58	
	JI-PN-01a	Striped anchovy	55	
	JI-PN-01a	Striped anchovy	51	
	JI-PN-01a	Striped anchovy	48	
	JI-PN-01a	Striped anchovy	50	
	JI-PN-01a	Bay anchovy	48	
	JI-PN-01a	Bay anchovy	49	
	JI-PN-01a	Striped anchovy	50	
	JI-PN-01a	Bay anchovy	48	
	JI-PN-01a	Bay anchovy	49	
	JI-PN-01a	Striped anchovy	56	
	JI-PN-01a	Bay anchovy	52	
	JI-PN-01a	Bay anchovy	60	
	JI-PN-01a	Striped anchovy	55	
	JI-PN-01a	Bay anchovy	51	
	JI-PN-01a	Striped anchovy	54	
	JI-PN-01a	Bay anchovy	47	
	JI-PN-01a	Bay anchovy	46	
	JI-PN-01a	Striped anchovy	52	
	JI-PN-01a	Striped anchovy	50	
	JI-PN-01a	Bay anchovy	43	
	JI-PN-01a	Bay anchovy	50	
	JI-PN-01a	Striped anchovy	47	
	JI-PN-01a	Striped anchovy	55	
	JI-PN-01a	Striped anchovy	51	
	JI-PN-01a	Bay anchovy	47	
	JI-PN-01a	Striped anchovy	46	
	JI-PN-01a	Striped anchovy	54	
	JI-PN-01a	Striped anchovy	50	
	JI-PN-01a	Striped anchovy	51	
	JI-PN-01a	Bay anchovy	50	
	JI-PN-01a	Bay anchovy	50	
	JI-PN-01a	Striped anchovy	47	
	JI-PN-01a	Bay anchovy	55	
	JI-PN-01a	Bay anchovy	50	
	JI-PN-01a	Striped anchovy	57	
	JI-PN-01a	Striped anchovy	50	
	JI-PN-01a	Bay anchovy	50	
	JI-PN-01a	Bay anchovy	50	
	JI-PN-01a	Striped anchovy	48	
	JI-PN-01a	Bay anchovy	45	
	JI-PN-01a	Bay anchovy	50	
	JI-PN-01a	Striped anchovy	58	

Table D-4
James Island Pop Net Collection Results – Summer/Spring

Season	Sample ID	Species	Length (mm)	Weight[a] (g)
Summer (continued)	JI-PN-01a	Bay anchovy	46	
	JI-PN-01a	Bay anchovy	46	
	JI-PN-01a	Striped anchovy	51	
	JI-PN-01a	Bay anchovy	49	
	JI-PN-01a	Bay anchovy	48	
	JI-PN-01a	Bay anchovy	47	
	JI-PN-01b	Atlantic silverside	85	
	JI-PN-01b	Bay anchovy	50	
	JI-PN-01b	Atlantic silverside	83	
	JI-PN-01b	Striped anchovy	50	
	JI-PN-01b	Striped anchovy	51	
	JI-PN-01b	Striped anchovy	48	
	JI-PN-01b	Striped anchovy	51	
	JI-PN-01b	Atlantic silverside	78	
	JI-PN-01b	Striped anchovy	48	
	JI-PN-01b	Striped anchovy	53	
	JI-PN-01b	Bay anchovy	45	
	JI-PN-01b	Bay anchovy	51	
	JI-PN-01b	Atlantic silverside	79	
	JI-PN-01b	Striped anchovy	42	
	JI-PN-01b	Striped anchovy	49	
	JI-PN-01b	Bay anchovy	45	
	JI-PN-01b	Bay anchovy	51	
	JI-PN-01b	Atlantic silverside	76	
	JI-PN-01b	Bay anchovy	49	
	JI-PN-02a	Bay anchovy	47	
	JI-PN-02a	Bay anchovy	56	
	JI-PN-02a	Bay anchovy	50	
	JI-PN-02a	Bay anchovy	49	
	JI-PN-02a	Bay anchovy	50	
	JI-PN-02a	Bay anchovy	55	
	JI-PN-02a	Bay anchovy	43	
	JI-PN-02a	Bay anchovy	50	
	JI-PN-02a	Bay anchovy	50	
	JI-PN-02a	Bay anchovy	51	
	JI-PN-02a	Bay anchovy	62	
	JI-PN-02a	Bay anchovy	47	
	JI-PN-02a	Bay anchovy	48	
	JI-PN-02a	Bay anchovy	42	
	JI-PN-02a	Bay anchovy	49	
	JI-PN-02a	Bay anchovy	56	
	JI-PN-02a	Bay anchovy	48	
	JI-PN-02a	Bay anchovy	52	
	JI-PN-02a	Bay anchovy	51	

Table D-4
James Island Pop Net Collection Results – Summer/Spring

Season	Sample ID	Species	Length (mm)	Weight[a] (g)
Summer (continued)	JI-PN-02a	Bay anchovy	48	
	JI-PN-02a	Bay anchovy	48	
	JI-PN-02a	Bay anchovy	47	
	JI-PN-02a	Bay anchovy	50	
	JI-PN-02a	Bay anchovy	49	
	JI-PN-02a	Bay anchovy	46	
	JI-PN-02a	Bay anchovy	50	
	JI-PN-02a	Bay anchovy	50	
	JI-PN-02a	Striped anchovy	50	
	JI-PN-02a	Striped anchovy	52	
	JI-PN-02a	Striped anchovy	55	
	JI-PN-02a	Striped anchovy	56	
	JI-PN-02a	Striped anchovy	56	
	JI-PN-02a	Striped anchovy	49	
	JI-PN-02a	Striped anchovy	50	
	JI-PN-02a	Striped anchovy	49	
	JI-PN-02a	Striped anchovy	50	
	JI-PN-02a	Striped anchovy	57	
	JI-PN-02a	Striped anchovy	59	
	JI-PN-02a	Striped anchovy	68	
	JI-PN-02a	Striped anchovy	56	
	JI-PN-02a	Striped anchovy	53	
	JI-PN-02a	Bay anchovy	36	
	JI-PN-02a	Bay anchovy	50	
	JI-PN-02a	Bay anchovy	52	
	JI-PN-02a	Bay anchovy	52	
	JI-PN-02a	Bay anchovy	50	
	JI-PN-02a	Bay anchovy	53	
	JI-PN-02a	Bay anchovy	56	
	JI-PN-02a	Bay anchovy	47	
	JI-PN-02a	Bay anchovy	50	
	JI-PN-02a	Bay anchovy	54	
	JI-PN-02a	Bay anchovy	43	
	JI-PN-02a	Bay anchovy	48	
	JI-PN-02a	Bay anchovy	44	
	JI-PN-02a	Bay anchovy	51	
	JI-PN-02a	Bay anchovy	47	
	JI-PN-02a	Bay anchovy	48	
	JI-PN-02a	Bay anchovy	56	
	JI-PN-02a	Bay anchovy	50	
	JI-PN-02a	Bay anchovy	51	
	JI-PN-02a	Bay anchovy	49	
	JI-PN-02a	Bay anchovy	48	
	JI-PN-02a	Bay anchovy	46	

Table D-4
James Island Pop Net Collection Results – Summer/Spring

Season	Sample ID	Species	Length (mm)	Weight[a] (g)
Summer (continued)	JI-PN-02a	Bay anchovy	44	
	JI-PN-02b	Bay anchovy	48	
	JI-PN-02b	Bay anchovy	46	
	JI-PN-02b	Bay anchovy	49	
	JI-PN-02b	Bay anchovy	48	
	JI-PN-02b	Bay anchovy	50	
	JI-PN-02b	Bay anchovy	49	
	JI-PN-02b	Bay anchovy	51	
	JI-PN-02b	Bay anchovy	53	
	JI-PN-02b	Bay anchovy	50	
	JI-PN-02b	Bay anchovy	48	
	JI-PN-02b	Bay anchovy	48	
	JI-PN-02b	Bay anchovy	52	
	JI-PN-02b	Bay anchovy	46	
	JI-PN-02b	Bay anchovy	47	
	JI-PN-02b	Bay anchovy	45	
	JI-PN-02b	Bay anchovy	54	
	JI-PN-02b	Bay anchovy	48	
	JI-PN-02b	Bay anchovy	45	
	JI-PN-02b	Bay anchovy	52	
	JI-PN-02b	Bay anchovy	53	
	JI-PN-02b	Bay anchovy	47	
	JI-PN-02b	Bay anchovy	48	
	JI-PN-02b	Bay anchovy	50	
	JI-PN-02b	Bay anchovy	49	
	JI-PN-02b	Bay anchovy	50	
	JI-PN-02b	Bay anchovy	49	
	JI-PN-02b	Bay anchovy	50	
	JI-PN-02b	Striped anchovy	50	
	JI-PN-02b	Striped anchovy	49	
	JI-PN-02b	Striped anchovy	50	
	JI-PN-02b	Striped anchovy	55	
	JI-PN-02b	Striped anchovy	56	
	JI-PN-02b	Striped anchovy	50	
	JI-PN-02b	Bay anchovy	49	
	JI-PN-02b	Bay anchovy	50	
	JI-PN-02b	Bay anchovy	43	
	JI-PN-02b	Bay anchovy	44	
	JI-PN-04b	Bay anchovy	43	
	JI-PN-04b	Bay anchovy	50	
	JI-PN-04b	Atlantic silverside	82	
	JI-PN-04b	Bay anchovy	54	
	JI-PN-04b	Bay anchovy	53	
	JI-PN-04b	Striped anchovy	57	

Table D-4
James Island Pop Net Collection Results – Summer/Spring

Season	Sample ID	Species	Length (mm)	Weight[a] (g)
Summer (continued)	JI-PN-04b	Bay anchovy	53	
	JI-PN-04b	Bay anchovy	49	
	JI-PN-04b	Bay anchovy	49	
	JI-PN-04b	Striped anchovy	50	
	JI-PN-04b	Bay anchovy	46	
	JI-PN-04b	Striped anchovy	52	
Spring	JI-PN-01a	Spot	25	0.2
	JI-PN-03a	Spot	24	0.1
	JI-PN-03a	Spot	25	0.1
	JI-PN-03a	Spot	23	0.1

Notes:

a. Weight was measured during the spring sampling event only

g: gram

mm: millimeter

A2: Submerged Aquatic Vegetation (SAV) Survey at James and Barren Island (Anchor, 2021b)

November 2021
Mid-Chesapeake Bay Island Environmental Surveys

Submerged Aquatic Vegetation (SAV) Survey
James and Barren Islands

Prepared for Maryland Environmental Service

In coordination with Maryland Department of Transportation, Maryland Port Administration

November 2021
Mid-Chesapeake Bay Island Environmental Surveys

Submerged Aquatic Vegetation Survey James and Barren Islands

Prepared for
Maryland Environmental Service
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ABBREVIATIONS

DGPS	differential global positioning system
DO	dissolved oxygen
EIS	environmental impact statement
ft	feet
FS	feasibility study
m^2	square meter
MDNR	Maryland Department of Natural Resources
MDOT MPA	Maryland Department of Transportation Maryland Port Administration
MES	Maryland Environmental Service
mg/L	milligrams per liter
NTU	Nephelometric Turbidity Unit
ppt	parts per thousand
Project	Mid-Chesapeake Bay Island Ecosystem Restoration Project
SAV	submerged aquatic vegetation
USACE	U.S. Army Corps of Engineers
VIMS	Virginia Institute of Marine Science

1 Introduction

Maryland Department of Transportation Maryland Port Administration (MDOT MPA) and U.S. Army Corps of Engineers (USACE) Baltimore District are proposing to restore 2,144 acres of remote island habitat in the Chesapeake Bay. In 2009, the Baltimore District USACE prepared an integrated feasibility study (FS) and environmental impact statement (EIS) for the Mid-Chesapeake Bay Island Ecosystem Restoration Project (Project), which focuses 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 (USACE 2009). The FS/EIS identified James Island and Barren Island, located in western Dorchester County, Maryland, as the preferred alternatives for island restoration (Figure 1-1).

James Island is a privately owned uninhabited island, situated near the mouth of the Little Choptank River, approximately 1 mile north of Taylors Island. Since 1847, more than 800 acres have eroded, and James Island currently consists of three eroding island remnants totaling approximately 3 acres. The Project will restore 2,072 acres of this island.

Barren Island is an uninhabited island, located in the Chesapeake Bay in Dorchester County, Maryland, near the Honga River and immediately west of Hoopers Island. At the time of the feasibility study (2004), Barren Island consisted of three eroding island remnants totaling approximately 180 acres in size (197 acres including tidal flats). Based on 2020 surveys, only 138 acres 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 acres per year. At this rate, Barren Island could be completely lost by the early 2050s (2050-2055) without ongoing and future protection measures. The Project will restore 72 acres of Barren Island, while also protecting approximately 1,325 acres of potential submerged aquatic vegetation (SAV) habitat adjacent to the island.

USACE and MDOT MPA began the Project in the 1990s to achieve the following three main goals:

1. Restore remote island habitat within the Mid-Chesapeake Bay.
2. Optimize the placement capacity for sediment dredged from shipping channels.
3. Cause no harm to the environment around the restoration site.

As part of the FS, a sampling program was implemented to document the existing environmental conditions on and adjacent to James Island and Barren Island (USACE 2009). Four seasonal studies were completed in 2002 and 2003 to document baseline environmental conditions. Both aquatic and terrestrial sampling were conducted, and the environmental surveys included water quality and nutrient analyses, fish and plankton sampling, benthic sampling and sediment testing, vegetation identification and mapping (both aquatic and terrestrial), submerged aquatic vegetation surveys, avian and other wildlife observations (both aquatic and terrestrial), horseshoe crab spawning surveys, diamondback terrapin nesting surveys, crab pot surveys, clam surveys, and pound net fishers phone surveys (USACE 2009).

Currently, the FS/EIS is being updated to provide timely data to support design of the Project elements at James Island and Barren Island. The purpose of this report is to summarize the results of SAV surveys that were conducted to document the current environmental conditions at the Project area. Design for the island restoration is ongoing and the conditions documented in this report will serve as the baseline environmental conditions of the Project area prior to the initiation of restoration activities.

SAV surveys in the Chesapeake Bay have been conducted since the 1970s in the vicinity of James and Barren Islands. Historic data in the project areas indicates that SAV was documented near James Island as early as 1990 and near Barren Island as early as 1978. Since those initial observations, the extent of the SAV has fluctuated significantly, ranging from 2 to 4 acres near James Island and from 5 to 360 acres around vicinity of the Barren Island.

During the initial studies for the FS/EIS at James Island (USACE 2009), widgeon grass (*Ruppia maritima*) and small patches of sea lettuce (*Ulva lactuca*), a macroalgae were observed in the during the summer study along the eastern shoreline. Horned pondweed (*Zannichellia palustris*) was observed in the spring surveys, along the eastern shoreline in an area similar to where SAV was observed the previous summer.

In the Barren Island studies for the FS/EIS (USACE 2009), widgeon grass (*Ruppia maritima*) (summer only) and horned pondweed (*Zannichellia palustris*) (spring only) were the only species of SAV observed. The wigeon grass was found in patchy beds along the eastern shorelines of Barren Island, and the horned pondweed. was observed in very low densities along the western shoreline and higher densities along the northern and eastern shorelines.

Figure 1
Mid-Chesapeake Bay Island Ecosystem Restoration Project Area

2 Methods

SAV surveys were focused in the area where the proposed restoration of Barren and James Islands overlap with the location and density of SAV as mapped by aerial surveys by Virginia Institute of Marine Science (VIMS) from 2014 to 2019 (Orth et al. 2015 to 2020). At James Island, the eastern shoreline of the southern remnant was the focus area. At Barren Island, the areas to be surveyed for SAV included the northeast shoreline, the area between the northern and southern remnants, and the southern tip of the southern remnant. In each of the target areas, transects were identified with sampling points along each transect to collect SAV data within a quadrat. The location and orientation of target transects sampled for the project were determined through consultation with MES and Maryland Department of Natural Resources (MDNR).

SAV surveys were conducted at James and Barren Islands from June 24th through June 28th, 2020 to sample the potential presence of horned pondweed (*Zannichellia palustris*) and eelgrass (*Zostera marina*). A total of 5 sampling transects were identified for James Island (Figure 2) and 19 transects were identified for Barren Island (Figure 3). A quadrat approach was used to collected SAV data at each location and quadrat spacing was adjusted based on the total length of each transect (Table 1), according to:

- transects between 50 and 300 meters long had quadrats that were spaced approximately 20 meters apart
- transects between 300 and 400 meters long had quadrats that were spaced approximately 30 meters apart
- transects longer than 400 meters had quadrats that were spaced approximately 40 meters apart

Table 1
SAV Transect Spacing

Transect	Length (meters)	Quadrat Spacing	Number of Quadrats Sampled
James Island			
JI-02	140	20	8
JI-03	200	20	11
JI-04	148	20	9
JI-05	156	20	9
JI-06	135	20	8
Barren Island – North Transects			
BI-N-06	379	30	13

Transect	Length (meters)	Quadrat Spacing	Number of Quadrats Sampled
BI-N-09	394	30	14
BI-N-11	325	30	11
BI-N-16	400	40	11
BI-N-20	400	40	11
Barren Island – West Transects			
BI-W-02	83	20	5
BI-W-03	87	20	6
BI-W-04	101	20	6
BI-W-05	96	20	6
BI-W-07	49	20	4
Barren Island – Central Transects			
BI-C-01	459	40	13
BI-C-02	469	40	13
BI-C-03	481	40	13
BI-C-04	486	40	13
Barren Island – South Transects			
BI-S-01	200	20	11
BI-S-03	242	20	13
BI-S-05	418	40	11
BI-S-07	200	20	11
BI-S-09	200	20	11

Once the quadrat was placed on the bottom at the target sampling location, the SAV within the quadrat was documented. For each quadrat, the presence/absence of SAV, total visual percent cover, identification of each SAV species present, and an assessment of SAV density was documented. A total of 45 quadrats at James Island and 196 quadrats at Barren Island were sampled for the project.

In addition to the quadrat data collected along each transect, shallow areas around each island were surveyed by wading and kayaking around the island during low tide to identity any areas of substantial SAV coverage that were not included using the transect approach for the project.

Sampling coordinates and water quality data - water depth, salinity, water temperature, dissolved oxygen, and water clarity (Secchi disk reading) - collected at the beginning, middle, and end of each transect are presented in Table 2 for James Island and Table 3 for Barren Island.

Figure 2
James Island - Target SAV Transects

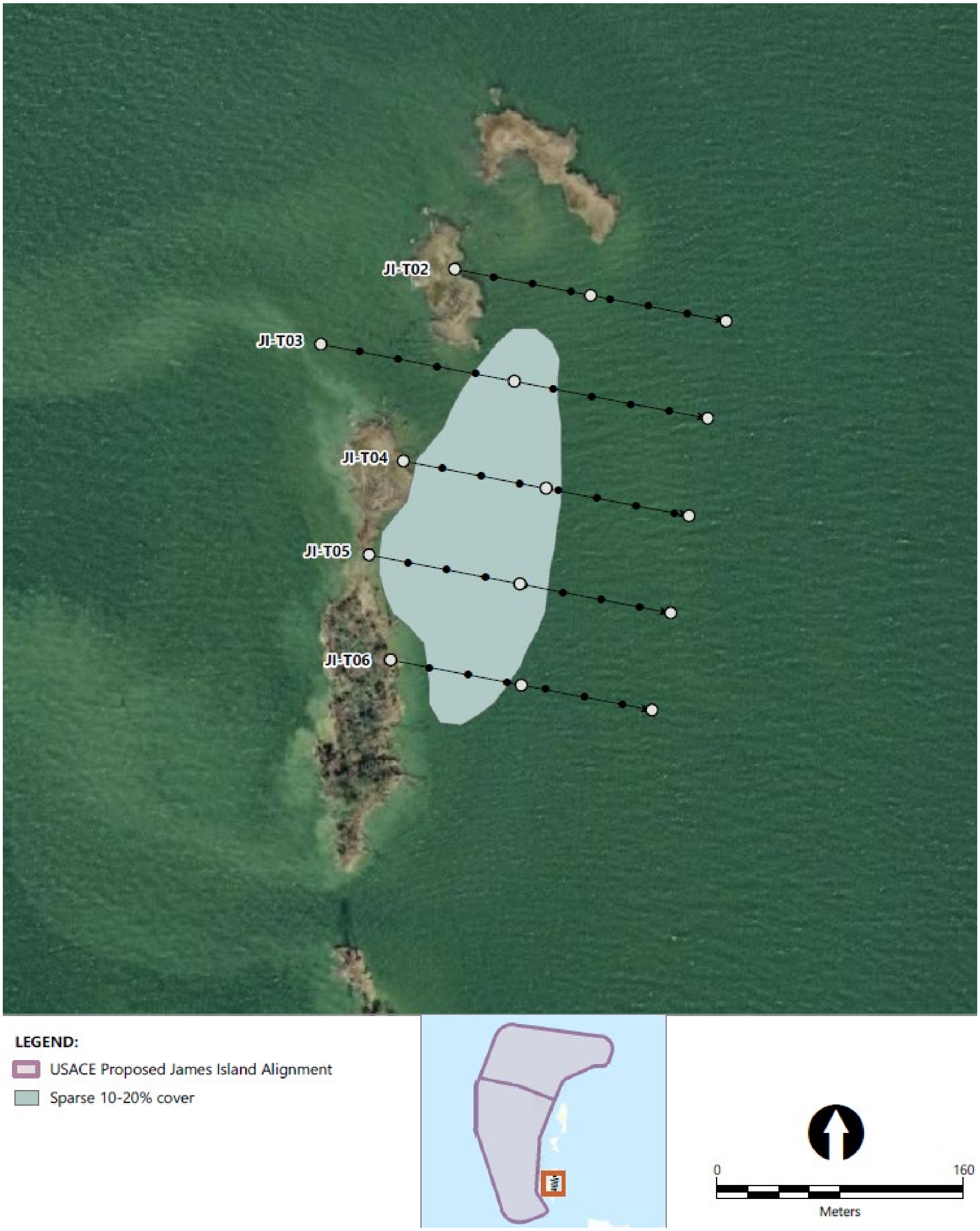


Figure 3
Barren Island - Target SAV Transects

Table 2
James Island - Water Quality Data for SAV Transects

Transect	Location	Water Depth (ft)	Water Clarity (ft)	Temperature (°C)	Dissolved Oxygen (mg/L)	Salinity (ppt)	Turbidity (NTU)
JI-02	Beginning	1.4	Bottom	27.2	7.58	11.33	17.4
	Middle	2.6	2.0	27.1	7.61	11.34	10.8
	End	3.9	2.3	27.4	7.62	11.34	9.8
JI-03	Beginning	3.1	2.1	27.3	7.60	11.35	9.4
	Middle	3.1	1.7	27.4	7.67	11.53	12.6
	End	3.5	2.3	27.4	7.67	11.34	7.6
JI-04	Beginning	1.5	Bottom	27.2	7.71	11.30	7.5
	Middle	2.7	2.3	27.0	7.71	11.31	7.6
	End	3.8	2.3	27.0	7.69	11.29	8.0
JI-05	Beginning	1.8	1.6	27.6	7.65	11.28	9.4
	Middle	2.4	1.9	27.4	7.62	11.35	8.2
	End	3.1	2.4	27.4	7.67	11.32	9.3
JI-06	Beginning	2.1	1.8	27.2	7.65	11.31	8.0
	Middle	2.5	2.2	27.1	7.64	11.29	9.1
	End	3.6	2.9	27.3	7.68	11.33	7.9

Notes: ft = feet
Mg/L = milligrams per liter
Ppt = parts per thousand
NTU = nephelometric turbidity unit

Table 3
Barren Island - Water Quality Data for SAV Transects

Transect	Location	Water Depth (ft)	Water Clarity (ft)	Temperature (°C)	Dissolved Oxygen (mg/L)	Salinity (ppt)	Turbidity (NTU)
Barren Island – North Transects							
BI-N-06	Beginning	2.8	1.7	27.4	7.01	12.58	9.8
	Middle	4.2	2.0	27.5	6.93	12.61	8.4
	End	6.5	2.1	27.6	6.88	12.62	9.5
BI-N-09	Beginning	2.3	1.6	26.9	7.20	12.54	9.3
	Middle	4.3	2.0	27.6	7.00	12.63	9.2
	End	6.8	1.9	27.6	6.96	12.64	9.4
BI-N-11	Beginning	2.7	1.9	27.7	7.47	12.54	7.3
	Middle	4.9	2.5	27.8	7.30	12.60	9.2
	End	5.5	1.8	27.6	7.06	12.66	11.1
BI-N-16	Beginning	1.3	Bottom	26.3	7.56	12.53	12.6
	Middle	4.7	2.2	27.7	8.28	12.36	8.7

Transect	Location	Water Depth (ft)	Water Clarity (ft)	Temperature (°C)	Dissolved Oxygen (mg/L)	Salinity (ppt)	Turbidity (NTU)
	End	5.2	2.3	27.9	7.36	12.67	8.7
BI-N-20	Beginning	1.1	Bottom	26.2	7.40	12.54	8.6
	Middle	2.8	1.6	25.2	7.12	12.57	12.3
	End	4.9	2.0	25.4	6.83	12.81	10.1
Barren Island – West Transects							
BI-W-02	Beginning	1.9	1.9	26.8	6.62	12.53	6.4
	Middle	2.7	1.6	26.8	6.31	12.50	6.9
	End	4.1	2.4	26.8	6.32	12.51	9.0
BI-W-03	Beginning	2.5	2.3	26.8	6.62	12.52	7.7
	Middle	2.9	1.7	27.2	6.25	12.55	11.3
	End	3.0	1.8	27.2	5.89	12.56	7.7
BI-W-04	Beginning	1.7	Bottom	26.6	6.80	12.47	6.7
	Middle	2.2	2.0	26.9	6.13	12.52	6.3
	End	3.9	2.4	26.9	5.67	12.55	8.5
BI-W-05	Beginning	1.3	Bottom	26.5	6.77	12.48	7.5
	Middle	2.5	2.1	26.3	6.56	12.57	8.4
	End	4.9	2.2	26.3	6.01	12.58	8.8
BI-W-07	Beginning	1.4	Bottom	26.4	6.18	12.45	15.7
	Middle	1.3	Bottom	26.4	-	-	-
	End	1.1	Bottom	24.0	5.37	12.48	11.8
Barren Island – Central Transects							
BI-C-01	Beginning	0.9	Bottom	30.3	7.86	12.48	9.2
	Middle	0.6	Bottom	33.4	10.32	12.72	5.8
	End	1.0	Bottom	30.5	9.43	12.54	68.8
BI-C-02	Beginning	1.2	Bottom	29.4	8.25	12.54	8.7
	Middle	1.4	Bottom	29.1	8.28	12.55	8.2
	End	1.6	Bottom	30.1	8.31	12.55	9.7
BI-C-03	Beginning	2.3	1.5	26.9	6.71	12.55	18.1
	Middle	3.5	1.8	26.7	6.98	12.60	12.1
	End	1.6	Bottom	32.9	9.96	12.58	9.6
BI-C-04	Beginning	2.8	1.6	26.9	6.38	12.54	17.5
	Middle	2.7	1.4	26.7	7.02	12.57	16.5
	End	1.8	1.5	27.4	7.51	12.59	10.0
Barren Island – South Transects							
BI-S-01	Beginning	2.1	Bottom	26.8	6.61	12.66	8.5
	Middle	2.4	1.6	26.4	6.23	12.67	12.5
	End	3.1	1.5	26.2	6.43	12.67	11.3

Transect	Location	Water Depth (ft)	Water Clarity (ft)	Temperature (°C)	Dissolved Oxygen (mg/L)	Salinity (ppt)	Turbidity (NTU)
BI-S-03	Beginning	1.2	Bottom	27.0	6.56	12.66	13.1
	Middle	2.7	1.8	26.6	6.79	12.67	11.5
	End	2.7	2.0	27.2	6.88	12.66	9.3
BI-S-05	Beginning	2.7	2.2	28.0	7.61	12.65	10.9
	Middle	3.5	2.3	27.6	7.35	12.65	8.7
	End	3.5	1.6	27.0	7.06	12.66	9.8
BI-S-07	Beginning	4.4	1.6	28.2	7.21	12.66	9.3
	Middle	4.2	2.3	28.2	7.27	12.65	8.5
	End	3.5	2.5	28.2	7.54	12.66	6.6
BI-S-09	Beginning	5.0	1.8	28.9	7.32	12.67	10.7
	Middle	4.6	1.9	28.1	7.23	12.72	9.8
	End	4.5	1.9	28.1	7.28	12.72	8.7

Notes: ft = feet
Mg/L = milligrams per liter
Ppt = parts per thousand
NTU = nephelometric turbidity unit

3 Results

The results of the spring 2020 SAV surveys at James and Barren Islands indicated that no SAV was observed in along the sampling transects or in the shallow water around James Island. For Barren Island, widgeon grass (*Ruppia maritima*) was the only SAV species identified along the sampling transects and it as also identified in in the shallow water on the eastern side of Barren Island (Figure 4). Neither of the two target species - horned pondweed (*Zannichellia palustris*) and eelgrass (*Zostera marina*) – were identified at James or Barren Island.

At James Island, the water depth drops off quickly adjacent to the remaining remnants and is more commonly greater than 5 feet, limiting the potential establishment of any SAV. The James Island remnants are also exposed to wave action with few sheltered or protected areas, which accelerates erosion and contributes to poor water clarity. The combination of water depths beyond optimal depths for SAV establishment, exposure to consistent wave action, and poor water clarity are limiting factors for SAV growth at James Island.

At Barren Island, widgeon grass was identified in only 10 of the quadrats from the northern, southern, western, and central transect areas, which was 0.05% of the total sampled quadrats. Percent cover of widgeon grass observed at quadrat points was low, ranging from 1-35%. SAV were observed at several quadrat locations outside of areas mapped with SAV during the qualitative survey, and these areas consisted of small, isolated patches of SAV and did not represent identifiable beds.

The widgeon grass identified around Barren Island (Table 4, Figure 4) was mostly limited to water depths of less than 4 feet, with dense beds observed in protected areas with water depths less than 2 feet. SAV growth along the transects and shallow areas adjacent to the exposed southeastern portion of Barren Island appear to be limited by wave action.

Table 4
Barren Island – SAV Observations

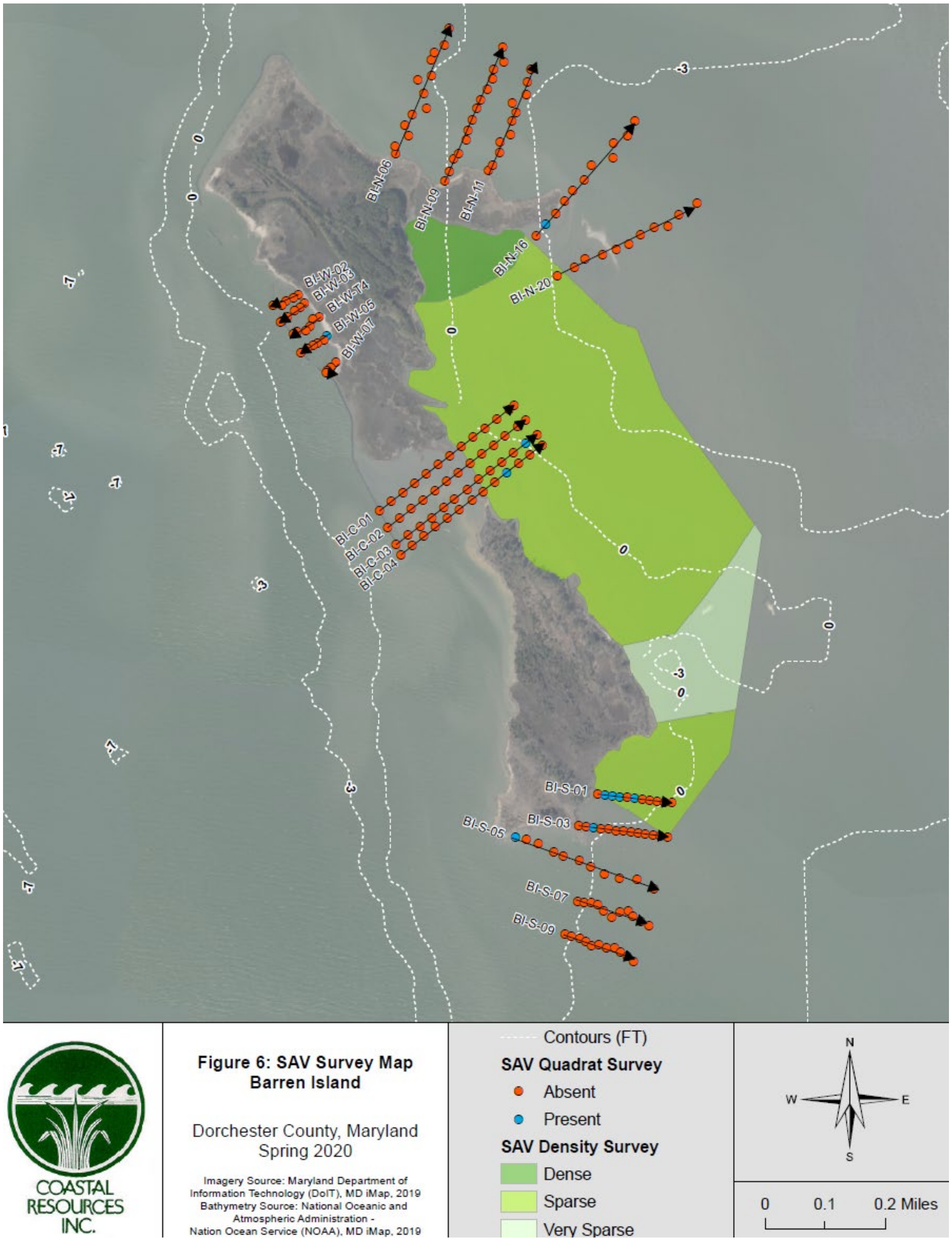
Sampling Area	Sampling Transect and Quadrat	SAV Species	Percent Cover
North	BI-N-16-02	Widgeon Grass	15%
West	BI-W-05-01	Widgeon Grass	8%
Central	BI-C-03-12	Widgeon Grass	8%
	BI-C-04-10	Widgeon Grass	8%
South	BI-S-01-02	Widgeon Grass	10%
	BI-S-01-03	Widgeon Grass	20%
	BI-S-01-04	Widgeon Grass	25%
	BI-S-01-06	Widgeon Grass	35%

Sampling Area	Sampling Transect and Quadrat	SAV Species	Percent Cover
	BI-S-03-02	Widgeon Grass	1%
	BI-S-05-01	Widgeon Grass	1%

Horned pondweed was observed floating in the water near the island, both there were not areas of documented growth. 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 James and Barren Islands 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 and James Island located just north and outside of the documented range. Although eelgrass was historically observed within salt ponds at Barren Island, SAV studies conducted for the FS/EIS did not document eelgrass in the waters surrounding Barren or James Island.

Figure 4
Barren Island – SAV Survey Results



4 References

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Appendix A
Quadrat Sampling Coordinates

Table A-1
James Island Quadrat Coordinates

Transect	Quadrat	Northing*	Easting*
JI-T02	1	307082.552	1501711.233
	2	307070.691	1501775.768
	3	307058.830	1501840.304
	4	307046.970	1501904.840
	5	307035.109	1501969.376
	6	307023.248	1502033.912
	7	307011.387	1502098.448
	8	306999.526	1502162.983
JI-T03	1	306956.673	1501488.637
	2	306944.812	1501553.172
	3	306932.951	1501617.708
	4	306921.091	1501682.244
	5	306909.230	1501746.780
	6	306897.369	1501811.316
	7	306885.508	1501875.852
	8	306873.647	1501940.387
	9	306861.787	1502004.923
	10	306849.926	1502069.459
	11	306838.065	1502133.995
JI-T04	1	306764.339	1501627.632
	2	306752.478	1501692.168
	3	306740.617	1501756.704
	4	306728.756	1501821.239
	5	306716.895	1501885.775
	6	306705.034	1501950.311
	7	306693.173	1502014.847
	8	306681.312	1502079.382
	9	306676.725	1502104.343
JI-T05	1	306607.882	1501571.413
	2	306596.021	1501635.949
	3	306584.160	1501700.485
	4	306572.299	1501765.020
	5	306560.438	1501829.556
	6	306548.577	1501894.092
	7	306536.717	1501958.628
	8	306524.856	1502023.164

Transect	Quadrat	Northing*	Easting*
	9	306515.386	1502074.690
JI-T06	1	306434.212	1501608.501
	2	306422.360	1501673.038
	3	306410.509	1501737.576
	4	306398.657	1501802.113
	5	306386.806	1501866.650
	6	306374.954	1501931.188
	7	306363.102	1501995.726
	8	306354.111	1502044.687

*Maryland State Pane, NAD83, US Survey feet

Table A-2
Barren Island North Transect Quadrat Coordinates

Transect	Quadrat	Northing*	Easting*
BI-N-T06	1	246603.471	1524679.773
	2	246694.149	1524718.049
	3	246784.826	1524756.326
	4	246875.504	1524794.601
	5	246966.181	1524832.878
	6	247056.859	1524871.153
	7	247147.537	1524909.429
	8	247238.214	1524947.705
	9	247328.892	1524985.981
	10	247419.569	1525024.257
	11	247510.247	1525062.533
	12	247600.925	1525100.809
	13	247691.602	1525139.085
BI-N-T09	1	246365.594	1525110.400
	2	246455.994	1525149.328
	3	246546.393	1525188.255
	4	246636.793	1525227.183
	5	246727.193	1525266.111
	6	246817.592	1525305.039
	7	246907.992	1525343.967
	8	246998.391	1525382.895
	9	247088.791	1525421.823
	10	247179.191	1525460.751
	11	247269.591	1525499.678
	12	247359.990	1525538.606
	13	247450.390	1525577.534
	14	247540.790	1525616.462
BI-N-T11	1	246442.082	1525501.252
	2	246532.625	1525539.845
	3	246623.168	1525578.438
	4	246713.711	1525617.031
	5	246804.254	1525655.624
	6	246894.798	1525694.216
	7	246985.341	1525732.809
	8	247075.884	1525771.402

Transect	Quadrat	Northing*	Easting*
	9	247166.427	1525809.995
	10	247256.971	1525848.588
	11	247347.514	1525887.181
BI-N-T16	1	245914.067	1525879.889
	2	246004.026	1526006.183
	3	246094.210	1526088.237
	4	246193.852	1526176.020
	5	246292.570	1526262.490
	6	246391.288	1526348.959
	7	246490.006	1526435.428
	8	246588.724	1526521.898
	9	246687.442	1526608.367
	10	246786.160	1526694.836
	11	246884.878	1526781.306
BI-N-T20	1	245565.484	1526130.924
	2	245623.403	1526248.685
	3	245681.321	1526366.446
	4	245739.239	1526484.207
	5	245797.158	1526601.968
	6	245855.077	1526719.729
	7	245912.995	1526837.490
	8	245970.913	1526955.251
	9	246028.832	1527073.012
	10	246086.750	1527190.773
	11	246144.669	1527308.534

*Maryland State Pane, NAD83, US Survey feet

Table A-3
Barren Island Central Transect Quadrat Coordinates

Transect	Quadrat	Northing*	Easting*
BI-C-T01	1	243479.830	1524566.345
	2	243561.886	1524644.656
	3	243637.195	1524744.860
	4	243711.283	1524842.030
	5	243800.271	1524960.868
	6	243890.824	1525066.771
	7	243967.094	1525168.962
	8	244049.579	1525269.610
	9	244125.482	1525362.908
	10	244206.357	1525467.380
	11	244286.358	1525571.118
	12	244366.346	1525680.128
	13	244422.849	1525728.520
BI-C-T02	1	243331.516	1524637.119
	2	243410.415	1524715.487
	3	243492.449	1524819.152
	4	243572.162	1524923.363
	5	243654.980	1525026.281
	6	243721.866	1525152.121
	7	243814.720	1525232.326
	8	243897.261	1525336.076
	9	243978.608	1525438.888
	10	244055.583	1525543.522
	11	244137.420	1525644.479
	12	244220.658	1525754.577
	13	244277.905	1525825.764
BI-C-T03	1	243199.443	1524706.166
	2	243264.030	1524788.849
	3	243341.193	1524897.849
	4	243416.291	1525000.480
	5	243505.290	1525105.700
	6	243577.045	1525197.732
	7	243664.161	1525310.527
	8	243751.760	1525412.442
	9	243842.442	1525515.473

Transect	Quadrat	Northing*	Easting*
	10	243908.770	1525615.600
	11	243987.802	1525718.385
	12	244069.186	1525824.664
	13	244151.032	1525925.454
BI-C-T04	1	243110.671	1524749.077
	2	243176.307	1524827.838
	3	243259.623	1524928.134
	4	243340.113	1525032.426
	5	243414.831	1525136.304
	6	243489.563	1525242.046
	7	243572.929	1525354.335
	8	243647.060	1525451.970
	9	243731.975	1525553.014
	10	243814.052	1525657.282
	11	243893.287	1525763.884
	12	243973.399	1525863.020
	13	244056.588	1525970.168

*Maryland State Pane, NAD83, US Survey feet

Table A-4
Barren Island West Transect Quadrat Coordinates

Transect	Quadrat	Northing*	Easting*
BI-W-T02	1	245381.594	1523827.394
	2	245355.619	1523767.137
	3	245329.644	1523706.881
	4	245303.669	1523646.624
	5	245277.694	1523586.368
BI-W-T03	1	245292.011	1523895.437
	2	245255.279	1523841.066
	3	245218.547	1523786.694
	4	245181.815	1523732.322
	5	245145.083	1523677.950
	6	245131.719	1523658.169
BI-W-T04	1	245182.848	1524024.181
	2	245145.868	1523969.978
	3	245108.888	1523915.775
	4	245071.907	1523861.571
	5	245034.927	1523807.368
	6	244997.947	1523753.164
BI-W-T05	1	245038.439	1524103.484
	2	245001.456	1524049.283
	3	244964.472	1523995.082
	4	244927.489	1523940.880
	5	244890.505	1523886.679
	6	244860.742	1523843.059
BI-W-T07	1	244767.734	1524177.402
	2	244715.401	1524137.819
	3	244663.068	1524098.235
	4	244639.061	1524080.077

*Maryland State Pane, NAD83, US Survey feet

Table A-5
Barren Island South Transect Quadrat Coordinates

Transect	Quadrat	Northing*	Easting*
BI-S-T01	1	240989.756	1526463.111
	2	240978.010	1526520.735
	3	240973.871	1526593.943
	4	240963.682	1526660.336
	5	240950.734	1526719.283
	6	240945.701	1526787.344
	7	240936.517	1526850.540
	8	240931.944	1526915.701
	9	240921.214	1526974.305
	10	240914.342	1527046.601
	11	240914.018	1527116.366
BI-S-T03	1	240706.057	1526305.891
	2	240701.688	1526358.628
	3	240692.482	1526421.002
	4	240679.006	1526486.938
	5	240676.743	1526554.928
	6	240664.694	1526619.583
	7	240657.516	1526683.527
	8	240648.436	1526751.073
	9	240642.625	1526814.917
	10	240635.034	1526876.220
	11	240622.717	1526944.924
	12	240619.420	1527009.108
	13	240608.728	1527072.999
BI-S-T05	1	240603.499	1525700.296
	2	240559.772	1525824.031
	3	240516.046	1525947.765
	4	240472.320	1526071.499
	5	240428.593	1526195.234
	6	240384.867	1526318.968
	7	240341.140	1526442.702
	8	240297.414	1526566.437
	9	240253.687	1526690.171
	10	240209.961	1526813.905
	11	240166.235	1526937.640

Transect	Quadrat	Northing*	Easting*
BI-S-T07	1	240057.128	1526267.244
	2	240036.464	1526329.522
	3	240015.799	1526391.800
	4	239995.134	1526454.077
	5	239974.470	1526516.355
	6	239953.805	1526578.633
	7	239933.140	1526640.911
	8	239912.475	1526703.188
	9	239891.811	1526765.466
	10	239871.146	1526827.744
	11	239850.481	1526890.021
BI-S-T09	1	239747.289	1526159.365
	2	239726.197	1526221.499
	3	239705.106	1526283.633
	4	239684.014	1526345.768
	5	239662.922	1526407.903
	6	239641.831	1526470.037
	7	239620.739	1526532.171
	8	239599.647	1526594.306
	9	239578.556	1526656.440
	10	239557.464	1526718.575
	11	239536.373	1526780.709

*Maryland State Pane, NAD83, US Survey feet

A3: Mid-Chesapeake Bay Islands Ecosystem Restoration Submerged Aquatic Vegetation (SAV) SPRING 2021 Surveys at James and Barren Islands (MDNR, 2021a)

Mid-Chesapeake Bay Islands Ecosystem Restoration Submerged Aquatic Vegetation (SAV) Surveys at Barren and James Islands
Contract Number: 09-07-105 Subtask 3.3

July 9, 2021

Project Overview

The Mid-Chesapeake Bay Island Ecosystem Restoration project is located on the islands of James and Barren in western Dorchester County, Maryland. The 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.

Submerged Aquatic Vegetation (SAV) is an important habitat in the Chesapeake Bay and SAV beds have historically surrounded both Barren and James Islands. There is evidence that some shoreline protection structures, including those proposed for the Mid-Bay Island project, can cause unintended declines in adjacent submerged aquatic vegetation (Patrick et al., 2014, 2016; Landry and Golden, 2018). However, creating conditions in which SAV continues to thrive in these shallow water areas is an important objective of the Mid-Bay Island project.

Project Tasks

The subcontractor will provide, manage, and coordinate qualified staff to assist the Maryland Environmental Service (MES) with SAV sampling and reporting efforts at Barren and James Islands to document the current aquatic resources present in and around the islands that are of importance to the Mid- Chesapeake Bay Island Ecosystem Restoration Project.

The primary tasks for this project are to investigate and document SAV occurrence and distribution in the vicinity of both Barren and James Islands. SAV will also be evaluated for species composition and relative density. SAV sampling will be conducted in early to mid-June, 2021 to observe the potential presence of horned pondweed (*Zannichellia palustris*) and eelgrass (*Zostera marina*), and from July 15 to August 30, 2021, to observe the potential presence of widgeon grass (*Ruppia maritima*) and other late-season species.

Methodology

Transect Selection

SAV surveys focused on the surrounding waters of areas where proposed island restoration activities will occur. Transects were identified where the existing SAV beds (2015 – 2019) overlapped with the area to be impacted by the recommended plan. At Barren Island, the areas surveyed for SAV were the northeast shoreline of the northern remnant, the western shoreline of the northern remnant behind the breakwaters, the area between the northern and southern island remnants, and the southern tip of the southern remnant. At James Island, the eastern shoreline of the southern remnant was the focus area.

The number and locations of transects were finalized upon agreement with MES, Maryland Department of Transportation, Maryland Port Authority, and United States Army Corps of Engineers prior to commencing work. The survey plan covered at least 10% of the impact area and transects extended from the shoreline of the island to an extent into the water passed the proposed breakwater/revetment/dike alignment (or to the limit of the SAV 5-year composite coverage, whichever was shorter). Transects were laid out with at least 50 meters between transects.

At Barren Island, the number of transects proposed are listed below and shown in Figure 1.

1. Northeast shoreline: 22 transects identified, 5 randomly selected to be surveyed
2. Span between remnants: 4 transects identified, all to be surveyed
3. Southern breakwater: 12 transects identified, 5 randomly selected to be surveyed
4. Western shoreline behind breakwaters: 7 transects identified, 5 randomly selected to be surveyed

At James Island, the number of transects proposed are listed below and shown in Figure 2.

1. Eastern shoreline: 8 transects identified, 5 randomly selected to be surveyed

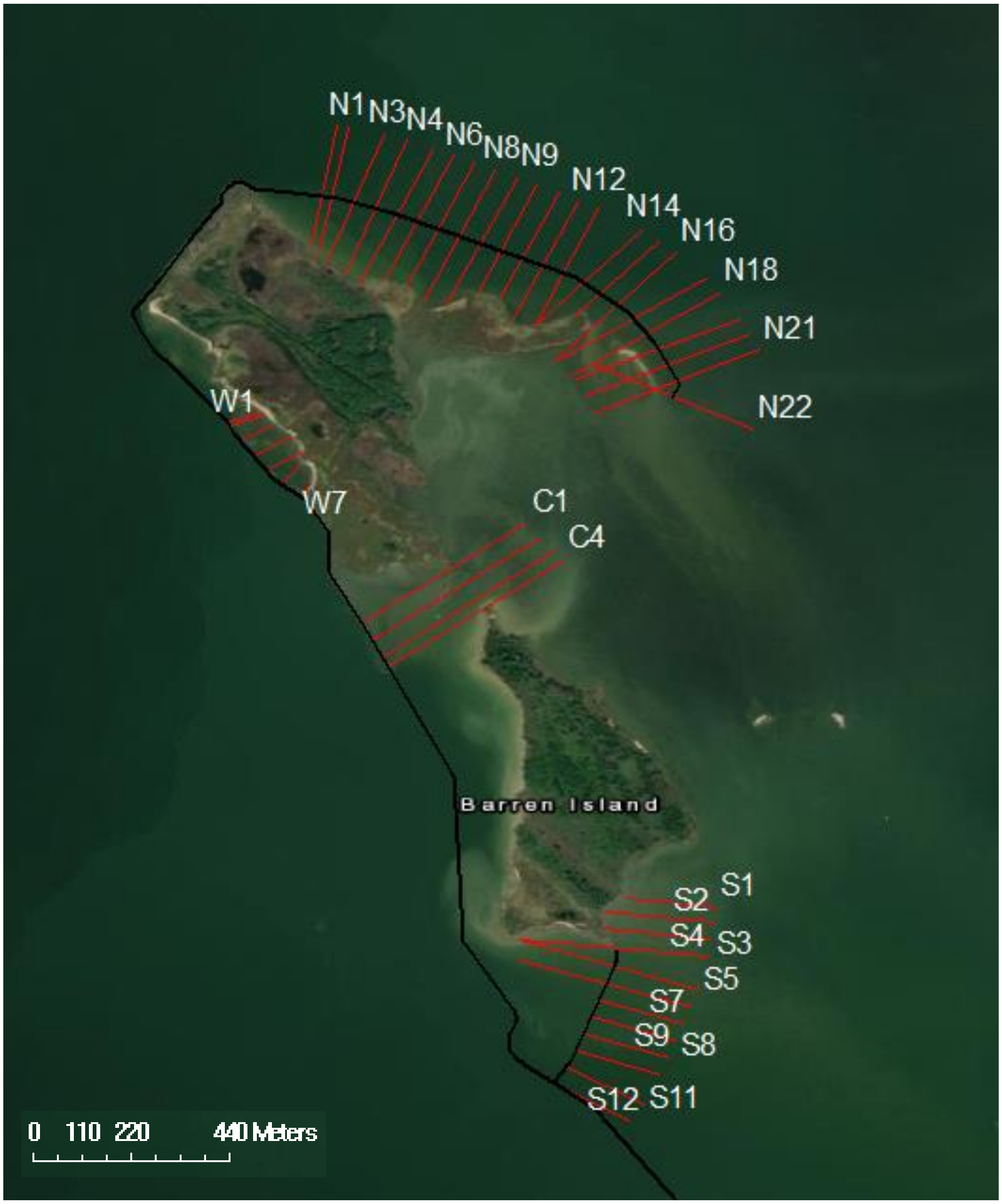

Figure 1. Overview map of Barren Island showing 22 transect locations on the northeastern shoreline, four transect locations between the spans, 12 transect locations on the southern shoreline and seven transect locations inshore of the western breakwater.

Figure 2. Overview map of James Island showing eight transect locations along the eastern shoreline of the southern span.

SAV surveys

Quadrats were placed every 20 meters along each randomly selected transect and were sampled with a ¼ meter square PVC frame. Due to water depths, the survey was conducted via snorkel or wading. Parameters measured included: the presence/absence of SAV, relative water depth, total

SAV visual percent cover, individual SAV species visual percent cover, and canopy height (see detailed methods in Landry and Golden, 2018). Coordinates for each transect (beginning, middle, and end) and quadrat were recorded using handheld Garmin GPSmap 78s units. All data were recorded on task-specific data sheets and entered into Microsoft Excel and Esri ArcMap.

Salinity, water temperature, and water clarity (Secchi disk reading, depending on water depth) were also collected at each location.

Project Outcomes to Date

Transect Selection

At Barren Island, the randomly selected transects were as follows:

1. Northeast shoreline: Transects 1, 9, 13, 20, and 22 (Figure 3)
2. Span between remnants: Transects 1 – 4 (Figure 4)
3. Southern breakwater: Transects 3, 6, 10, 11, and 12 (Figure 5)
4. Western shoreline behind breakwaters: Transects, 2, 4, 5, 6, and 7 (Figure 6)

At James Island, the randomly selected transects were as follows:

1. Eastern shoreline: Transects 2 - 6 (Figure 7)

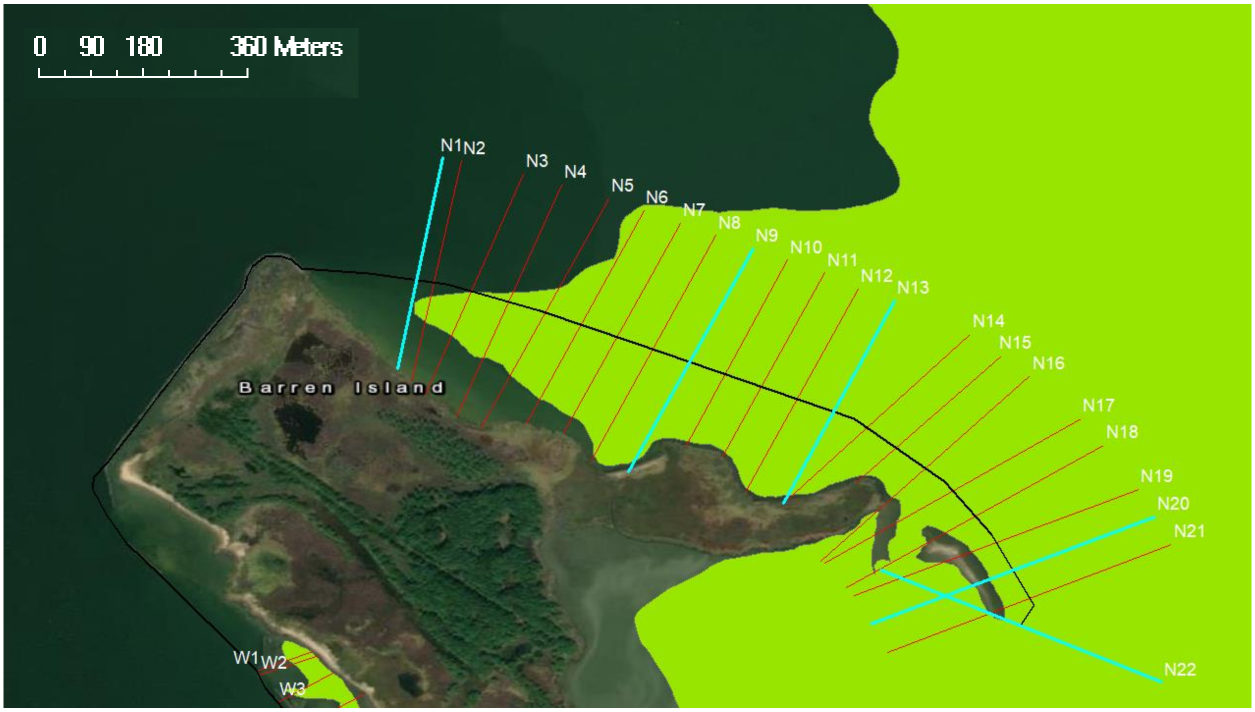

Figure 3. Location of selected transects (blue) on the northeastern shore of Barren Island. 2015 - 2019 SAV locations are shown in green.

Figure 4. Location of selected transects (blue) between the spans of Barren Island. 2015 - 2019 SAV locations are shown in green.

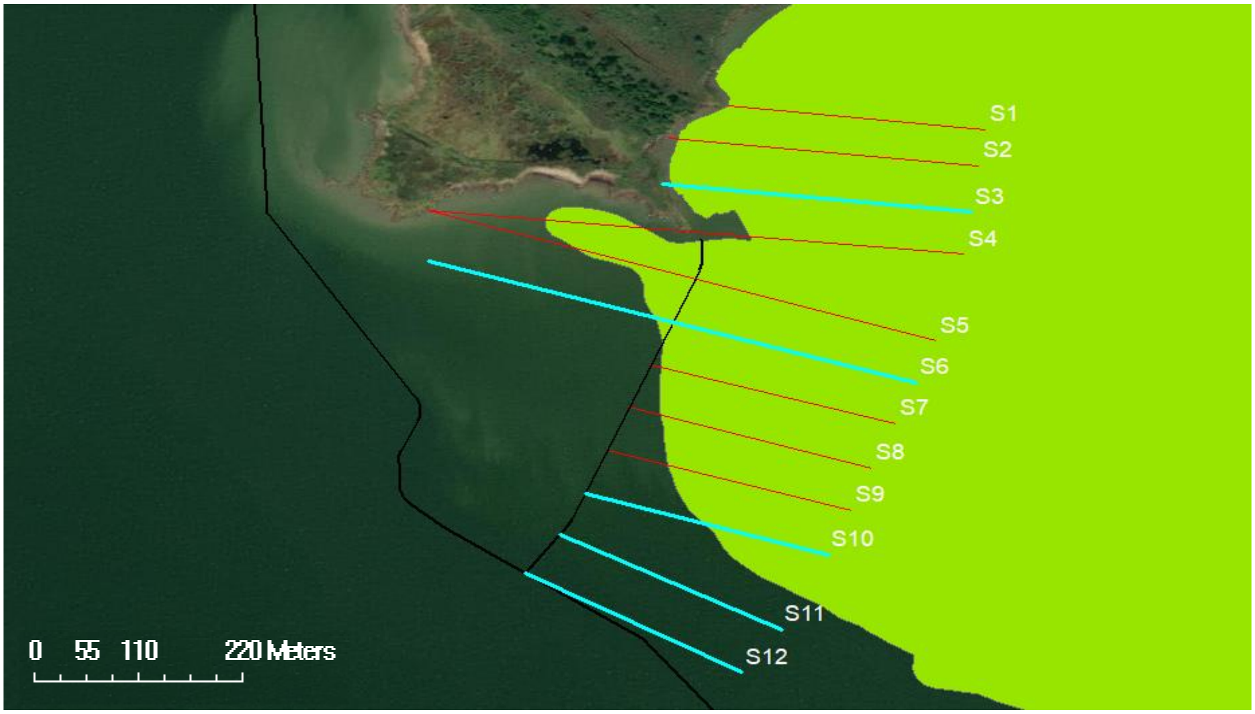

Figure 5. Location of selected transects (blue) on the southern shore of Barren Island. 2015 - 2019 SAV locations are shown in green.

Figure 6. Location of selected transects (blue) on the western shore of Barren Island. 2015 - 2019 SAV locations are shown in green.

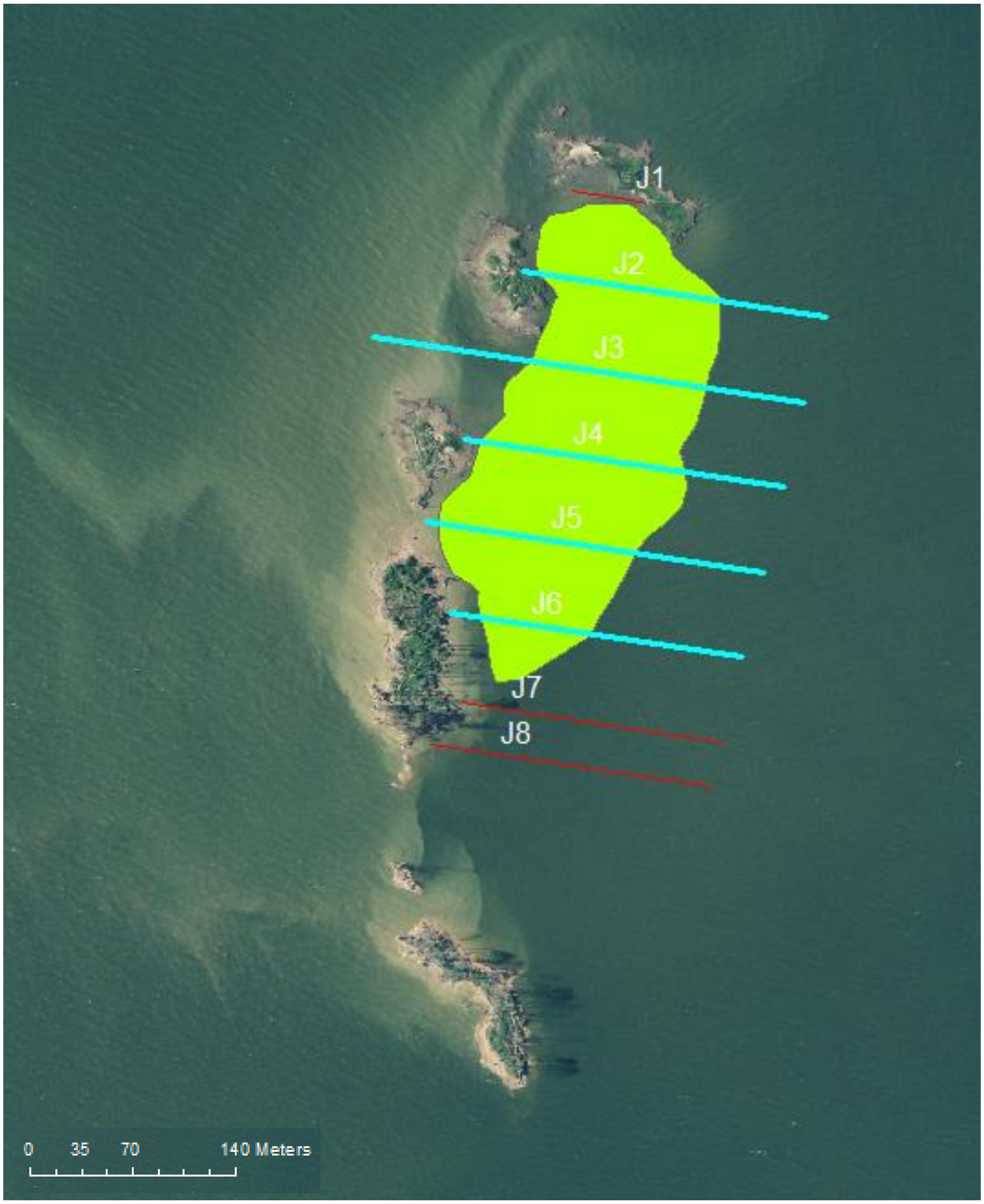

Figure 7. Location of selected transects (blue) on the eastern shore of James Island (southern span). 2015 - 2019 SAV locations are shown in green.

SAV surveys

Barren Island

Northeastern shoreline: SAV surveys were conducted on Barren Island's northeast shoreline on June 1, 2021. Weather conditions went from sunny and calm to overcast and breezy. Water temperatures averaged 70.2 F and salinity was 11. Seas progressed from calm to choppy. Water clarity was poor due to sediment resuspension and Secchi depths averaged 0.7 meters at the deeper edges of the northeastern transects. No SAV was observed on northeastern transects 1, 9 or 13 (Figure 8). Bottom sediment was classified as mud or peat nearshore and sandy or oyster shell offshore. Water depths ranged from 15 to 160 centimeters. Sparse and patchy widgeongrass was found along transects 20 and 22 (Figure 8). SAV percent cover ranged from 0 to 50% along transect 20 and 0 to 70% along transect 22. The bottom type was characterized as sand, shoal and oyster shells and water depths ranged from 0 to 120 centimeters.

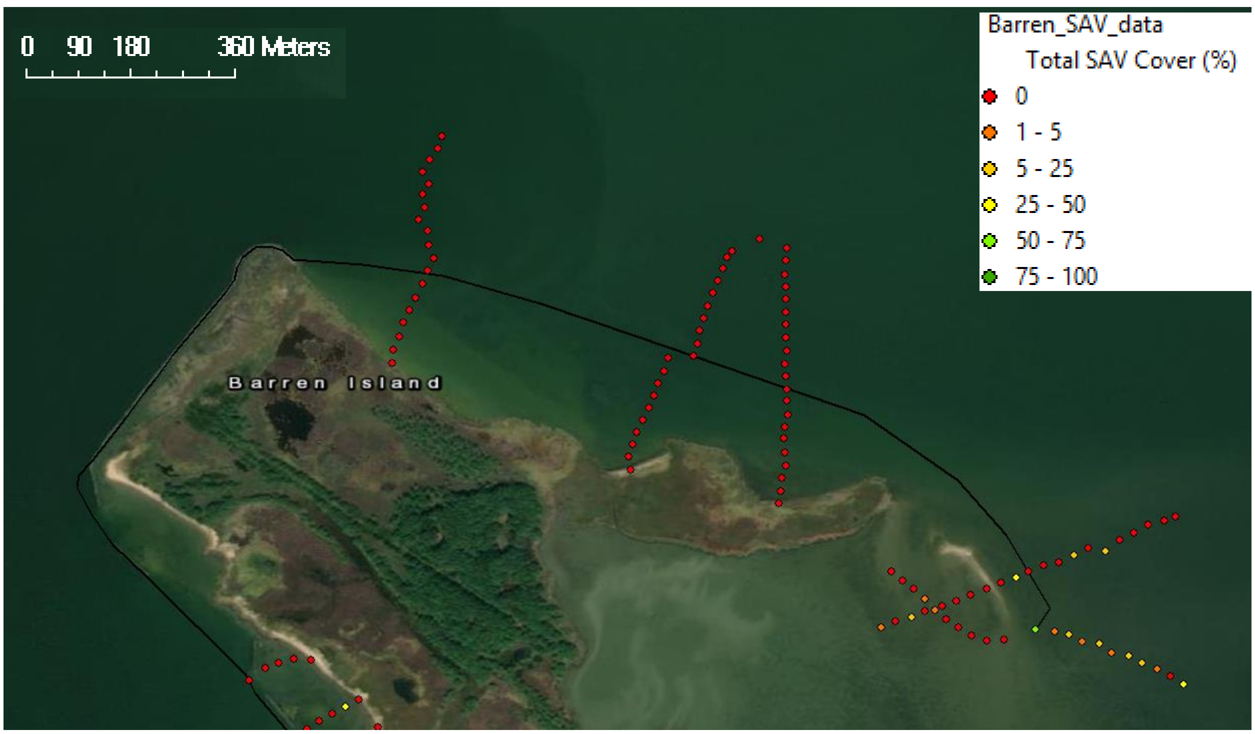

Figure 8. Total SAV % cover observed at each quadrat location on the northern shoreline of Barren Island.

Central span: SAV surveys were conducted on the central transects on June 2, 2021. The weather conditions were sunny and breezy. Water temperatures averaged 71.4 F and salinity was 11. Seas were choppy with waves 1 – 2 feet. Given the shallow and more sheltered nature of the central transects, most Secchi depths were "on the bottom". SAV (horned pondweed and widgeongrass) was observed along all four transects, with greater percent cover values on the middle transects (2 and 3) (Figure 9). The bottom type was characterized as sandy or muddy. Water depths ranged from 9 to 85 centimeters, with deeper depths closer to the breakwater.

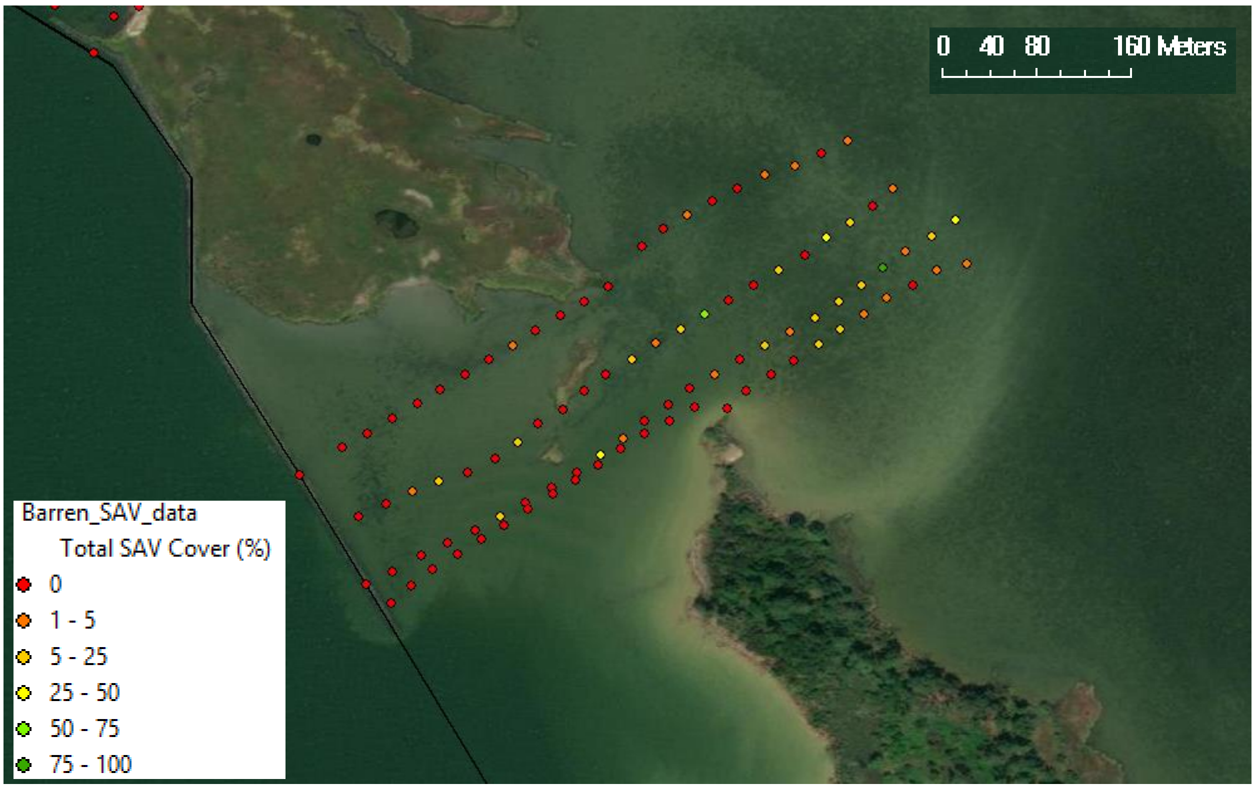

Figure 9. Total SAV percent cover observed at each quadrat location between the spans of Barren Island.

Southern shoreline: SAV surveys were conducted on the southern transects on June 2, 2021. Weather conditions were overcast and windy. Water temperatures averaged 71.0 F and salinity was 11. Seas were choppy with waves 1 – 2 feet. Water clarity was poor and Secchi depths averaged 0.5 meters along the deeper portions of the southern transects. Due to unsafe conditions, only the eastern half of transects 6 and 12 were surveyed. No SAV was observed on southern transects 6, 10, or 11 (Figure 10). One patch (2% cover) of widgeongrass was observed along transect 3, approximately 240 meters from the shoreline (Figure 10). One patch (1% cover) of horned pondweed was observed along transect 12, approximately 175 meters east of the proposed plan (Figure 10). The bottom type was characterized as sandy. Water depths ranged from 0 to 170 centimeters with deeper depths observed along the offshore transects (10-12).

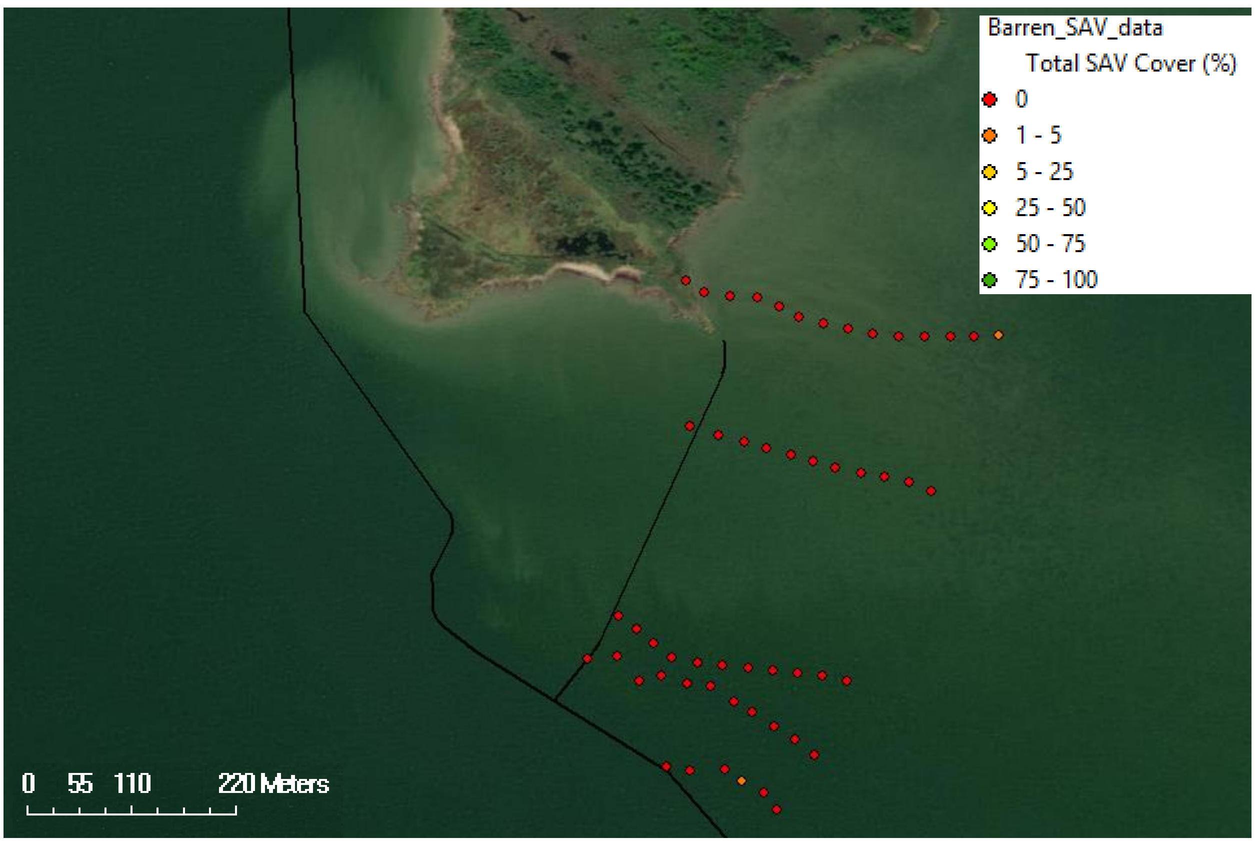

Figure 10. Total SAVpercent cover observed at each quadrat location on the southern shoreline of Barren Island.

Western shoreline: SAV surveys were conducted on the western transects on June 2, 2021. The weather conditions were sunny and breezy. Water temperatures averaged 71.4 F and salinity was 11. Seas were choppy with waves 1 – 2 feet, but calm inshore of the breakwaters. Water clarity was poor and Secchi depths averaged 0.5 meters along the deeper portions of the transects. No SAV was observed on western transects 2, 5, 6, or 7 (Figure 11). One patch (50% cover) of widgeongrass was observed along transect 4 approximately 20 meters from shore (Figure 11). The bottom type was a combination of peat, sand and gravel. Water depths ranged from 0 to 170 centimeters inshore of the breakwater.

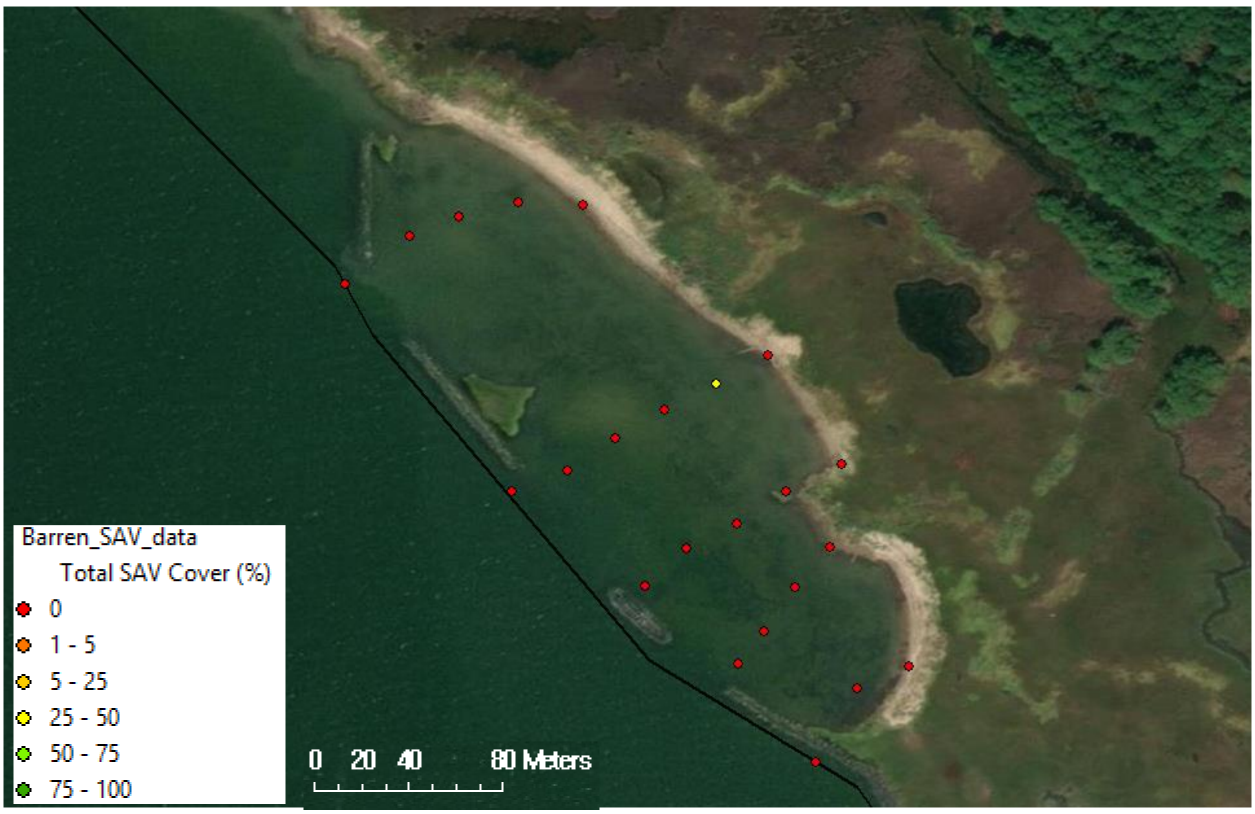

Figure 11. Total SAV percent cover observed at each quadrat location on the western shoreline of Barren Island.

James Island

SAV surveys were conducted on the eastern shoreline of the southern portion of James Island on June 16, 2021. The weather conditions were sunny and calm. Water temperatures averaged 76.9 F and salinity was 7. The seas were calm and the water clarity was good. Secchi depths averaged

0.75 meters at the deeper edges of the transects. No SAV was observed on any of the four transects (Figure 12), but floating fragments of both widgeongrass and horned pondweed were observed frequently. Transect 3 was not surveyed between island fragments due to unsafe conditions (underwater obstructions, unstable bottom and shallow, fast-moving water). Bottom sediment was classified as eroding peat nearshore and sandy offshore with the occasional submerged tree or stump. Water depths ranged from 15 to 160 centimeters.

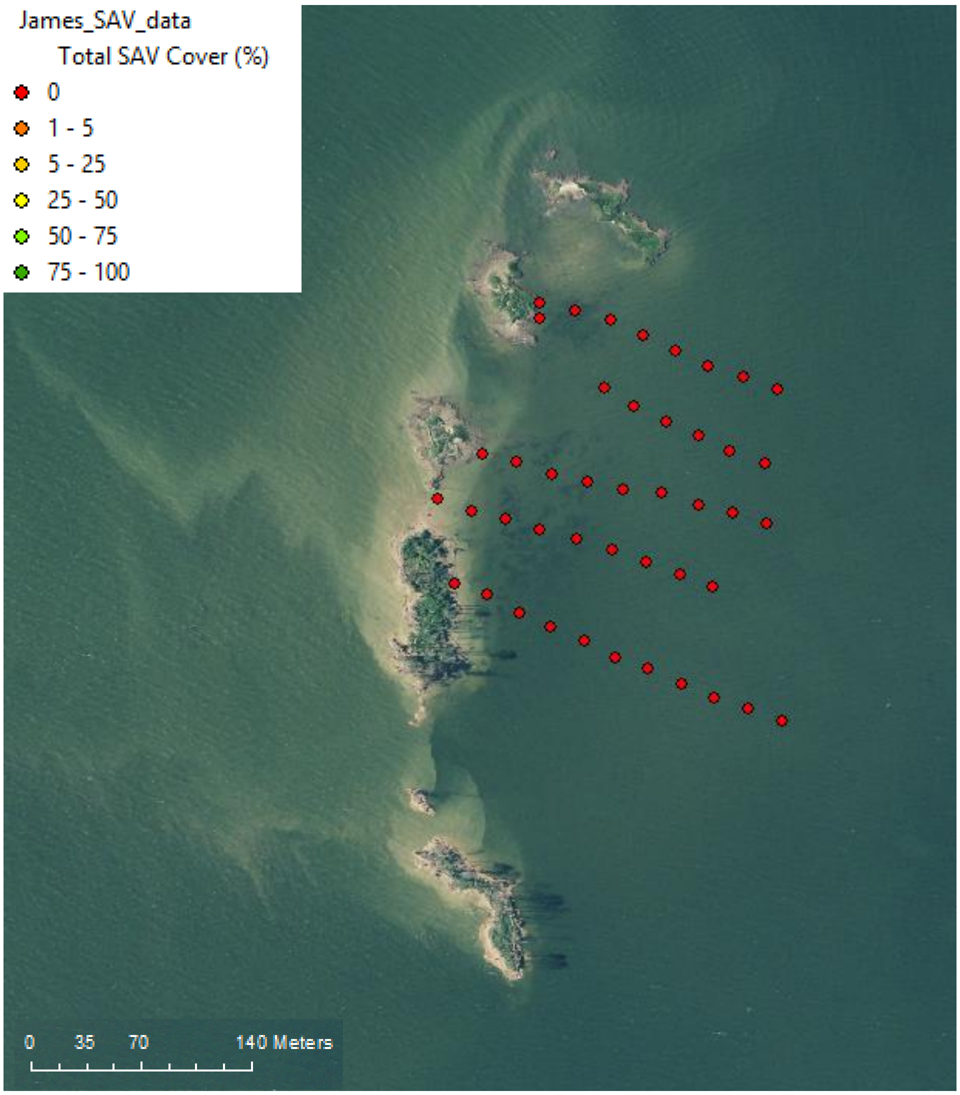

Figure 12. Total SAVpercent cover observed at each quadrat location on the eastern shoreline of the southern span of James Island.

Deliverables included with this report:

- Appendix with site photographs
- Electronic copies of datasheets
- Attributed GIS shapefiles of transect locations

Point Of Contact for Subtask 3.3

Becky Raves Golden (Rebecca.golden@maryland.gov) 410-260-8698

References

Landry, J.B. and R.R. Golden. 2018. In Situ Effects of Shoreline Type and Watershed land Use on Submerged Aquatic Vegetation Habitat Quality in the Chesapeake and Mid-Atlantic Coastal Bays. Estuaries and Coasts. 41(S1): 101–113.

Patrick, C.J., Weller, D.E., X. Li, and M. Ryder. 2014. Effects of shoreline alteration and other stressors on submerged aquatic vegetation in subestuaries of Chesapeake Bay and the Mid-Atlantic Coastal Bays. Estuaries and Coasts. 37: 1516-1531.

Patrick, C.J., Weller, D.E., and M. Ryder. 2016. The relationship between shoreline armoring and adjacent submerged aquatic vegetation in Chesapeake Bay and nearby Atlantic coastal bays. Estuaries and Coasts. 39: 158–170.

A4: Mid-Chesapeake Bay Islands Ecosystem Restoration Submerged Aquatic Vegetation (SAV) SUMMER 2021 Surveys at James and Barren Islands (MDNR, 2021b)

Mid-Chesapeake Bay Islands Ecosystem Restoration Submerged Aquatic Vegetation (SAV) Surveys at Barren and James Islands Final Report
Contract Number: 09-07-105 Subtask 3.3

November 4, 2021

Project Overview

The Mid-Chesapeake Bay Island Ecosystem Restoration project is located on the islands of James and Barren in western Dorchester County, Maryland. The 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.

Submerged Aquatic Vegetation (SAV) is an important habitat in the Chesapeake Bay and SAV beds have historically surrounded both Barren and James Islands. There is evidence that some shoreline protection structures, including those proposed for the Mid-Bay Island project, can cause unintended declines in adjacent submerged aquatic vegetation (Patrick et al., 2014, 2016; Landry and Golden, 2018). However, creating conditions in which SAV continues to thrive in these shallow water areas is an important objective of the Mid-Bay Island project.

Project Tasks

The subcontractor will provide, manage, and coordinate qualified staff to assist the Maryland Environmental Service (MES) with SAV sampling and reporting efforts at Barren and James Islands to document the current aquatic resources present in and around the islands that are of importance to the Mid- Chesapeake Bay Island Ecosystem Restoration Project.

The primary tasks for this project are to investigate and document SAV occurrence and distribution in the vicinity of both Barren and James Islands. SAV will also be evaluated for species composition and relative density. SAV sampling will be conducted in early to mid-June, 2021 to observe the potential presence of horned pondweed (*Zannichellia palustris*) and eelgrass (*Zostera marina*), and from July 15 to August 30, 2021, to observe the potential presence of widgeon grass (*Ruppia maritima*) and other late-season species.

Project Reporting Period

This report details the results of the late summer/early fall 2021 SAV surveys at Barren and James Islands. Results of the early summer 2021 SAV surveys were provided in the previous report.

Methodology

<u>Transect Selection</u>

SAV surveys focused on the surrounding waters of areas where proposed island restoration activities will occur. Transects were identified where the existing SAV beds (2015 – 2020) overlapped with the area to be impacted by the recommended plan. At Barren Island, the areas surveyed for SAV were the northeast shoreline of the northern remnant, the western shoreline of the northern remnant behind the breakwaters, the area between the northern and southern island remnants, and the southern tip of the southern remnant. At James Island, the eastern shoreline of the southern remnant was the focus area.

The number and locations of transects were finalized upon agreement with MES, Maryland Department of Transportation, Maryland Port Authority, and United States Army Corps of Engineers prior to commencing work. The survey plan covered at least 10% of the impact area and transects extended from the shoreline of the island to an extent into the water passed the proposed breakwater/revetment/dike alignment (or to the limit of the SAV 5-year composite coverage, whichever was shorter). Transects were laid out with at least 50 meters between transects.

At Barren Island, the number of transects proposed are listed below and shown in Figure 1.

1. Northeast shoreline: 22 transects identified, 5 randomly selected to be surveyed
2. Span between remnants: 4 transects identified, all to be surveyed
3. Southern breakwater: 12 transects identified, 5 randomly selected to be surveyed
4. Western shoreline behind breakwaters: 7 transects identified, 5 randomly selected to be surveyed

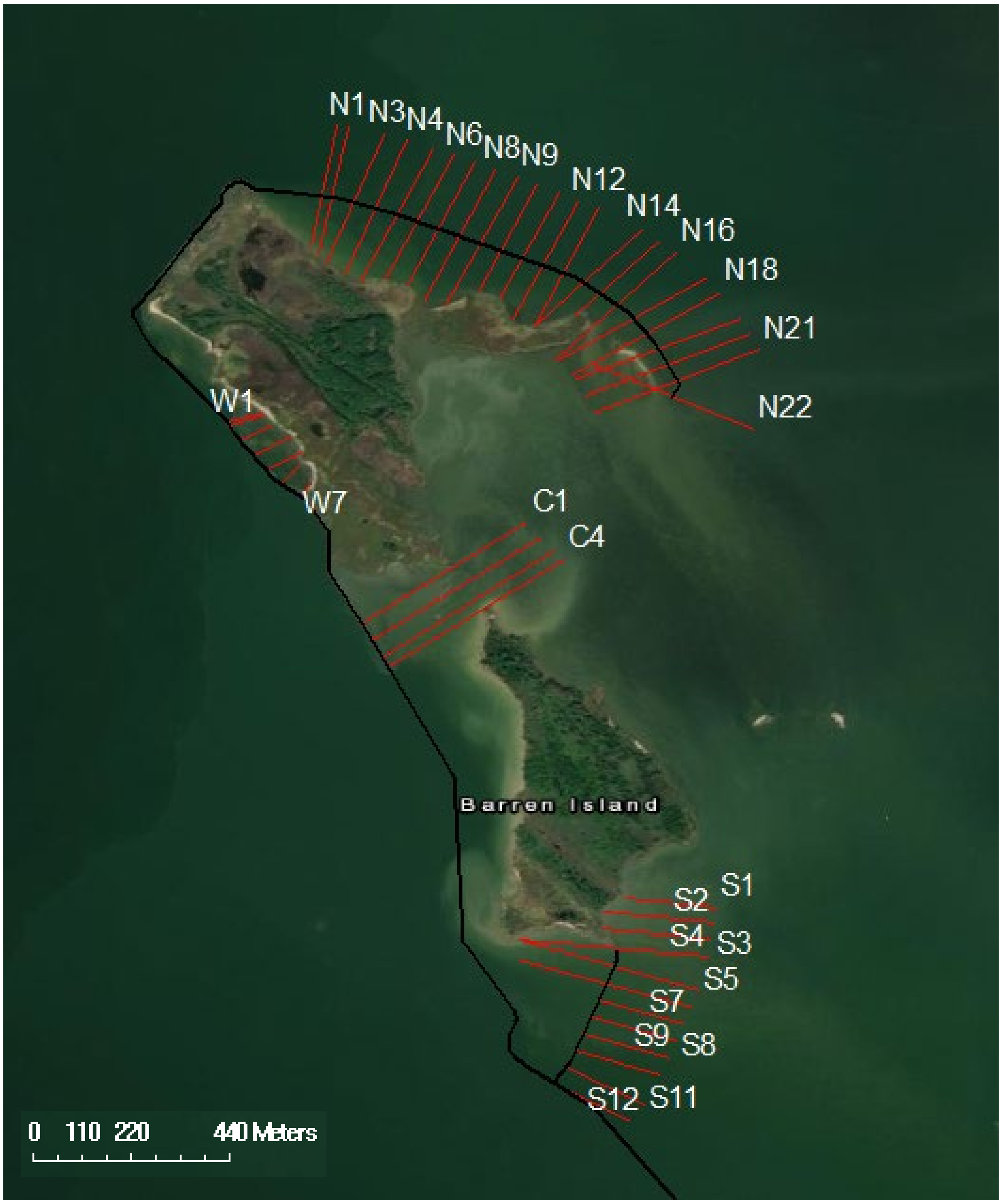

Figure 1. *Overview map of Barren Island showing 22 transect locations on the northeastern shoreline, four transect locations between the spans, 12 transect locations on the southern shoreline and seven transect locations inshore of the western breakwater.*

At James Island, the number of transects proposed are listed below and shown in Figure 2.

1. Eastern shoreline: 8 transects identified, 5 randomly selected to be surveyed

***Figure 2**. Overview map of James Island showing eight transect locations along the eastern shoreline of the southern span.*

SAV surveys

SAV surveys were performed at James Island on August 19, 2021 and on September 15 and 16, 2021 at Barren Island. Quadrats ($0.25m^2$) were sampled along the length of each transect at even intervals. The number of quadrats sampled per transect was based on the overall length of the transect. For example, a 100 meter transect would contain 11 quadrats spaced every 10 meters. A 200 meter transect would contain 11 quadrats spaced every 20 meters. Due to expected water depths, the survey was conducted via snorkel or wading. Parameters measured included: the presence/absence of SAV, relative water depth, total SAV visual percent cover, individual SAV species visual percent cover, and canopy height (see detailed methods in Landry and Golden, 2018). Coordinates for each transect (beginning, middle, and end) and quadrat were recorded using handheld Garmin GPSmap 78s units. All data were recorded on task-specific data sheets and entered into Microsoft Excel and Esri ArcMap.

Salinity, water temperature, and water clarity (Secchi disk reading, depending on water depth) were also collected at each location.

Project Outcomes

Transect Selection

At Barren Island, the randomly selected transects were as follows:

1. Northeast shoreline: Transects N8, N10, N14, N16, and N18
2. Span between remnants: Transects C1 – 4
3. Southern breakwater: Transects S1, S2, S3, S9, and S11
4. Western shoreline behind breakwaters: Transects W2, W3, W4, W5, and W6

At James Island, the randomly selected transects were as follows:

1. Eastern shoreline: Transects J1, J2, J4, J5, and J6

Transect locations are shown in Figure 1 (Barren Island) and Figure 2 (James Island).

SAV surveys

Barren Island

Our intention was to perform all of the surveys in August, but due to staff illness and several weeks of severe weather, the Barren Island survey was pushed back into September.

Northeastern shoreline: SAV surveys were conducted on Barren Island's northeast shoreline on September 15, 2021. Weather conditions were overcast and windy. Water temperatures averaged 76 °F and salinity was 13. Seas were rough with 0.3 – 0.6 meter waves. Water clarity was poor due to sediment resuspension and Secchi depths averaged 0.25 meters at the deeper edges of the northeastern transects. SAV was observed on northeastern transects N8, N10, N14, N16, and N18 (Figure 3). Bottom sediment was classified as mud or peat nearshore and sandy or oyster shell offshore. Water depths ranged from 0.26 to 2 meters.

Transects N14 and N16 were not surveyed along the deeper offshore portions due to strong currents and 0.6 meter waves.

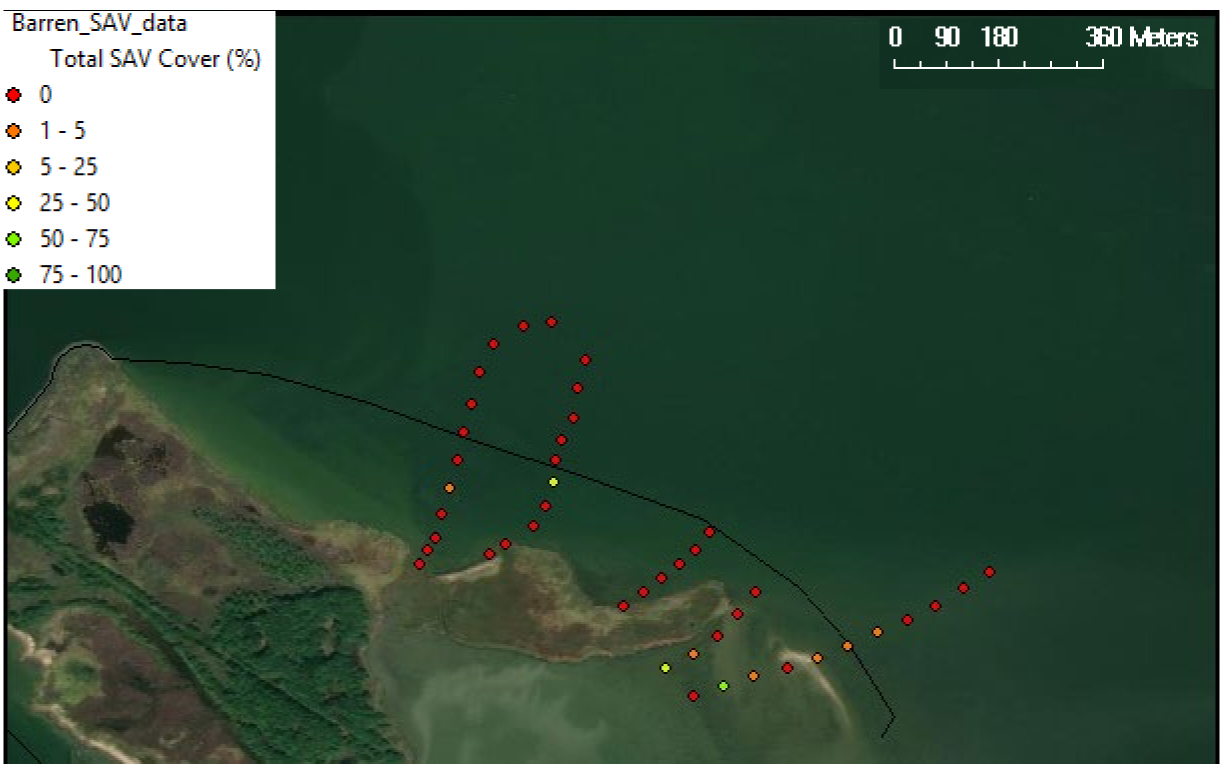

Figure 3. *Total SAV % cover observed at each quadrat location on the northern shoreline of Barren Island.*

Central span: SAV surveys were conducted on the central transects on September 15, 2021. The weather conditions were sunny and breezy. Water temperatures averaged 77 °F and salinity was 13. Seas were rough with waves 0.3 - 0.6 meters. Secchi depths averaged 0.20 meters due to the shallow depths of the area and poor clarity due to sediment resuspension from the passing storms. Widgeon grass was observed along all four transects, with greater percent cover values on the eastern side of the island remnants (Figure 4). The bottom type was characterized as sandy or muddy. Water depths ranged from 0.15 to 1 meters, with deeper depths closer to the breakwater.

Due to rough seas and high winds, we did not attempt to reach the southern or western areas of the island on September 15th.

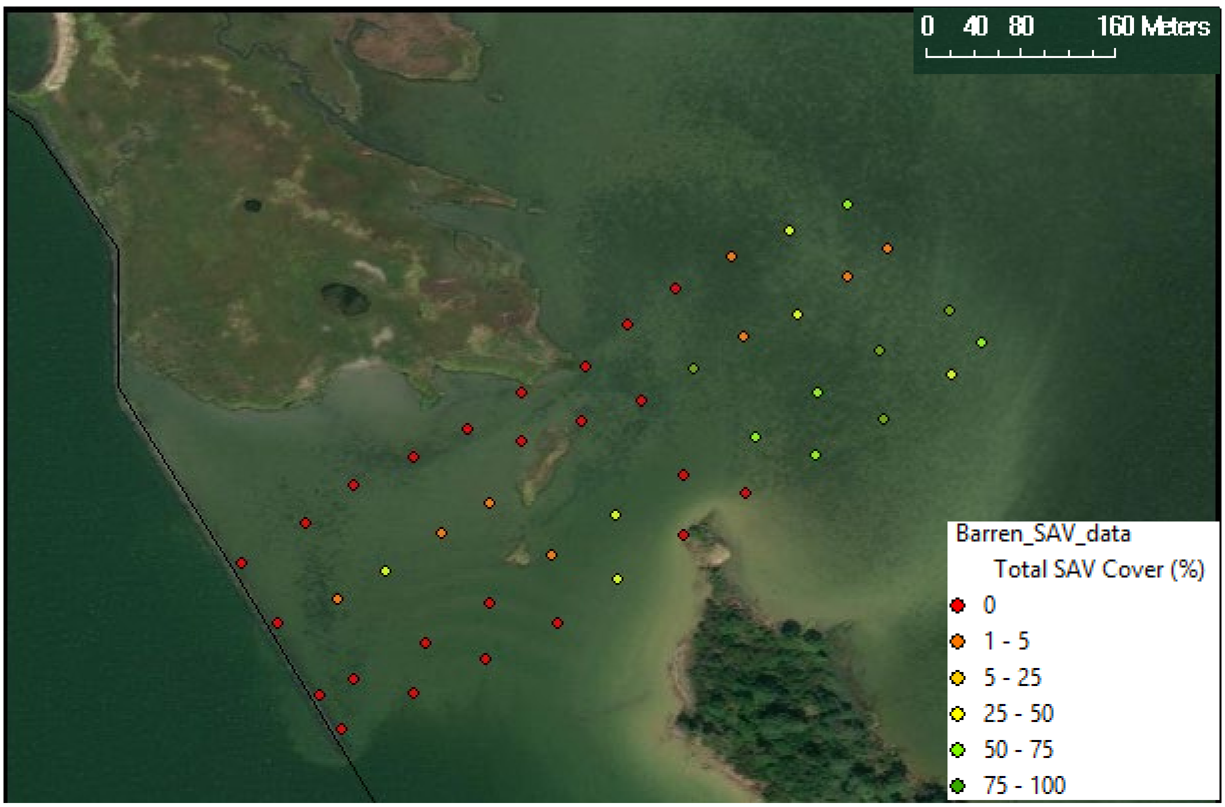

Figure 4. *Total SAV percent cover observed at each quadrat location between the spans of Barren Island.*

Southern shoreline: SAV surveys were conducted on the southern transects on September 16, 2021. Weather conditions were stormy. Water temperatures averaged 76 °F and salinity was 14. Seas were rough with waves 0.3 – 0.6 meters. Water clarity was poor and Secchi depths averaged 0.6 meters along the deeper portions of the southern transects. We completed three (S1, S2, S3) of the southern transects as thunderstorms approached. Widgeongrass was observed on southern transects 1 and 2 (Figure 5). No SAV was observed along the southern transect S3. The bottom type was characterized as sandy. Water depths ranged from 0.45 to 1.05 meters.

The team decided to forgo the remaining two southern transects (S9, S11) and instead sampled the five western transects before the storms hit. Our decision was based on the following:

- S9 and S11 were located in deeper water (> 1.8m)
- No widgeon grass was observed in that area during our spring sampling
- No SAV was observed when we did a few rake throws in the vicinity of S9 and S11
- No SAV was mapped by VIMS in those areas since 2017
- The alternative would have been no SAV transects on the western side of Barren

Figure 5*. Total SAV percent cover observed at each quadrat location on the southern shoreline of Barren Island.*

Western shoreline: SAV surveys were conducted on the western transects on September 16, 2021. The weather conditions were stormy. Water temperatures averaged 77 °F and salinity was 13. Seas were choppy with waves 0.3 – 0.6 meters, but calm inshore of the breakwaters. Water clarity was poor and Secchi depths averaged 0.5 meters along the deeper portions of the transects. Widgeon grass was observed on western transects W2, W3, and W4 (Figure 6). No SAV was observed along western transects W5 or W6 (Figure 6). The bottom type was a combination of peat, sand and gravel. Water depths ranged from 0.25 to 1.91 meters inshore of the breakwater.

Figure 6*. Total SAV percent cover observed at each quadrat location on the western shoreline of Barren Island.*

James Island

SAV surveys were conducted on the eastern shoreline of the southern portion of James Island on August 19, 2021. The weather conditions were sunny and calm, although the remnants of Tropical Storm Fred produced locally heavy rainfall and winds as it moved over the area the day before. Water temperatures averaged 81 °F and salinity was 11. Secchi depth averaged 1 meter at the deeper edges of the transects. Only one patch of widgeon grass was observed along Transect J5 (Figure 7), but floating fragments of both widgeon grass were observed frequently. Bottom sediment was classified as eroding peat nearshore and sandy offshore with the occasional submerged tree or stump. Water depths ranged from 0.41 to 1.47 meters.

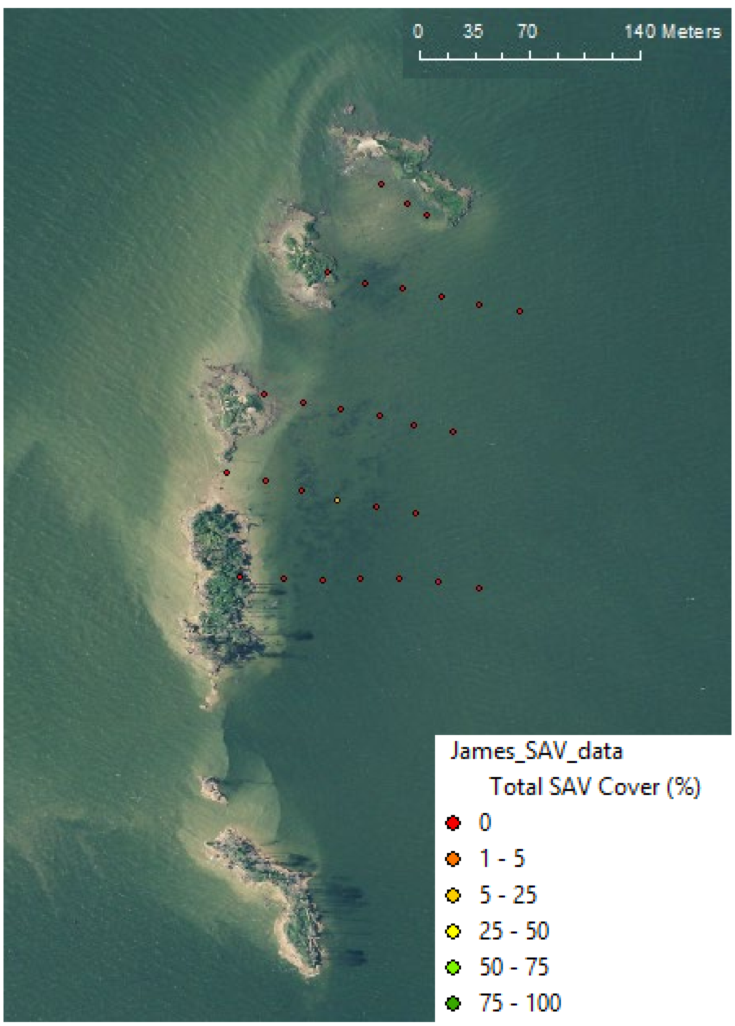

***Figure** 7. Total SAV percent cover observed at each quadrat location on the eastern shoreline of the southern span of James Island.*

Conclusion

The primary objectives of this project were to document SAV occurrence and distribution in the vicinity of both Barren and James Islands, and to evaluate species composition and relative density.

Given the unique site conditions (water depth, wave action, and bottom type), SAV distribution, abundance and composition varied between sampling locations and periods (Table 1, Figures 8 and 9). SAV was observed at both Barren and James Islands during the summer of 2021. *Zannichellia palustris* (horned pondweed) was observed during the June survey and *Ruppia maritima* (widgeon grass) was observed in both the June and September surveys. Observed SAV percent cover and mean canopy height were greater during the September survey due to higher biomass and the presence of reproductive shoots.

Patches of SAV were observed within the breakwaters on the northwestern side, offshore of the southeastern side and offshore of the northeastern side of Barren Island (Figure 8). Denser, more continuous SAV beds were observed within the shallow waters on the southeastern side, along the northeastern side near the oyster bar and between the two island spans (Figure 8).

Floating rafts of both horned pondweed and widgeon grass were observed within the project vicinity of James Island. However, only one small patch of widgeon grass was observed near James Island in September (Figure 9)

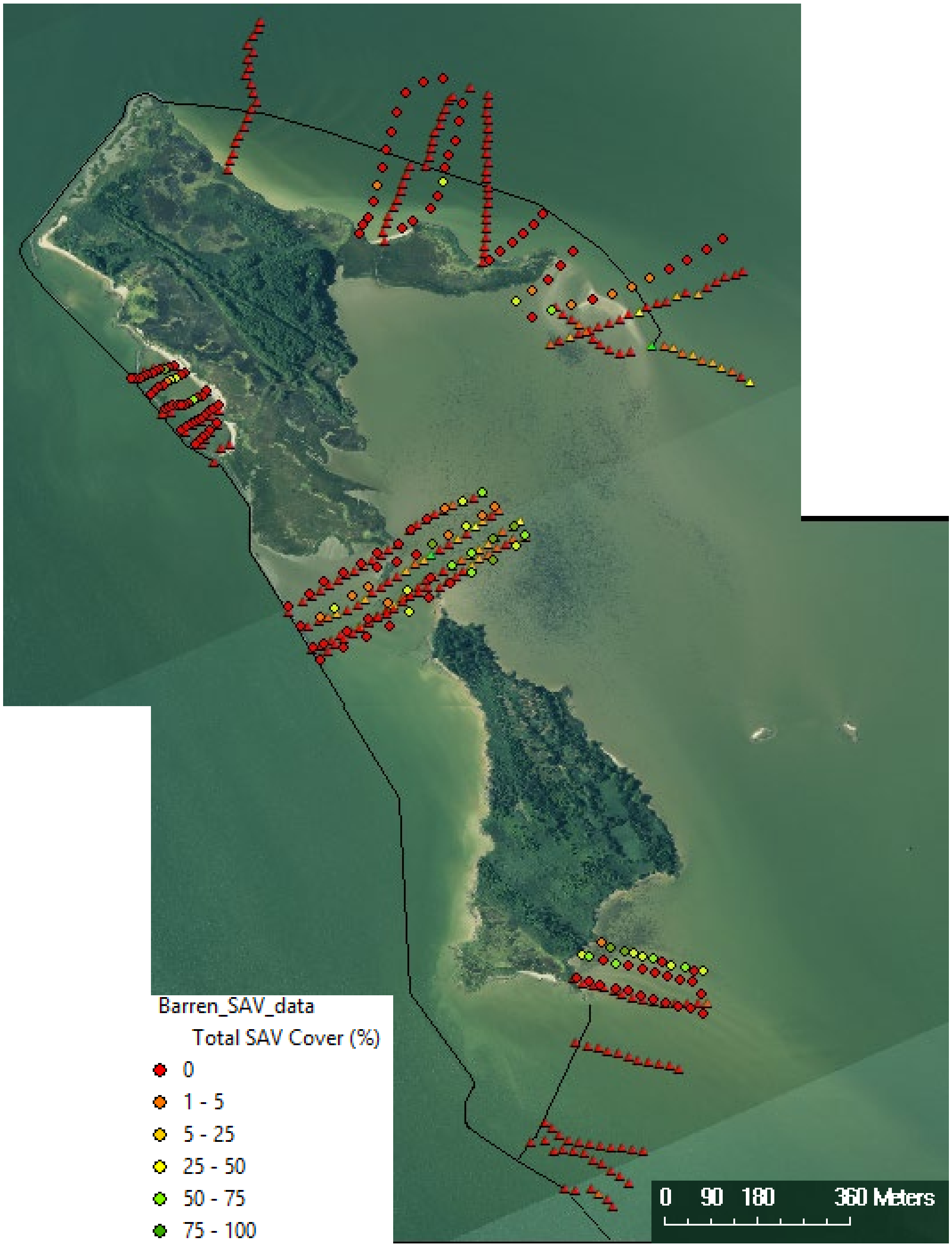

Figure 8. *Total SAV percent cover observed at each quadrat location along Barren Island shoreline. Circles denote June observations. Triangles denote September observations.*

Table 1*. Summary of water depth range (mean), total SAV % cover range (mean) and mean canopy height observed at Barren Island SAV survey locations during June and September, 2021.*

Location	Sampling Period	Water Depth (cm)	Total SAV % Cover	Mean Canopy Height (cm)
Central	Jun-21	9-85 (33.7)	0-80 (5.4)	8.7
	Sep-21	15-100 (42.8)	0-80(13)	21.3
North	Jun-21	0-160 (86.2)	0-70 (2.5)	9.5
	Sep-21	25-200 (122.4)	0-40 (2.3)	10.4
South	Jun-21	0-177 (110.7)	0-2 (0.05)	5.5
	Sep-21	45-110 (75.7)	0-75(13)	18.5
West	Jun-21	0-170 (81.8)	0-50 (2.2)	7
	Sep-21	25-191 (97.3)	0-60 (2.4)	15.4

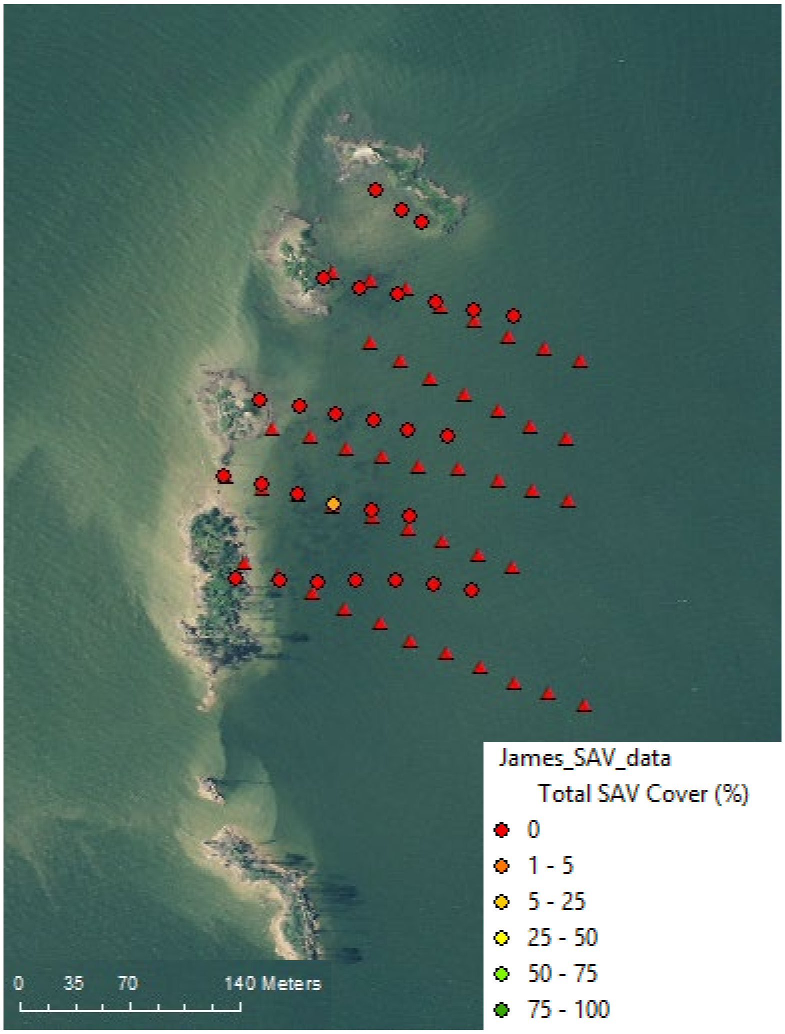

Figure 9. *Total SAV percent cover observed at each quadrat location along James Island shoreline. Circles denote June observations. Triangles denote August observations.*

Deliverables included with this report:

- Appendix with site photographs
- Electronic copies of datasheets
- Attributed GIS shapefiles of transect locations

Point Of Contact for Subtask 3.3

Becky Raves Golden (Rebecca.golden@maryland.gov) 410-260-8698

References

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Patrick, C.J., Weller, D.E., and M. Ryder. 2016. The relationship between shoreline armoring and adjacent submerged aquatic vegetation in Chesapeake Bay and nearby Atlantic coastal bays. Estuaries and Coasts. 39: 158–170.

A5: Draft Phase I Cultural Survey Report and Programmatic Agreement

DRAFT PROGRAMMATIC AGREEMENT
AMONG
THE U.S. ARMY CORPS OF ENGINEERS, BALTIMORE DISTRICT
AND THE MARYLAND STATE HISTORIC PRESERVATION OFFICE
REGARDING
THE MID-CHESAPEAKE BAY ISLANDS ECOSYSTEM RESTORATION PROJECT
AT JAMES ISLAND

WHEREAS, the purpose of the Mid-Chesapeake Bay Islands Ecosystem Restoration Project (Project) is to restore and protect valuable but threatened Chesapeake Bay remote island ecosystems through the beneficial use of dredged material; and,

WHEREAS, the Project is authorized under Section 7002 of the Water Resources Reform and Development Act of 2014; and,

WHEREAS, the U.S. Army Corps of Engineers, Baltimore District (USACE) has drafted a Supplemental Environmental Impact Statement (sEIS) and has identified a Recommended Plan that includes ecosystem restoration, access channel placement, and turning basins at James Island; and,

WHEREAS, the USACE is the lead Federal Agency for compliance with Section 106 of the National Historic Preservation Act of 1966 (NHPA) for the Project pursuant to 26 Code of Federal Regulations (CFR) Part 800.2(a)(2); and,

WHEREAS, the Project is a federally funded undertaking, as defined in 36 CFR § 800.16(y), and is therefore subject to the requirements of Section 106 of the NHPA (54 U.S. Code (U.S.C.) § 306108; Section 106); and,

WHEREAS, the USACE has determined that the proposed undertaking may have the potential to cause an adverse effect on properties eligible for the National Register of Historic Places (NRHP) pursuant to Section 106 and 36 CFR § 800; and,

WHEREAS, the USACE has consulted about the Project with the Maryland Historical Trust, which serves as the Maryland State Historic Preservation Office (SHPO), pursuant to 36 CFR § 800, the regulations implementing Section 106; and,

WHEREAS, in consultation with the MD SHPO, the USACE has established the Project's area of potential effects (APE) as the areas of proposed access channel and turning basin placement; and,

WHEREAS, the USACE has conducted Phase I and II archaeological investigations to identify historic properties within the APE; and, WHEREAS, the USACE identified a buried paleochannel within the APE that would have been sub-aerially exposed during human occupation of the area and may have the potential to contain archaeological resources; and,

WHEREAS, due to low preservation potential and a low likelihood of finding intact archaeological resources through traditional excavation methods, the USACE is proposing to implement archaeological monitoring during dredging activities; and,

WHEREAS, 36 CFR Part 800.14(b)(1)[ii] allows federal agencies to fulfill their obligations under Section 106 through the development and implementation of Programmatic Agreements (PA) when effects on historic properties cannot be determined prior to approval of an undertaking; and,

WHEREAS, the MD SHPO has concurred with the use of a PA and in being a Signatory to this PA; and,

WHEREAS, in accordance with 36 CFR § 800.6(a)(1)(i)(C) and in accordance with 36 CFR § 800.14(b), the USACE has invited the Advisory Council on Historic Preservation (ACHP) to participate in consultation via the ACHP e106 submission and they have elected to/not to participate; and,

WHEREAS, in accordance with 36 CFR § 800.14(b)(2)(i), the USACE has invited the Delaware Nation and the Delaware Tribe of Indians to sign this PA as Concurring Parties, and the Delaware Nation has elected to participate as a consulting party, but has requested not to sign this agreement; and,

WHEREAS, in accordance with 36 CFR § 800.14(b)(2)(ii), this PA and the sEIS has undergone public review through the National Environmental Policy Act review process; and,

WHEREAS, the USACE and the MD SHPO are collectively referred to as Signatories in the PA; and,

WHEREAS, the Delaware Nation is referred to as a Concurring Party in this PA; and,

WHEREAS, the Signatories and Concurring Parties agree that it is advisable to accomplish compliance with Section 106 of the NHPA through the development and execution of this PA in accordance with 36 CFR § 800.6 and § 800.14(b)(1)(ii); and,

NOW, THEREFORE, the Signatories agree that the Project shall be implemented in accordance with the following stipulations in order to consider the effects of the Project on historic properties:

DRAFT STIPULATIONS

The USACE shall ensure that the following measures are carried out:

I. Timeframes and Review Procedures

A. For all draft and final documents and deliverables produced in compliance with this PA, the USACE shall provide documents electronically for formal review and for communications among the Signatories and Concurring Parties. Upon request, a hardcopy via mail may be provided to any Signatory or Concurring Party, time and size permitting. Any written comments provided on draft documents by the Signatories and Concurring Parties within 30 calendar days from the date of receipt shall be considered in the revision of the document or deliverable. The USACE shall document and report the written comments received for the document or deliverable and how comments were addressed. The USACE shall provide a revised final document or deliverable to the Signatories and Concurring Parties. The Signatories and Concurring Parties shall have 30 calendar days to respond. Failure of the Signatories and Concurring Parties to respond within 30 calendar days of receipt of any document or deliverable shall not preclude the USACE from moving to the next step of this PA. A copy of the final document or deliverable shall be provided to the Signatories and Concurring Parties subject to the limitations in Stipulation IX (Confidentiality).

II. Archaeological Monitoring

A. The USACE shall provide an archaeological monitor to observe dredging activities taking place within the boundaries of the previously identified buried paleochannel and margin systems.

B. The archaeological monitor shall meet the Professional Qualifications Standards listed in Stipulation VII.B (Monitoring Standards).

C. Within 90 days of completing dredging activities associated with the buried paleochannel and margin systems, the USACE shall submit a brief monitoring report prepared by the professional archaeologist that performed the monitoring. The monitoring report shall include the following components: project name and number; name(s) and qualification(s) of archaeologist(s) that conducted the monitoring; description of activities monitored to include depth; description of cultural material identified or lack thereof; and photos of the monitoring activities.

III. Public Interpretation Component

A. The USACE shall consult with the MD SHPO and other consulting parties to develop an interpretation component to share with the public and other interested parties. The purpose of the public interpretation component would be to share information about the paleochannels and place them within the context of the Chesapeake Bay's archaeological history. Components could include, but are not limited to, an ArcGIS StoryMap, pamphlets, signage in appropriate locations, etc.

IV. Inadvertent Discoveries

A. If historic properties are inadvertently discovered or if unanticipated adverse effects to known historic properties are made during implementation of the Project the USACE will ensure that the following stipulations are met, and that the following provisions will be included in all construction, operations, and maintenance plans.

B. When a previously unidentified cultural resource, including but not limited to, archaeological sites, properties of traditional religious and cultural significance to Indian Tribes, or submerged vessels, are discovered during the execution of the Project, the individual(s) who made the discovery shall immediately notify the USACE and the Project's Contracting Officer (CO), secure the vicinity, make a reasonable effort to avoid or minimize harm to the resource and comply with the following:

1. All ground-disturbing activities shall cease within a minimum of 50 feet from the inadvertent discovery until the USACE's agency official issues a notice to proceed.

2. The USACE will notify the Signatories and Concurring Parties by email or telephone within 48 hours of the discovery or unanticipated effect.

3. The USACE will consult with the Signatories and Concurring Parties by email, virtual meeting, or telephone to determine whether additional investigations are needed to determine if the resource is a historic property or if the available information is sufficient to make such a determination.

   i. If the USACE determines through consultation that the resource does not warrant further investigation, they will provide written notification by email to the Signatories and Concurring Parties, outlining the USACE's justification and requesting concurrence. If no comments are received within 72 business hours of acknowledged receipt, construction may resume. Should any party object, the USACE will proceed in accordance with Stipulation X (Dispute Resolution), except that the calendar day periods in the timeframe for resolution in X.A shall be reduced from 30 calendar days to not to exceed 10 business days.

ii. If the USACE determines through consultation that the resource warrants further investigation, a scope of work (SOW) will be developed.

a. The SOW will be submitted to the Signatories and Concurring Parties for review and comment within a timeframe established in the SOW. If no comments are received within this period, work shall be implemented in accordance with the scope. If comments are received, the USACE shall take them into account and carry out the SOW. A report of the investigations will be completed within the timeframe established in the SOW and copies provided to the Signatories and Concurring Parties. Should any party object to the proposed results, the USACE will proceed in accordance with Stipulation X (Dispute Resolution), except that the calendar day periods in the timeframe for resolution X.A. shall be reduced from 30 calendar days to not to exceed 10 business days.

b. If the resource(s) are found to be not eligible for listing in the NRHP, construction may proceed as planned.

c. If the resources are determined to be eligible for listing in the NRHP, the USACE shall then initiate communication with the Project design team to determine if alternative design or construction methods can be implemented to avoid, protect, or minimize adverse effects to the resource. If the resources cannot be avoided by construction activities, then a mitigation/treatment plan or other measures will be adopted. Undertaking activities in the 50-foot buffer, or another appropriate distance determined by the USACE, will remain suspended until the USACE resolves the adverse effect.

iii. Inadvertent discovery and the treatment of human remains is governed by Stipulation V (Tribal Consultation and Treatment of Human Remains).

V. Tribal Consultation and Treatment of Human Remains

A. At any point during construction of a Project component that may affect historic properties, particularly traditional cultural places (TCPs) or human remains of Native American origin, any Indian Tribe(s) may request to consult on the undertaking whether or not the Tribe(s) is a Concurring Party to this PA. If requested, the USACE will consult with the Tribe(s) on a government-to-government basis in recognition of their sovereign status.

B. The USACE will make every effort to avoid the disturbance of historic and precontact human remains. If human remains are identified, consultation would occur with any Indian Tribe(s) that claim cultural affiliation with the identified human remains and any associated funerary objects, sacred objects, and objects of cultural patrimony.

C. If encountered, the contractor will contact the Contracting Office immediately. When human remains are encountered, all activity that might disturb the remains shall not resume until authorized by the District Medical Examiner or the State Archaeologist.

1. If, upon inspection by the appropriate legal authorities, the remains are determined to be a criminal matter and no archaeological, the USACE will ensure that appropriate legal and contractual requirements are followed.

2. If the remains are determined to be archaeological, the State Archaeologist has jurisdiction to determine the appropriate treatment and options for the remains following additional coordination with the MD SHPO, Tribes, and other Concurring Parties.

   a. The USACE will coordinate with the MD SHPO, Tribes, and other Concurring Parties or descendent communities to develop a treatment plan consistent with Stipulation V (Inadvertent Discoveries).

VI. Curation

A. The USACE shall ensure that all original archaeological records (research notes, field records, maps, drawings, and photographic records) and all archaeological collections recovered from the Project produced as a result of implementing the Stipulations of this PA are provided for permanent curation. The USACE shall ensure that the treatment of records and collections, and the curation facility, complies with standards set forth in 36 C.F.R. 79, Curation of Federally Owned and Administered Archaeological Collections.

B. Any collections resulting from the Stipulations as part of this PA are the property of the landowner at the time the collection was retrieved. The USACE does not retain ownership of any collection removed from land(s) it does not own.

C. The final disposition of collected material will be decided in consultation with the MD SHPO, Tribes, and other Concurring Parties, and those parties will be notified in writing when records and collections have been placed in the permanent curation facility.

VII. Qualifications

A. Professional Qualifications

All key personnel for technical work shall meet or exceed the SOI's Historic Preservation Professional Qualifications Standards, as specified in 36 C.F.R. Part 61 for archaeology (48 F.R. 44739). The term "technical work" is defined as all efforts to inventory, evaluate, monitor, and perform subsequent treatment of potential historic properties that is required under this PA. This stipulation shall not be construed to limit peer review, guidance, or editing of documents by the Signatories or other Concurring Parties.

B. Monitoring Standards

1. Archaeological monitoring activities required for exploratory, construction, or construction-related, ground-disturbing activities implemented pursuant to this PA shall be carried by an individual meeting, at a minimum, the SOI's Historic Preservation Professional Qualifications Standards for archaeology (48 C.F.R. 44739). The term "archaeological monitoring" is defined as monitoring ground-disturbing activities that have been determined by the USACE to be occurring in areas potentially sensitive for historic properties or buried resources.

2. Archaeological monitoring will comply with all applicable guidelines and requirements specified in the MD SHPO Standards and Guidelines.

VIII. Public Comment and Public Notice

The interested public shall be invited to provide input at appropriate times during the implementation of this PA. The USACE may carry this out through letters of notification, public meetings, site visits, and by utilizing the USACE's Baltimore District Public website and will provide a link to that location through social media and/or a press release. The USACE shall ensure that any comments received from members of the public are considered and incorporated where appropriate. Review periods for such comments shall be consistent with Stipulation I (Timeframes and Review Procedures). In seeking input from the interested public, locations of historic properties will be handled in accordance with Stipulation X (Confidentiality).

IX. Confidentiality

Signatories to this PA acknowledge that information about historic properties is subject to the provisions of Section 304 of the NHPA (54 U.S.C. § 307103) and 36 C.F.R. § 800.11(c), relating to the disclosure of information about the location, character, or ownership of an historic property, and will ensure that any disclosure under this PA is consistent with the terms of this PA and with Section 304 of the NHPA, 36 C.F.R. § 800.11(c), the Freedom of Information Act (5 U.S.C. § 552), as amended, and S.C. Code Ann. § 30-4-10, et al., as applicable. Confidentiality regarding the specific nature and location of the archaeological sites and any other cultural resources discussed in this PA shall be maintained to the extent allowable by law. Dissemination of such information shall be limited to appropriate personnel within the USACE (including their contractors), Concurring Parties, and those parties involved in planning, reviewing, and implementing this PA. When information is provided to the USACE by the MD SHPO or others who wish greater control over the discretionary dissemination of that information, the USACE will make a good faith effort to do so, provided the information to be controlled and the rationale for withholding is clearly identified, to the extent consistent with applicable law.

X. Dispute Resolution

A. At any time during the term of the PA, should any Signatory or Concurring Party object to any actions proposed or the manner in which the terms of this PA are implemented, the USACE will immediately notify the Signatories and Concurring Parties of the objection and proceed to consult with the objecting party(s) for a period of time, not to exceed 30 calendar days, to resolve the objection. If the objection is resolved through consultation, the USACE may authorize the disputed action to proceed in accordance with the terms of such resolution. If the USACE determines that such objection cannot be resolved, the USACE will:

1. Forward all documentation relevant to the dispute, included the USACE's proposed resolution, to the ACHP. The ACHP shall provide the USACE with its recommendation on the resolution of the objection within 30 calendar days of receiving adequate documentation (see 36 C.F.R. § 800.11). Prior to reaching a final Agency decision, the USACE shall prepare a written response that takes into account any timely advice or comments regarding the dispute from the ACHP, and other relevant Concurring Parties, and provide the objecting party with a copy of this written response. The USACE will then proceed according to its final Agency decision.

2. If the ACHP does not provide its recommendation regarding the dispute within the 30-day time period, the Baltimore District Commander may make a final Agency decision and proceed accordingly. Prior to reaching such a final Agency decision, the USACE shall prepare a written response that takes into account any timely comments regarding the dispute from the Signatories or Concurring Parties to the PA and provide them and the ACHP with a copy of such written response.

3. The USACE's responsibility to carry out all other actions subject to the terms of this PA that not the subject of the dispute remains unchanged.

B. At any time while this PA is in effect, should a substantial objection pertaining to the implementation of this PA be raised by a member of the public, the USACE shall notify the Signatories and other Concurring Parties and take the objection under consideration. The USACE will consult with the MD SHPO and other Concurring Parties to this PA, regarding the objection for no longer than 15 calendar days. The USACE shall consider the objection and all comments provided by the Signatories and other Concurring Parties in reaching its decision. Within 15 calendar days following closure of the Signatories and other Concurring Parties' comment period, the USACE will render a written decision regarding the objection and respond to the objecting party. The USACE will promptly provide written notification of its decision to the Signatories and other Concurring Parties, including a copy of the response to the objecting party. The USACE's decision regarding resolution of the objection will be final. Following issuance of its final decision, the USACE may authorize the action that was the subject of the dispute to proceed in accordance with the terms of that decision. The USACE's responsibility to carry out all other actions under this PA shall remain unchanged.

XI. Notices

A. Unless otherwise agreed by the Signatories and other Concurring Parties, notices, demands, requests, consents, approvals, or any other types of communications regarding this PA, shall be sent digitally, requiring confirmation of receipt. If a party to this PA requests communication sent by United States Mail, that party shall be considered in receipt of the communication five (5) calendar days after the initial communication is deposited in the United States Mail, certified and postage prepaid, return receipt requested.

B. The ACHP has requested electronic documents and/or electronic communications be used for formal communication among themselves for activities in support of Stipulation I (Timeframes and Review Procedures) as well as all notices, demands, requests, consents, or approvals. Any Concurring Party may consent to electronic documents and/or electronic communications used in lieu of physical copies.

XII. Amendments, Termination, and Duration

A. Amendment

Any Signatory to this PA may propose that the PA be amended, whereupon the USACE shall consult with the Signatories to consider such amendment. This PA may only be amended when all Signatories agree in writing to such an amendment. The amendment will be effective as of the date the amendment is signed by all the Signatories and filed with the ACHP.

C. Amended Appendices

All appendices to this PA, and other instruments prepared pursuant to this PA, may be revised or updated by the USACE through consultation consistent with Stipulation I (Timeframes and Review Procedures) and written agreement of the Signatories without requiring an amendment to this PA. In accordance with Stipulation VIII (Public Comment and Public Notice), the Signatories and other Concurring Parties will receive copies and interested members of the public will receive notice of any amendment(s) to this PA.

D. Termination

If any Signatory to this PA determines that its terms will not or cannot be carried out, that party shall immediately consult with the other Signatories to attempt to develop an amendment per Stipulation XII.A above, If within thirty (30) days (or another time agreed to by all Signatories) an amendment cannot be reached, any Signatory may terminate the PA upon written notification to the other Signatories.

Once the PA is terminated, and prior to work continuing on the undertaking, the USACE must either (a) execute a new PA pursuant to 36 C.F.R. § 800.6 or (b) request, take into account, and respond to the comments of the ACHP under 36 C.F.R. § 800.7. The USACE shall notify the Signatories as to the course of action it will pursue.

E. Duration

This PA shall remain in effect for a period of 10 years after the date it takes effect and shall expire at the end of this 10-year period, unless it is terminated prior to that time. No later than 90 calendar days prior to the expiration date of the PA, the USACE shall initiate consultation with all Signatories to determine if the PA should be allowed to expire or whether it should be extended. Unless the Signatories unanimously agree in accordance with Stipulation XII (Amendments, Termination, and Duration), this PA shall automatically expire and have no further force or effect.

XIII. Monitoring and Reporting

Each year following the execution of this PA until it expires or is terminated, the USACE shall provide all parties to this PA, on or about the annual anniversary date of execution, a summary memorandum detailing work undertaken pursuant to its terms. Such report shall include any scheduling changes proposed, any problems encountered, and any disputes and objections received in the USACE's efforts to carry out the terms of this PA.

XIV. The Anti-Deficiency Act

The USACE's and other Federal agencies' obligations under this PA are subject to the availability of appropriated funds, and the stipulations of the PA are subject to the provisions of the Anti-Deficiency Act, 31 U.S.C. § 1341, et seq. The USACE and other Federal agencies shall make reasonable and good faith efforts to secure the necessary funds to implement their obligations under this PA. If compliance with the Anti-Deficiency Act alters or impairs the USACE's ability to implement its obligations under this PA, the USACE shall consult in accordance with the amendment and termination procedures found in Stipulation XII (Amendments, Termination, and Duration).

XV. Communications

Electronic main (email) may serve as the official correspondence method for all communications regarding this PA and its provisions. See Appendix C for a list of contacts and email addresses. Contact information in Appendix C may be updated as needed without an amendment to this PA. It is the responsibility of each party to the PA to immediately inform the USACE of any change in name, address, email address, or phone number of any point-of-contact. The USACE shall forward this information to all parties to this PA by email.

XVI. Electronic Copies

Within one (1) week of the last signature on this PA, the USACE shall provide the Signatories and other Concurring Parties with one (1) high-quality, legible, color, electronic copy of this fully executed PA and all of its appendices fully integrated into one, single document. Internet links shall not be used as a means to provide copies of the appendices since web-based information often changes. If the electronic copy is too large to send by email, the USACE shall provide the Signatories and other Concurring Parties with a copy of this PA on a compact disc or other appropriate means.

XVII. Effective Date

This PA shall take effect on the date that is has been fully executed by the Signatories.

XVIII. Execution

By execution of this PA in the pages provided below, the Signatories agree to the terms of this PA, and the execution and implementation of the terms of this PA by the Signatories evidence that the USACE has taken into account the effects of this Project on historic properties and afforded the ACHP an opportunity to comment.

Appendix A – Area of Potential Effects
Appendix B – Location of Buried Paleochannel and Margin Systems (not for public release)
Appendix C – Contact Information

Signatures Follow on Separate Page

DRAFT PROGRAMMATIC AGREEMENT AMONG THE U.S. ARMY CORPS OF ENGINEERS, BALTIMORE DISTRICT AND THE MARYLAND STATE HISTORIC PRESERVATION OFFICE REGARDING THE MID-BAY ISLAND ECOSYSTEM RESTORATION PROJECT AT JAMES ISLAND

SIGNATORY:

U.S. Army Corps of Engineers

___________________________________ _____________________

Colonel Esther S. Pinchasin, Date
Commander and District Engineer

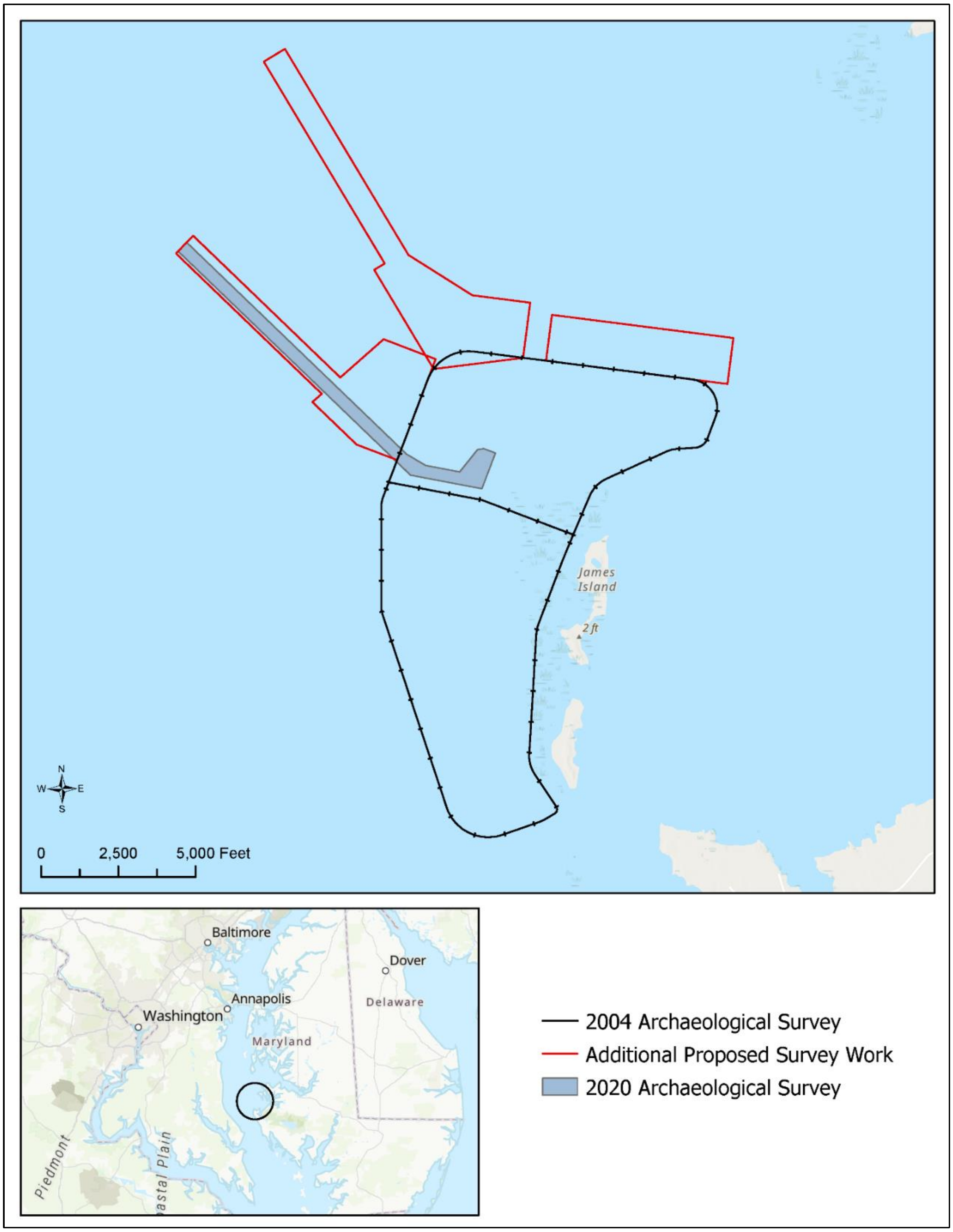
DRAFT PROGRAMMATIC AGREEMENT AMONG THE U.S. ARMY CORPS OF ENGINEERS, BALTIMORE DISTRICT AND THE MARYLAND STATE HISTORIC PRESERVATION OFFICE REGARDING THE MID-BAY ISLAND ECOSYSTEM RESTORATION PROJECT AT JAMES ISLAND

SIGNATORY:

Maryland State Historic Preservation Officer

_________________________________ ____________________
Elizabeth Hughes, SHPO Date

DRAFT APPENDIX A
Area of Potential Effects (James Island)



DRAFT APPENDIX B

Location of Buried Paleochannel and Margin Systems (not for public release)

DRAFT APPENDIX C
Contact Information

U.S. Army Corps of Engineers, Baltimore District

Ethan A. Bean
Cultural Resources Specialist
U.S. Army Corps of Engineers
Baltimore District (NAB)
2 Hopkins Plaza
Baltimore, MD 21201
Office: (410) 962-2173
Ethan.a.bean@usace.army.mil

Maryland Historical Trust

100 Community Place, 3rd Floor
Crownsville, MD 21032
Office: (410) 697-9591

A6: Draft James Island Sea Level Change and Datum Assessment

Mid-Chesapeake Bay Project
Relative Sea Level Change and Vertical Datum Assessment for James Island

Daoxian Shen, Ph.D., P.E., D.CE.

October 2023

1. Introduction

The James Island Habitat Restoration project seeks to restore habitat through beneficial use of dredged material. NAB has currently been performing the plans and designs of the new wetland creation and restoration for ecosystem at James Island of Mid-Bay. Climate is important for all USACE Civil Works projects because of the role it plays in modulating streamflows that underpin the flood risk management, aquatic ecosystem restoration, navigation, water supply, and emergency management services that USACE provides to the Nation. Relative Sea level change (RSLC) and associated vertical datum of the water levels is an important factor for the planning and design of James Island.

In addition, there is no long-term measurement water level data available at the James Island since it is a wild island. Therefore, we need to assess the RSLC and vertical datum based on collected data. The purpose of this technical note is to provide a summary of the scopes and approaches on the assessment of SLR and vertical datum for the project design and modeling studies.

The key guidelines for the assessment are:

(1) USACE. "Incorporating Sea Level Change in Civil Works Programs", ER 1100-2-8162, 15 June 2019. U.S. Army Corps of Engineers, Washington, D.C.
(2) USACE. "Standards and Procedures for Referencing Project Elevation Grades to Nationwide Vertical Datums", Engineer Manual, ER 1110-2-6056, 31 December 2010. U.S. Army Corps of Engineers, Washington, D.C.
(3) USACE. "Procedures to Evaluate Sea Level Change: Impacts, Responses, and Adaptation", ETL 1100-2-1, 30 June 2019. U.S. Army Corps of Engineers, Washington, D.C.
(4) USACE, 2022. ECB 2018-14, Guidance for Incorporating Climate Change Impacts to Inland Hydrology in Civil Works Studies, Designs, And Projects. August 2022, United States Army Corps of Engineers, Washington, DC, USA

1.1 Tide Data

There are three tide gauges near James Island (see Figure 1). The first one is located at Solomons Island, NOAA/NOS 8577330, the second at Barren Island, NOAA/NOS 851579, and the third at James Island with local gauge #1386.

The data duration of the tide gauge at James is very limited, thus the long-term data at Solomans are very useful for the analysis. The data from Barren Island was not considered since its data length is very short compared with that at Solomans.

Table 1 provides a comparison summary of the tidal levels and, data durations as reference.

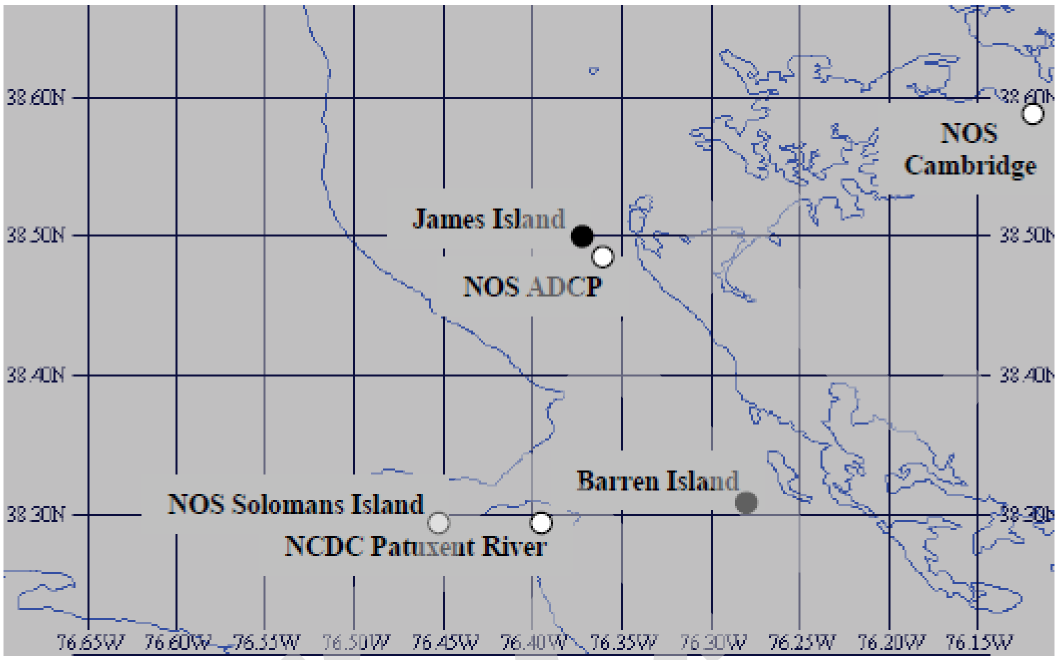


Figure 1. Locations of three tide gauges for James Island Project.

Table 1 – Selected tide gauge locations and data comparisons

Contents	Solomon Island	Barren Island	James Island
Gauge No	NOS 8577330	NOS 8571579	Local #1385
Measure period	~1937 to 2022	1/1/2002-3/31/2003	12/18/2004-2/9/2005
Date for MSL	1992	1992	1992
Data source	NOAA	NOAA	EDRC
MHHW (ft)	1.48	1.55	1.68
MLW (ft)	1.33	1.38	1.46
MSL (ft)	0.76	0.79	0.82*
MTL (ft)	0.75	0.77	0.80
MLW (ft)	0.16	0.16	0.16

Contents	Solomon Island	Barren Island	James Island
MLLW (ft)	0.00	0.00	0.00
NAVD88 (ft)	0.85	1.22	0.80

Note: * estimated by author

2. Methodologies and Procedures

2.1 Methodology

Planning studies and engineering designs over the project life cycle, for both existing and proposed projects, will consider alternatives that are formulated and evaluated for the entire range of possible future rates of Sea Level Change (SLC), represented here by three scenarios of "low," "intermediate," and "high" SLC.

In USACE RSLC curve calculation, the base year for calculations, is usually in 1992, which is the midpoint of the last National Tidal Datum Epoch, 1983-2001, with the following governing equation:

$$E(t) = a\, t + b\, t^2 \qquad (1)$$

where: a corresponds to the observed global mean sea level (GMSL) change per year presented at IPCC (2007a), t is time in years, and b is a coefficient corresponding to the scenario being considered (low, intermediate, or high).

Relative Sea Level Change (RSLC) is the local change in sea level relative to the elevation of the land at a specific point on the coast. Relative SLC is a combination of both global and local SLC caused by changes in estuarine and shelf hydrodynamics, regional oceanographic circulation patterns (often caused by changes in regional atmospheric patterns), hydrologic cycles (river flow), and local and/or regional vertical land motion (subsidence or uplift). Thus, RSLC is variable along the coast.

Alternatives should be evaluated using "low," "intermediate," and "high" rates of future SLC for both "with" and "without" project conditions. The historic rate of SLC represents the "low" rate, in general.

Historic trends in local MSL are best determined from tide gauge records.

The "intermediate" rate of local mean sea level change is estimated using the modified National Research Council (NRC) Curve I and equations (1) above and (2) below.

The "high" rate of local mean SLC is estimated using the modified NRC Curve III and equations (1) and (2).

RSLC calculations were performed with the USACE Sea-Level Change Curve Calculator (Ver. 2017.55), based on ER 1100-2-8162 (2013), with the governing equation:

$$E(t2) - E(t1) = a\,(t2 - t1) + b\,(t2^2 - t1^2) \qquad (2)$$

RSLC calculations were performed with the USACE Sea-Level Change Curve Calculator (Ver. 2017.55), based on ER 1100-2-8162 (2013), with the governing equation:

where $t1$ is the time between the project's construction date and 1992 and $t2$ is the time between a future date at which one wants an estimate for sea level change and 1992 (or $t2 = t1$ + number of years after construction). The b corresponds to the scenario under consideration.

For typical three Scenarios, the factor b is assigned as follows:

- **Low**: Linear prediction based on historically recorded data sets (b = 0.00)
- **Intermediate**: Modified NRC Curve I (b = 2.71E-5)
- **High**: Modified NRC Curve III (b = 1.13E-4)

2.2 Procedures

The USACE RSLC curves are adopted for the RSLC estimate which is based on the rate of RSLC regional till 2006 while linear trend analysis and vertical datum assessment are based on the newest NOAA database till 2021.

RSCL and vertical datum assessment need a long-term measured water elevation data. The assessment concept is to separate the RLSC estimate to two stages; the first one is to handle the period between reliable tidal epoch period and recent surveyed site data years, where we can adopt historical data; then adopt prediction using USACE RSLC curves till the end of future service life covering period, with the future project.

To accomplish the comparison with different scenarios for different design service life, the following steps were taken:

1) Evaluate the site topography and bathymetry data including survey dates, coverage, and quality. Then estimate RSLC from the site topography and bathometric site data to the start of service life of the project by entering those into the Sea-Level Change Curve Calculator (Ver. 2022.72).
2) Estimate RSLC from the start of service life of the project to the design service life (50-year or 100-year) by entering those into the Sea-Level Change Curve Calculator (Ver. 2022.72).
3) Evaluate the mean sea level (MSL) from the available tidal data, usually NOAA's the fourth NTDE 1983-2001, and transfer the MSL with the RSLC values to NAVD88 for all assessed scenarios.
4) The results produced by these efforts will be compiled for comparison and alternative sensitivity study.

3. RSLC Estimation and MSL Assessment

3.1 RSLC Trends at Solomons Island

Sea level change trend analysis was performed by NOAA and presented on the NOAA website for different locations and gauges (https://tidesandcurrents.noaa.gov/sltrends).

The Solomons Island gauge (#8577330) was used for the RSLC analysis trend and estimates for James Island. It is located approximately 12 miles to the northeast and was adopted for the analysis in this Memo. The numbers from James are considered as reference or cross-check.

Figure 2 provides the SLR trend curves at Solomons Island based on the data from 1937 to 2022. The blue bold trend line is 19-year average data, and the solid green trend line is the 5-year average data. The rate of the SLC is 0.0119 ft per year (regional 2006, https://cwbi-app.sec.usace.army.mil/rccslc/slcc_calc.html). Figure 3 shows the linear trend analysis results conducted by NOAA. The SRLC trend in Figure 3 is 3.97 mm/year (0.01302 ft/yr) with a 95% confidence interval based on monthly sea level data from 1937 to 2022.

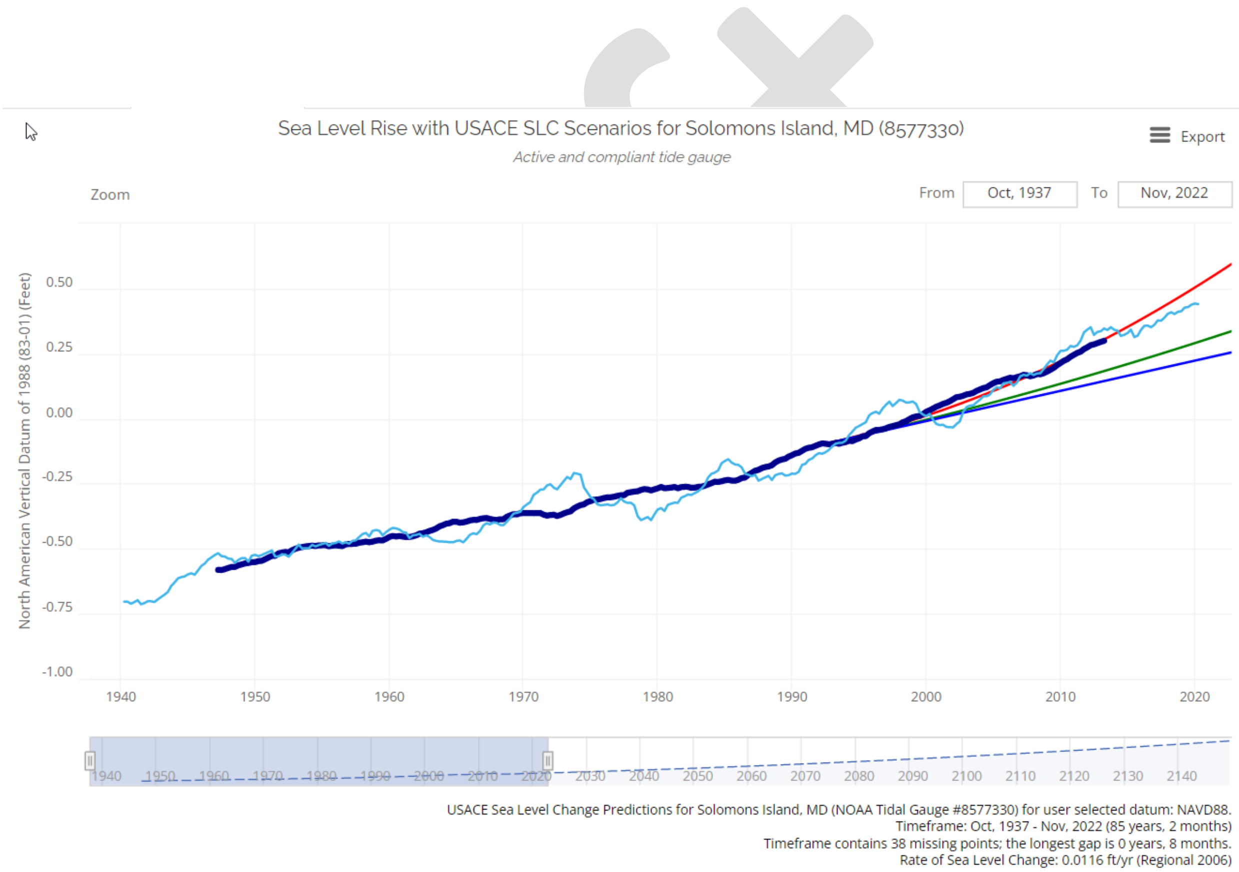


Figure 2. RSLC curved trend analysis by NOAA at Solomons Island.

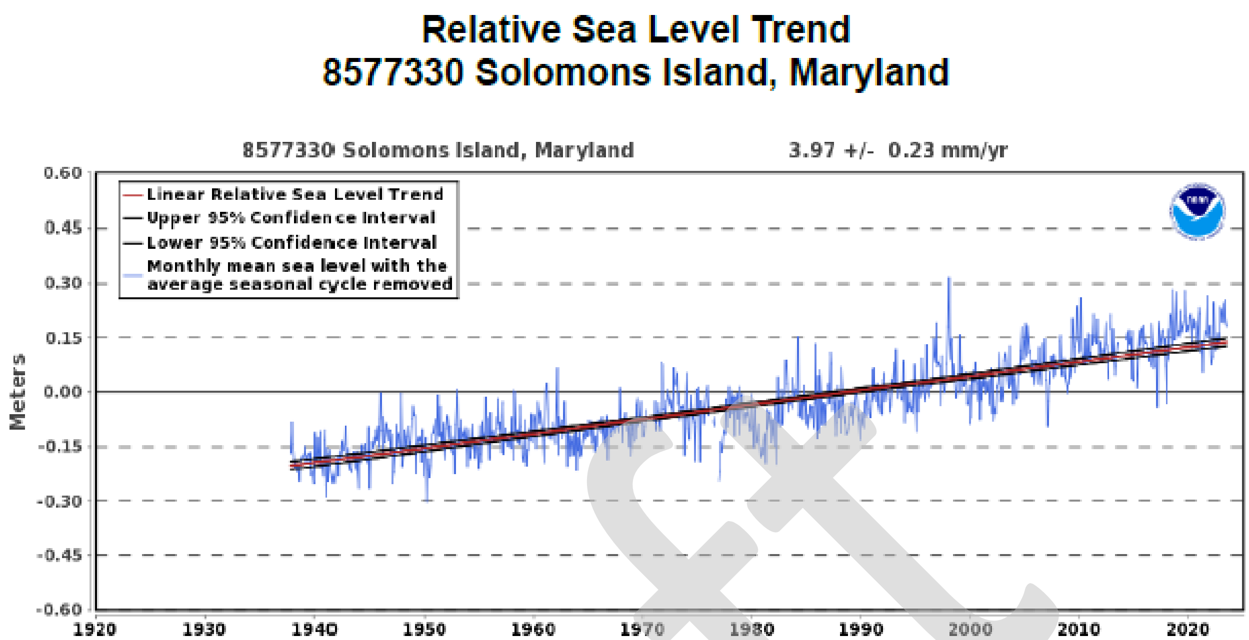


Figure 3. RSLC linear trend analysis by NOAA at Solomons Island (till 2022)

3.2 RSLC Values for 43-year Construction and 50-year Service Life

James Island construction will start in 2025, and the construction duration is 43 years per construction plan, thus the full-service starting year is 2068. If the service life is 50-yr, thus the service end is at the end of 2117 or the beginning of 2118.

Figure 4 provides an example of the estimated RSLC curve till the end of 50-year service life from 2022 to 2118 based on the SLC Curve Calculator (Ver 2022.72), and the SLRC values are listed in Table 2. The RSLC values are based on the NOAA's 2006 published rate of 0.01119 ft/year, which is a 95% confidence based on monthly MSL data from 1937 to 2006.

From last subsection, we know NOAA has the measured data till 2022 and calculated or estimated 95% confidence limit SLC rate 3.97 mm/yr. Thus, it is necessary to estimate RSLC from the 2022 to the end of construction 2068, as well as the end of 100-yr service life 2168.

Table 3 provide a comparison summary of three scenarios of RSLC at Solomons Island based on the calculator's recommended values.

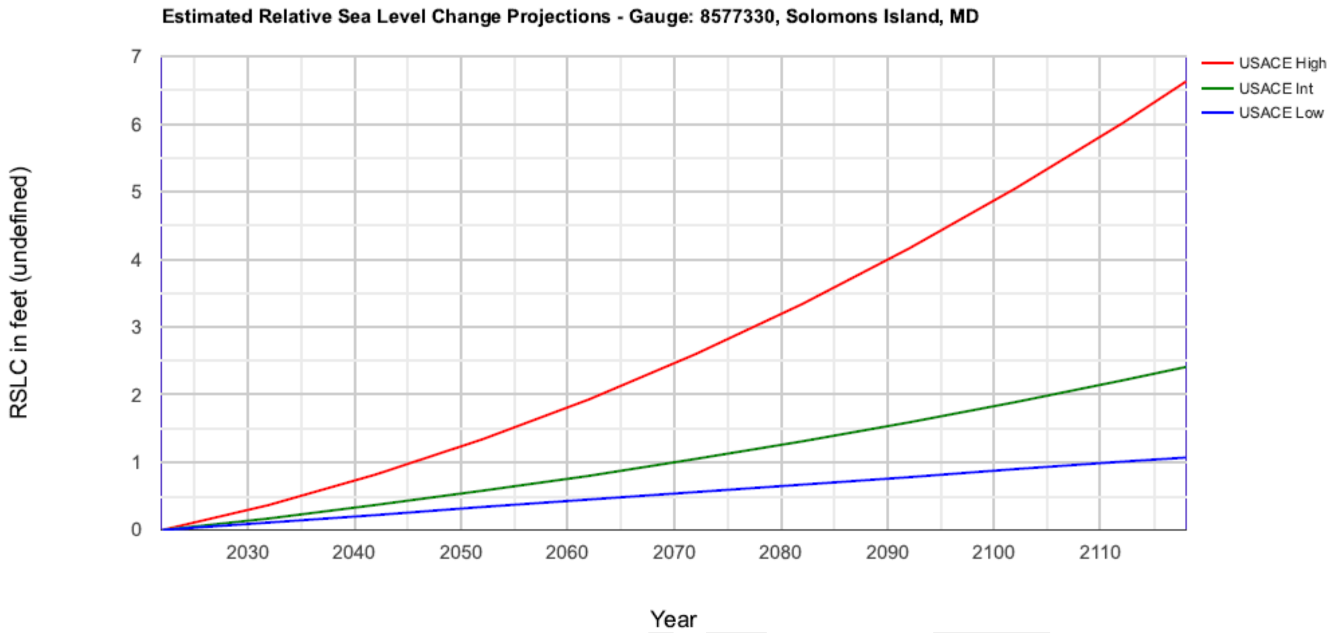


Figure 4. Estimated 50-year service life RSLC from 2022 to 2118 at Solomons Island by SLC Curve Calculator (Ver 2022.72) for James Island Project.

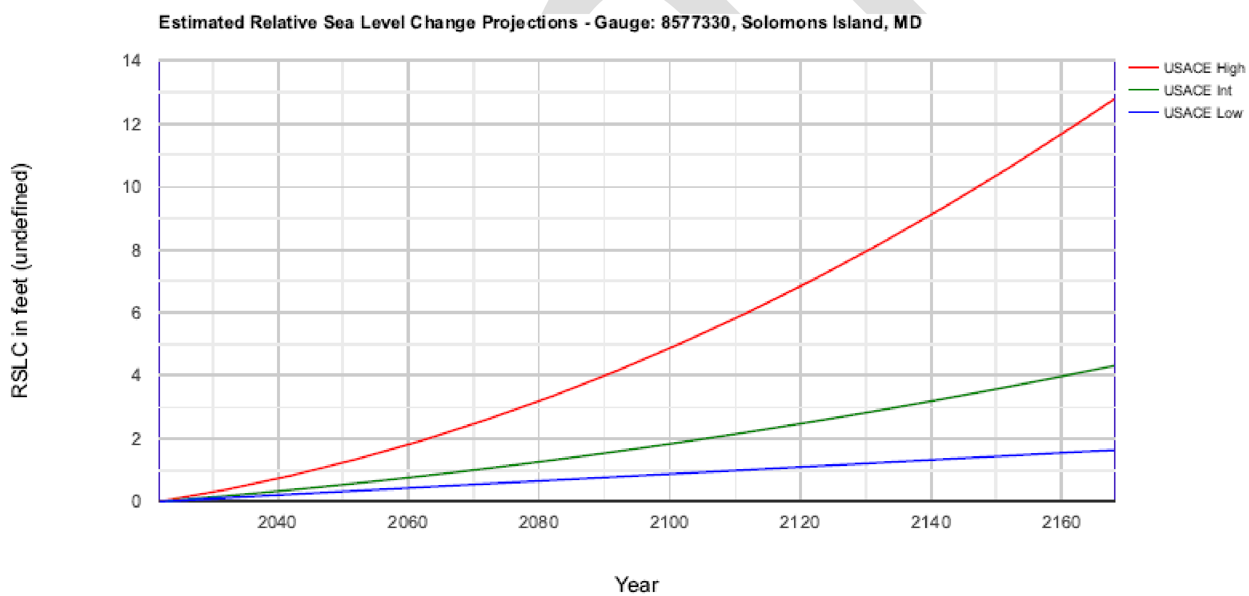


Figure 5. Estimated 100-year service life RSLC from 2022 to 2168 at Solomons Island by SLC Curve Calculator (Ver 2022.72) for James Island Project.

Table 2. Estimated 50-year RSLC from 2024 to 2074 at Solomons Island

Estimated Relative Sea Level Change
from 2022 To 2118
8577330, Solomons Island, MD
NOAA's 2006 Published Rate: 0.01119 feet/yr
All values are expressed in feet
Gauge Status: Compliant

Year	USACE Low	USACE Int	USACE High
2022	0.00	0.00	0.00
2032	0.11	0.17	0.37
2042	0.22	0.37	0.82
2052	0.34	0.58	1.34
2062	0.45	0.80	1.93
2072	0.56	1.05	2.60
2082	0.67	1.31	3.34
2092	0.78	1.59	4.16
2102	0.90	1.89	5.05
2112	1.01	2.21	6.01
2118	1.07	2.41	6.63

Table 3 Summary of three scenarios of RSLC at Solomon Island for James Island Project (Unit: ft)

	RSLC: Low	RSLC: Interim	RSLC: High
Scenario 0: Start construction (2022-2025)	0.03	0.05	0.10
Scenario 1: Start service (2022-2068)	0.51	0.95	2.32
Scenario 2: 50-yr service life (2022-2118)	1.07	2.41	6.63
Scenario 3: 100-yr service life (2022-2168)	1.63	4.31	12.78

3.3 Mean Sea Level (MSL) Assessment with RSLC

The USACE recommended RSLC curve calculator provides a rate of 0.1119 ft/yr (3.41mm/yr) while the NOAA RSLC linear trend analysis gives 0.01302 ft/yr (3.97 mm/yr). For this assessment and given the uncertainties of SLR, the 95% confidence limit value of 3.97 mm/yr is adopted for the assessment.

For the MSL assessment at James Island, based on Table 1, the local gauge data (#1385) at James Island is considered as reference and long-term measured data at Solomans is adopted. The MSL in July 1992 is estimated at -0.09 ft NAVD88 (0.76ft-0.85ft), thus the MSL in 2022 (bathy and topo surveyed year) can be:

MSL in 2022 = MSL in July 1992 +3.97mmx0.00328084 ft/mm x (2022-1992) = -0.09 + 0.3907 =-0.3007 ft NAVD88

Per the guideline ER 1100-2-8162, the historical rate of “low” RSLC is considered for Scenario 1 at the start service year. The “low” value is based on a 95% confidence limit, and the trends also show the prediction is approaching the “high” RSLC curve but lower than the “high”.

The scenarios considered in Table 3 were transferred as MSL referred to NAVD88.

Scenario 0: Start construction 2025 MSL= MSL in 2022 + RSLC to 2025 in three SLC values.

Scenario 1: Start service 2068 MSL= MSL in 2022 + RSLC to 2068 in three SLC values.

Scenario 2: End of 50-yr service 2118 MSL= MSL in 2022 + RSLC to 2118 in three SLC values.

Scenario 3: End of 100-yr service 2168 MSL= MSL in 2022 + RSLC to 2168 in three SLC values.

Table 4 provides a summary of the MSL values refer to NAVD88 for different scenarios for sensitivity study.

Table 4 Summary of MSL values for four scenarios of RSLC at Solomon Island for James Island Project (Unit: ft NAVD88)

	RSLC: Low	RSLC: Interim	RSLC: High
Scenario 0: Start construction (2022-2025)	**0.33**	**0.35**	**0.40**
Scenario 1: Start service (2022-2068)	**0.31**	**1.25**	**2.62**
Scenario 2: 50-yr service life (2022-2118)	**1.37**	**2.71**	**6.93**
Scenario 3: 100-yr service life (2022-2168)	**1.93**	**4.61**	**13.08**

4. Stillwater Levels with RSLC Sensitivity - Study Application

Per ERDC (2023 – report to be provided by EDRC), the design waves and the design water levels were separately assessed and estimated. Stillwater conditions are mainly from the CSTORM and life-cycle modeling conducted by ERDC (2023). It is assumed that MSL from the extracted points by ERDC (2023) is based on the year 2022.

Figure 6 shows the extraction point layout for reference. Figure 7 provides the results of the water levels in reference to the MSL in the different return periods around the James Island.

It can be seen that there is no notice change of the Stillwater levels around the Island, thus one saved point at 2500 with large waves is selected for presenting results purpose. The 90% confidence limit Stillwater levels with different RSLC are listed in Table 5, and the mean Stillwater levels with different RSLC are listed in Table 6.

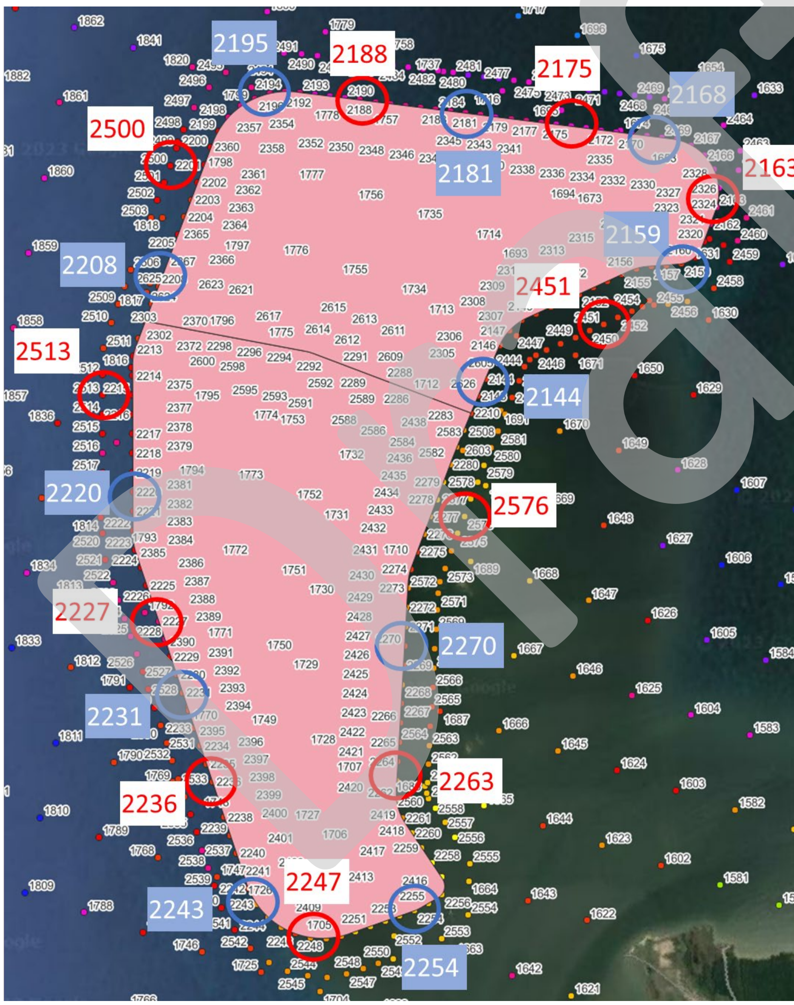


Figure 6. Saved Extraction Point around the James Island from EDRC report (2023)

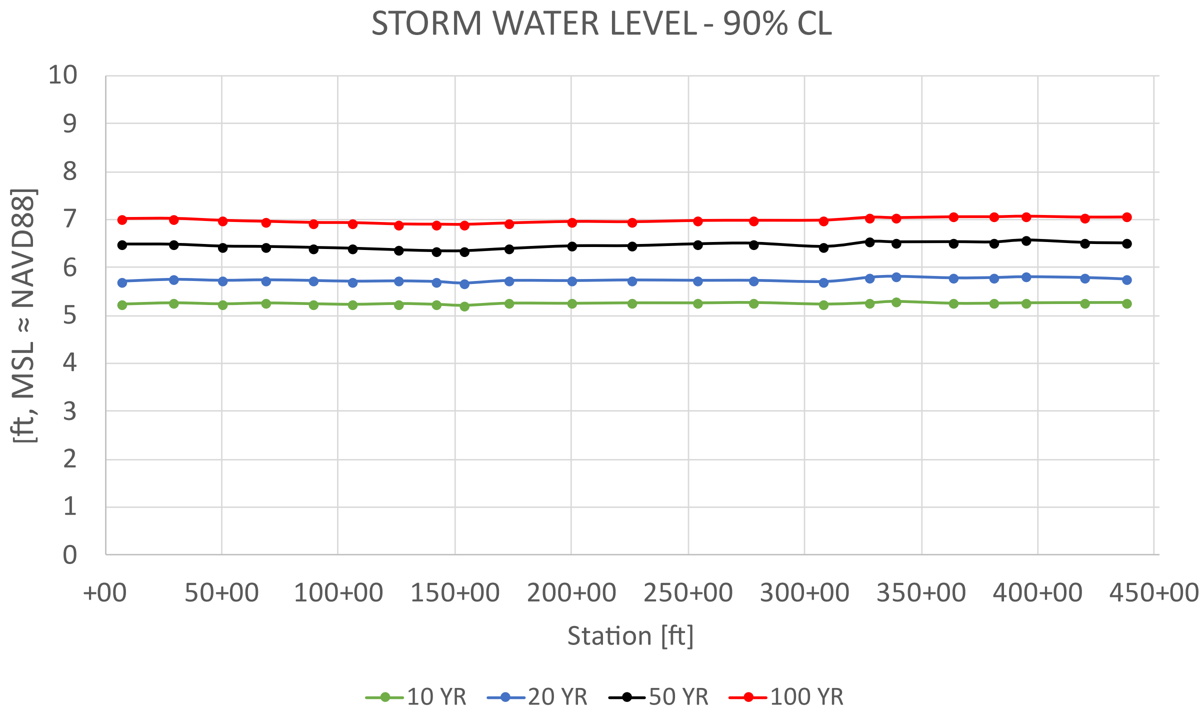


Figure 7. Storm water levels in 2022 in different return periods with different saved extraction point around the James Island from EDRC Report (2023)

Table 5 90% Confidence limit Stillwater levels (ft NAVD88) in different return periods with different RSLC at Point 2500 (James Island)

year	RSLC	2	5	10	20	50	100	200
2022	ft	3.79	4.70	5.27	5.76	6.48	7.03	7.56
2068 Low	0.510	4.30	5.21	5.78	6.27	6.99	7.54	8.07
2068 Int	0.950	4.74	5.65	6.22	6.71	7.43	7.98	8.51
2068 High	2.320	6.11	7.02	7.59	8.08	8.80	9.35	9.88
2118 Low	1.070	4.86	5.77	6.34	6.83	7.55	8.10	8.63
2118 Int	2.410	6.20	7.11	7.68	8.17	8.89	9.44	9.97
2118 High	6.630	10.42	11.33	11.90	12.39	13.11	13.66	14.19
2168 Low	1.630	5.42	6.33	6.90	7.39	8.11	8.66	9.19
2168 Int	4.310	8.10	9.01	9.58	10.07	10.79	11.34	11.87
2168 High	12.780	16.57	17.48	18.05	18.54	19.26	19.81	20.34

Table 6 Mean Stillwater levels (ft NAVD88) in different return periods with different RSLC at Point 2500 (James Island)

year	RSLC	2	5	10	20	50	100	200
2022	ft	2.91	3.73	4.24	4.68	5.37	5.92	6.45
2068 Low	0.510	3.42	4.24	4.75	5.19	5.88	6.43	6.96
2068 Int	0.950	3.86	4.68	5.19	5.63	6.32	6.87	7.40
2068 High	2.320	5.23	6.05	6.56	7.00	7.69	8.24	8.77
2118 Low	1.070	3.98	4.80	5.31	5.75	6.44	6.99	7.52
2118 Int	2.410	5.32	6.14	6.65	7.09	7.78	8.33	8.86
2118 High	6.630	9.54	10.36	10.87	11.31	12.00	12.55	13.08
2168 Low	1.630	4.54	5.36	5.87	6.31	7.00	7.55	8.08
2168 Int	4.310	7.22	8.04	8.55	8.99	9.68	10.23	10.76
2168 High	12.780	15.69	16.51	17.02	17.46	18.15	18.70	19.23

5. Conclusions

Based on the assessment, here are the conclusions:

1) The RSLC assessment methodology and procedures meet the USACE guideline requirements and are appropriate, and the RSLC assessment results are reliable.
2) The RSLC follow a trend toward a “high” level recent years but lower than the “high” level trend at Solomons Island.
3) The RSLC rate at a 95% confidence limit is 0.013024 ft/yr (3.97 mm/yr) based on the newest data in 2023.
4) The Mean Sea Level in 2022 at Solomans is estimated as +0.30 ft NAVD88. However, the real MSL reference to NAVD88 at James Island may be very similar to the Solomans or very minor higher than that at Solomans (0.1 ft?).
5) The RSLC values for starting construction 2025, the end construction 2068 and the end of 50-yr service life 2118 and the end of 100-yr service life 2168 are listed below in Table 7

Table 7 Summary of MSL values for four scenarios of RSLC at Solomon Island for James Island Project (Unit: ft NAVD88)

	RSLC: Low	RSLC: Interim	RSLC: High
Scenario 0: Start construction (2022-2025)	**0.33**	**0.35**	**0.40**
Scenario 1: Start service (2022-2068)	**0.31**	**1.25**	**2.62**
Scenario 2: 50-yr service life (2022-2118)	**1.37**	**2.71**	**6.93**
Scenario 3: 100-yr service life (2022-2168)	**1.93**	**4.61**	**13.08**

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(1) Massey, T. C., M.E. Owensby, M., Stephon, A., Lin, L., Tritinger A., Fatima, B., and Melby, J. (2021). Storm Surge, Currents and Wave Modeling for the Mid-Chesapeake Bay Islands Ecosystem Restoration Project: Barren Island, Draft ERDC/CHL LR-xx-x. U.S. Army Engineer Research and Development Center, Vicksburg, MS, April 2021.

(2) USACE. "Mid-Chesapeake Bay Island Ecosystem Restoration Project, Barren Island Restoration, Phase 1 Stone Structures Design Documentation Report." September 2021. U.S. Army Corps of Engineers Baltimore District.

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(5) USACE. "Standards and Procedures for Referencing Project Elevation Grades to Nationwide Vertical Datums", Engineer Manual, ER 1110-2-6056, 31 December 2010. U.S. Army Corps of Engineers, Washington, D.C.

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