FINAL MID-CHESAPEAKE BAY ISLAND ECOSYSTEM RESTORATION
INTEGRATED FEASIBILITY REPORT
& ENVIRONMENTAL IMPACT STATEMENT (EIS)

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Mid-Chesapeake Bay Island Ecosystem Restoration Integrated Feasibility Report and Environmental Impact Statement (EIS)

REPORT SUMMARY

STUDY INFORMATION

Study Authority. United States Army Corps of Engineers, Baltimore District (USACE-Baltimore) received the authority to conduct the Mid-Chesapeake Bay Island (Mid-Bay Island) Ecosystem Restoration Study under the resolution of the Senate Committee on Environment and Public Works on 5 June 1997, which reads:

> *Resolved by the Committee on Environment and Public Works of the United States Senate, That the Secretary of the Army is requested to review the report of the Chief of Engineers on the Chesapeake Bay, Maryland and Virginia, published as House Document 176, Eighty-eighth Congress, First Session, and other pertinent reports with a view to conducting watershed management studies, in cooperation with other Federal agencies, the State of Maryland and the State of Delaware, their political subdivisions and agencies and instrumentalities thereof, of water resources improvements in the interest of navigation, flood control, hurricane protection, erosion control, environmental restoration, wetlands protection, and other allied purposes in watersheds of the Eastern Shore, Maryland and Delaware.*

The Eastern Shore, Maryland (MD) and Delaware (DE) Section 905(b) analysis concluded that a Federal interest existed to assess the needs and opportunities within the study area and recommended a variety of potential projects for further study. The Mid-Chesapeake Bay Island Ecosystem Restoration Study was initiated specifically to evaluate protecting and/or restoring island habitat loss because of erosion and subsidence through the beneficial use of dredged material

Study Sponsor. The Maryland Department of Transportation [Maryland Port Administration (MPA)].

Study Purpose and Scope. The purpose of this study was to determine the technical, economic, and environmental feasibility of protecting, restoring, and creating aquatic, intertidal wetland, and upland habitat for fish and wildlife within the Mid-Chesapeake Bay Islands study area using suitable dredged material from the Upper Chesapeake Bay approach channels to the Port of Baltimore and the southern approach channels to the Chesapeake and Delaware (C&D) Canal. Specifically, this integrated feasibility study (FS)/environmental impact statement (EIS) (1) examined and evaluated the problems and opportunities related to the restoration of island habitat through the beneficial use of dredged material; (2) formulated plans to address these problems and opportunities; and (3) recommended cost-effective solutions for implementing a project(s) that will restore island ecosystem habitat and address dredged material management options recommended in the Federal Dredged Material Management Plan (DMMP) prepared by USACE- Baltimore District in 2005. To meet the needs identified by the Federal DMMP, the proposed project should provide the capability of receiving 30 to 70 million cubic yards (mcy) of clean dredged material over a 20-year period (3.2 mcy/yr). The Federal Standard, or baseline, is defined as the least costly, environmentally acceptable alternative(s) consistent with sound engineering practices and which meet the environmental standards established by the 404(b)(1) evaluation process (See 33 CFR Part 335 et seq.). The Federal Standard for the Chesapeake Bay approach channels to the Port of Baltimore and the C&D Canal is overboard placement; an area known as the Deep Trough, which is just south of the William Preston Lane, Jr. Memorial Chesapeake Bay Bridge, for the Port of Baltimore approach channels, and Pooles Island for the C&D Canal southern approach channels. The ecosystem restoration project costs above the level of the Federal Standard would be cost-shared with the non-Federal sponsor.

Project Location/Congressional District. Chesapeake Bay, Dorchester County, Maryland. Congressional District: MD-01, as represented by Honorable Frank M. Kratovil, Jr.

Prior Reports and Existing Water Projects. ***The Baltimore Harbor and Channels Dredged Material Management Plan and Tiered Environmental Impact Statement*** (DMMP EIS) (USACE, 2005) recommended the construction of a large island restoration project in the Mid-Chesapeake Bay region to meet the long-term dredged material placement capacity shortfall for the Upper Chesapeake Bay Approach Channels to the Port of Baltimore. The Mid-Bay Island project was identified as a high priority based on dredging needs studies conducted as part of the State of Maryland's Dredged Material Management Program. Planning and design needs for the Mid-Bay Island project were based on lessons learned from the construction and wetland development at the Paul S. Sarbanes Ecosystem Restoration Project at Poplar Island (PIERP), as documented in the ***Poplar Island, Maryland, Environmental Restoration Project Adaptive Management Plan*** (USACE/MPA, 2006) ***and the General Reevaluation Report (GRR) and Supplemental Environmental Impact Statement (SEIS) for the Poplar Island Environmental Restoration Project*** (USACE/MPA, 2005).

The Mid-Bay Island restoration would support dredged material placement for the following navigation projects: 1) **The Baltimore Harbor and Channels Federal Navigation Project,** under the jurisdiction of the USACE-Baltimore District; 2) **The Inland Waterway, Delaware River to Chesapeake Bay, Delaware and Maryland, C&D Canal Project** under the jurisdiction of USACE-Philadelphia District; and 3) Federal navigation projects in the vicinity of Barren Island in Dorchester County, under the jurisdiction of the USACE-Baltimore District. Dredged material from within Baltimore Harbor, as statutorily defined by the North Point-Rock Point line within the Patapsco River, will not be considered for placement in the Mid-Bay Island project.

Federal Interest. The Federal interest in the project is a combination of ecosystem restoration and deep-draft navigation maintenance dredging. Maintenance of Federal channels is a Federal responsibility and is regularly performed using Federal Operations and Maintenance (O&M) funds. There is a mutual interest in finding beneficial uses for this material that may cost more than the Base Plan which is the Federal Standard for placement of this dredged material. The Mid-Chesapeake Bay Island study explores options for a cost shared environmental restoration project exceeding the Federal Standard that will allow USACE and MPA to restore valuable habitat while solving the long term need for dredged material placement. Material from the Upper Chesapeake Bay Approach Channels to the Port of Baltimore and the southern approach channels to the C&D Canal will be beneficially used to restore remote island habitat, which is rapidly vanishing in the Chesapeake Bay region.

STUDY OBJECTIVES

Problems and Opportunities. Land subsidence, rising sea level, and wave action are causing valuable remote island habitats to be lost throughout the Chesapeake Bay. Approximately 10,500 acres of island habitat has been lost in middle-eastern portion of Chesapeake Bay in the last 150 years, and should present island loss rates continue in the future, it is estimated that remote island habitats will disappear from the Mid-Chesapeake Bay region within 20 years. Through the beneficial use of dredged material, the Mid-Bay Island project would restore thousands of acres of lost wetland and upland remote island habitat. This habitat would improve productivity in the surrounding area, while providing an environmentally sound method for the use of dredged material from the Chesapeake Bay approach channels to the Port of Baltimore.

The ***DMMP EIS*** (USACE, 2005) concluded that there is insufficient capacity for dredged material placement to meet Federal and State of Maryland dredging needs in the next twenty years and that there is potential for overloading and subsequent loss of capacity at existing placement sites if new placement sites are not constructed. More than 130 miles of dredged shipping channels serve the Port of Baltimore, and channel maintenance and improvement projects require that approximately 4 to 5 million cubic yards of sediment be dredged from the Federal and State channels each year, 3.2 mcy of which comes from the upper Chesapeake Bay approach channels and the southern approach channels to the C&D Canal. The State of Maryland's Dredged Material Management Act of 2001 phases out open water placement of dredged material within Maryland waters by 2010, which will result in insufficient placement capacity to meet the annual need for maintenance dredging activity.

The Mid-Bay Island project provides multiple opportunities to address the problems by:

- Restoring habitat that is used by many species of migratory birds, as well as fish and other wildlife species, as resting/nesting/foraging/production areas;
- Reducing the rate of island erosion, thereby promoting conditions conducive to restoration/protection of SAV by decreasing localized sediment inputs and improving local water clarity;
- Providing spawning, nursery, and sheltered habitat for juvenile and forage fish species, epibenthic invertebrates, and benthic infauna by restoring wetland and shallow water areas;
- Protecting shallow water areas from storm and wave forces, providing suitable habitat for the sustainable growth of SAV;
- Providing essential nursery and foraging habitat for numerous fish in restored wetland and shallow water habitats;
- Protecting shoreline for avian, reptilian, and mammalian species resting/nesting/foraging areas;
- Meeting the dredged material capacity shortfall as projected in the DMMP of 30 to 70 million cubic yards of dredged material over the 20-year planning period; and
- Providing shoreline protection and reducing impacts from storms by reducing wave heights.

Planning Objectives. The objectives of the Mid-Bay Island study were:

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

Planning Constraints. A number of environmental, engineering, and legal constraints were considered by the project delivery team (PDT) based on recommendations of the Federal DMMP, results of preliminary assessment studies at selected project sites, and lessons learned from PIERP, but the following four constraints were initially identified as the most critical in evaluating the feasibility of the recommended plan:

- Minimize impacts to existing fisheries (nursery, feeding, and protective habitats);
- Minimize impacts to rare, threatened, and endangered species and their habitat;
- Minimize impacts to existing commercial fisheries; and
- Minimize establishment of invasive species to maximum extent possible.

Two other important environmental constraints – avoiding natural oyster bars (NOBs) and avoiding existing submerged aquatic vegetation (SAV) beds – were also factored into the design of island alignment footprints. Several important engineering constraints were also considered throughout the planning process, including the availability of suitable foundation material to support dike construction and the amount and quality of sand borrow material within the footprint of the project for dike construction. Having the majority, if not all, of the sand borrow source area within the footprint of the project area was a high priority in designing alternative alignments to minimize impacts to Bay-bottom habitats, while increasing the project's capacity.

ALTERNATIVES

Plan Formulation Rationale. Plan formulation was conducted to determine a recommended plan that would provide ecosystem benefits within site-specific constraints and meet the long-term dredged material placement need of 3.2 mcy/y. The plan formulation process had two primary phases, both of which included various ranking, scoring, and screening processes. First, potential locations suitable for a large island restoration project and meeting the project objectives of habitat restoration and dredged material capacity were identified. Feasible alternative alignments were then developed to meet the engineering and environmental design constraints for the potential site (or sites).

Management Measures and Alternative Plans.

Island Site Selection. The process to select a site for large island restoration had two components: 1) identify all potential locations for a large island restoration project within the study area (105 total existing or former island sites), and 2) rank these sites using engineering criteria, environmental criteria, and public input to eliminate sites that were not feasible. Eight feasible island sites were carried forward for additional consideration using the environmental criteria ranking process developed by the Bay Enhancement Working Group (BEWG) as part of the State of Maryland's DMMP process. The environmental ranking process evaluated sites on the basis of 52 parameters to determine each site's environmental suitability as a dredged material placement site. Based on the results of the island site selection process, James and Barren Islands (Figure 1) were selected for detailed alternatives development.

Selection of Alternatives. Four Barren Island alignments, five James Island alignments, and 20 additional alignments that were combinations at both James Island and Barren Island were used to develop an array of 145 feasible alignment alternatives for evaluation. The screening of the alternatives involved multiple analysis tools, including: 1) geographic information system (GIS) analysis, 2) engineering and design suitability screening, 3) ecosystem benefits determination [using Island Community Units (ICU) analysis], 4) cost effectiveness/incremental cost analysis, and 5) input from resource agencies. Once feasible alignment alternatives were identified, these alignments were optimized to maximize ecosystem benefits and placement efficiency by evaluating multiple wetland/upland proportions in conjunction with variable upland dike heights, minimization of the project footprint, and resource agency input.

Key Assumptions. Once island sites were selected for restoration, several key assumptions were used in the analysis of the alternatives, including: 1) a minimum of 50 percent wetland habitat would be maintained at James Island; 2) restoration efforts at Barren Island would be designed to protect the existing SAV beds as well as the existing island; 3) annual dredged material inflow quantities would be in-line with current projections, 4) wetland cells would not be constructed on top of areas dredged for sand borrow due to difficulties in assuring final elevations; and 5) because the intent was to restore island habitats that have been lost, the ICU analysis would calculate the ecosystem benefits for restored habitats and would not estimate the value of the habitat lost as a result of construction.

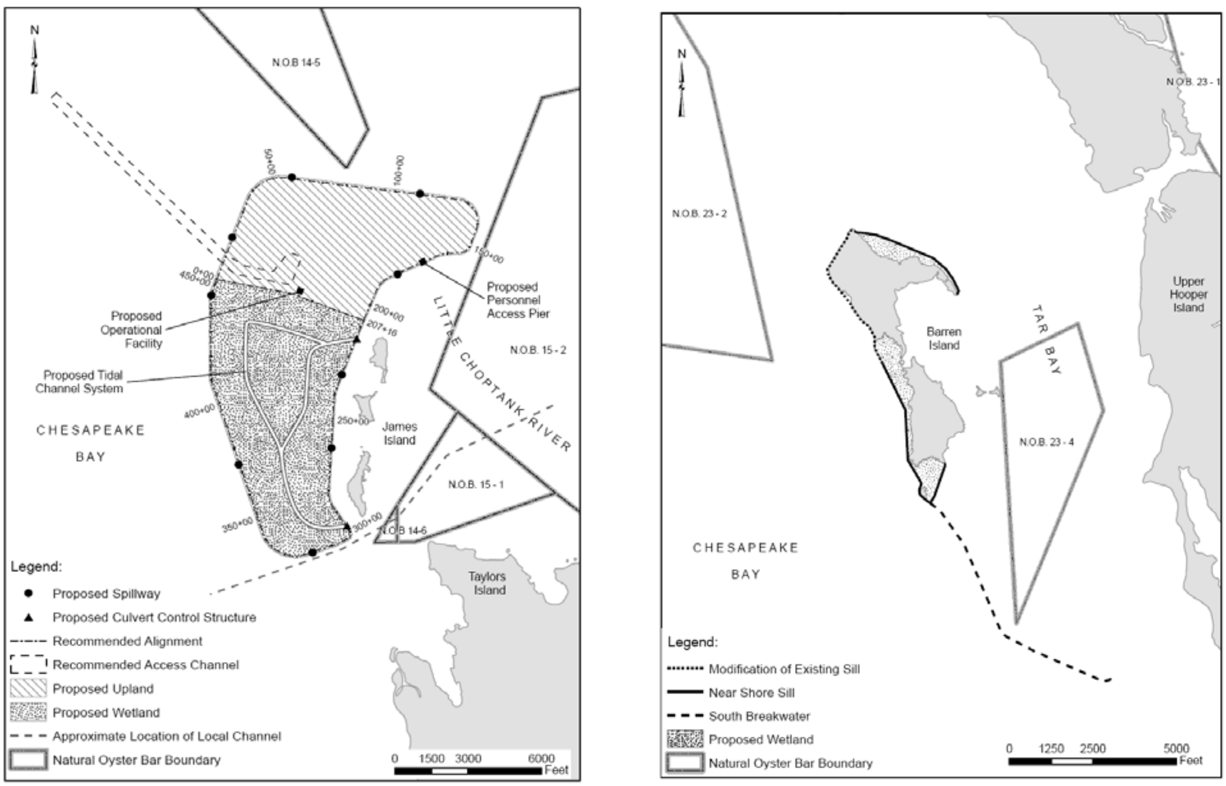

Figure 1. Mid-Chesapeake Bay Island Ecosystem Restoration Project Recommended Plan for James Island (left) and Barren Island (right)

Final Array of Alternatives. Project alignment alternatives and habitat proportions considered in the plan formulation process were screened out if they did not meet the capacity need, failed to provide a minimum of 50 percent vegetated wetlands, did not provide sufficient ecosystem benefits, or were not cost effective for the project ecosystem output. A total of three alignment alternatives remained after the plan formulation process (Table 1): 1) **Barren Island Alignment A** would total 1,354 acres, with a habitat distribution of 45% upland and 55% wetland and an upland dike height of 25 ft; 2) **James Island Alignment 5 plus Barren Island Alignment D** would total 2,756 acres (2,072 acres at James Island; 684 acres at Barren Island), with a habitat distribution of 40% upland and 60% wetland and an upland dike height of 25 ft; and 3) **James Island Alignment 5 plus Barren Island Alignment E** would total 2,144 acres (2,072 acres at James Island; 72 acres at Barren Island), with a habitat distribution of 45% upland and 55% wetland and an upland dike height of 20 ft. The no-action alternative was defined as the projected future without project remaining acreage at both James Island and Barren Island based on estimated long term rate of erosion (James Island = 13 ft/yr per year;

Barren Island = 14 ft/yr per year). Based on these estimates, James Island, currently less than 100 ac will be submerged by 2033, and Barren Island, approximately 180 ac, will be submerged by 2076.

Comparison of Alternatives. Each of the alternatives met the planning objectives and constraints. To quantify the ecosystem benefits for the project, island community units (ICUs) were developed by a technical working group comprised of local and regional experts as a metric to determine habitat value. Significant differences between the alternatives included: 1) the impact area footprint of the project, 2) the proportion of wetland habitat created, 3) total dredged material placement capacity, 4) the ecosystem benefits (ICUs), and 5) the preliminary estimate of the cost for implementation.

TABLE 1
Comparison of Alternatives Considered for the Mid-Bay Island

	Barren Island Alignment A	James Island Alignment 5 plus Barren Island Alignment D	James Island Alignment 5 plus Barren Island Alignment E
Impact Area of Footprint	1,354	2,756	2,144
Wetland Proportion (%, acres)	55%, 745	60%, 1,927 (assumes 60% at James, 100% at Barren)	55%, 1,212 (assumes 55% at James, 100% at Barren)
Total Placement Capacity (mcy)	53	86	90-95
Ecosystem Benefits (ICUs)	668	937	813

Key risks and uncertainties associated with the alternatives included the timing of the proposed project with respect to the authorized expansion of PIERP were evaluated to ensure there was no negative impact to the anticipated benefits of PIERP. This was critical because the Chief's Report for the Poplar Island Expansion GRR/SEIS (USACE/MPA, 2005) was signed on March 31, 2006 and the Record of Decision (ROD) was signed on October 11, 2006. To evaluate the timing issue, the dredged material placement schedule, costs, and impact to the ecosystem benefits were evaluated to: 1) determine the most efficient implementation scheme for the Mid-Bay Island project, with respect to the plan approved for the PIERP expansion; 2) achieve optimal operational effectiveness; 3) maximize site life by avoiding overloading the cells; and 4) realize significant ecosystem benefits for both the Poplar Island expansion and Mid-Bay projects. Based on the anticipated funding schedule, three timing scenarios were evaluated - start of dredged material placement at James Island in 2014, 2018, or 2023. The analysis indicated that developing James Island concurrently with the PIERP expansion will decrease the cost per ICU at PIERP because of the benefits gained by delaying the development of the upland cells (these areas provide higher ecosystem benefits as undeveloped mudflats than as fully developed upland cells). This scenario will also increase operational efficiencies by significantly reducing the potential to overload cells and slightly extending the site life of both PIERP and James Island.

The National Economic Development (NED)/Environmental Quality (EQ) tradeoff involves a comparison of placement capacity to total ecosystem benefits of the project. Project alternatives were formulated to maximize ecosystem outputs (NER) by maximizing the wetland acreage restored by the project and minimizing the overall footprint of the project, which resulted in a tradeoff of reduced dredged material placement capacity (NED).

<u>Recommended Plan</u>. The recommended plan (Figure 1) consists of constructing James Island Alignment 5, with a habitat proportion of 45% upland to 55% wetland and an upland dike height of 20 ft MLLW, in combination with protection/restoration at Barren Island through the construction of Alignment E. The recommended plan will restore 2,144 acres of remote island habitat (2,072 acres at James Island and 72 acres at Barren Island), while also protecting approximately 1,325 acres of potential SAV habitat adjacent to Barren Island and providing approximately 90 to 95 mcy, or approximately 28 to 30 years, of dredged material placement capacity. The James Island Alignment 5/Barren Island Alignment E combination was chosen as the recommended plan because it was among the best buy alternatives, met each of the seven project objectives and exceeded five of them, and minimized the footprint of the project.

The recommended plan (James Alignment 5/Barren Alignment E) was chosen to minimize the project footprint (resulting in less impact to Bay bottom habitat) and reduce overall project costs without significantly reducing the capacity or ecosystem benefits or dredged material capacity of the project. The recommended plan had fewer ICUs than the James Alignment 5/Barren Alignment D alternative (813 versus 937 ICUs) mainly because the recommended plan has a smaller wetland habitat proportion (55% versus 60%) in the James Island portion of the project, and a smaller Barren Island component of the project (72 versus 684 acres). The James Alignment 5/Barren Alignment E was also significantly less expensive, however.

In response to an External Peer Review comment, an additional analysis was performed with the ICUs to determine a net benefit that incorporates the loss of open water habitat from island restoration. The net benefits analysis identified impacts to waterfowl foraging habitat, fisheries habitat, and benthic communities as a result of filling open water to restore remote islands, but did not result in a change in the selection of the recommended plan. The open water ICU value at James Island is 0.18 ICU/ac while the value is 0.37 ICU/ac at Barren Island. The Barren Island open water ICU value is nearly double that of James Island due to a diverse benthic community that increases the potential impact to both benthic invertebrates and fisheries resources. At James Island, open water impacts are greatest to the waterfowl community. Over its project life, the recommended plan provides a total of 22,045 net ICUs. The only alternative that provides a greater number of total net ICUs is the James 5/Barren protection alternative at 40%/60% upland/wetland ratio which provides a net of 23,275 ICU. This alternative, however, was not a ‘Best Buy’ Plan. The full analysis is discussed in Section 4.7.6 with results presented in Table 4-38.

<u>Systems / Watershed Context</u>. The Mid-Bay Island project will restore remote island habitat, a scarce and rapidly vanishing ecosystem component within the Chesapeake Bay region. Loss of remote island habitat within the middle-eastern Chesapeake Bay has been estimated at approximately 10,500 acres in the last 150 years, a trend that will continue because of erosive forces and sea level rise. Remote islands in the Chesapeake Bay serve as an important stop-over point for migratory avian species, providing forage and protected resting habitat during spring and fall migration along the Atlantic Flyway for many shorebird and waterbird species. Additionally, the remote island habitat restored at James and Barren Islands will provide valuable wetlands and a vital connection between open-water and mainland terrestrial habitats within the region and provide valuable nesting habitat for a variety of colonial nesting and wading bird species. At the PIERP, even though habitats are not fully developed and site operations are on-going, multiple species have already begun to nest, including Least Terns; Common Terns; Snowy Egrets; Willets; Osprey; and diamondback terrapins. For aquatic species, remote islands such as James and Barren Island may increase the potential for commercially important large predator finfish species (such as bluefish, striped bass, and Atlantic croaker) to utilize the habitat because of the island’s proximity to deep open water as opposed to the shallows adjacent to mainland marshes. Protection of the extensive SAV beds east of Barren Island will provide nursery habitat for blue crabs and many species of fish, while also providing foraging habitat for waterfowl.

The Mid-Bay Island project is an integral component of the Federal DMMP, which is the long-term regional plan for managing sediments from the Chesapeake Bay Federal navigation channels. The significance of the fish and wildlife resources of the Chesapeake Bay is widely recognized by resource agencies, the public, and academic institutions. For more than 20 years, extensive efforts have been expended to support natural resources management and restoration plans in the Chesapeake Bay region. The restoration projects at James and Barren Island would contribute to the goals of the Chesapeake Bay Program watershed partnership through its habitat and ecosystem recovery and preservation efforts. Both James and Barren Islands would contribute to the Chesapeake 2000 Agreement goal to restore 25,000 acres of tidal and non-tidal wetlands. In addition, the protection of 1,325 acres of SAV habitat adjacent to Barren Island would contribute to the Chesapeake 2000 Agreement goal to protect and restore 114,000 acres of SAV and to develop strategies to address water clarity in areas of critical importance for SAV. Both the James and Barren Island projects would improve water clarity by reducing localized erosion by reducing wave heights and buffering storm impacts to the shoreline.

No Federal agencies were formally invited to be cooperating agencies for this project because of the long history of agency cooperation through the State of Maryland DMMP, BEWG, Federal DMMP, and PIERP GRR/SEIS processes. However, because the U.S. Fish and Wildlife Service (USFWS) is the current owner of Barren Island, the USFWS Chesapeake Bay Field Office and USFWS Blackwater National Wildlife Refuge manager, as well as the U.S. Environmental Protection Agency (USEPA) and National Marine Fisheries Service (NMFS), were particularly active participants throughout the study to ensure a significant level of agency coordination.

Environmental Operating Principles. The plan recommended by the Mid-Bay Island FS/EIS supports each of the seven USACE Environmental Operating Principles. The recommended plan will **strive to achieve environmental sustainability** by creating a diverse, productive ecosystem to replace rapidly vanishing remote island habitats, including vegetated wetlands, intertidal zones, uplands, and bird islands, that will be utilized by a wide variety of avian, terrestrial, and aquatic species. The recommended plan **recognizes the interdependence of life and the physical environment** by creating habitats representative of typical wetland and uplands in the Chesapeake Bay region that will promote interaction and exchange with the surrounding ecosystems. The recommended plan **seeks balance and synergy among human development activities and natural systems** by managing sediments that originate from land use practices and natural erosion processes within the watershed, by maintaining consistency with the existing aesthetics of the region, and by promoting recreational and educational use of the project. By implementing the recommended plan, the Corps will **accept responsibility and accountability under the law** to ensure that the project complies with all applicable Federal laws, continues extensive environmental monitoring, and utilizes adaptive management practices. The recommended plan **seeks ways and means to assess and mitigate cumulative impacts to the environment** by minimizing environmental consequences to important regional resources, such as open-water, shallow water, and Bay bottom habitats, while providing direct and indirect ecosystem benefits through creation of scarce island wetland and upland habitats. Through extensive and on-going consultation, coordination and outreach with other Federal and State agencies, scientific experts from universities, local government, and the public, the recommended plan will continue to **build and share an integrated scientific, economic, and social knowledge base.** Since the inception of the study, the Project Delivery Team (PDT) has **listened to, respected, and learned from the perspectives of individuals and groups interested in Corps activities** by maintaining extensive coordination with Federal and State agency representatives, actively participating in the State of Maryland's DMMP process and the BEWG, and conducting additional meetings with interested members of the public and local watermen. The PDT has worked with these stakeholders to develop a **win-win solution** – a recommended plan that maximizes ecosystem benefits and meets the dredged material capacity need, while minimizing impacts to natural resources.

Independent Technical Review (ITR). USACE-Philadelphia District conducted the ITR for the Draft Mid-Bay Island Integrated Feasibility Study/EIS prior to the document's public release and for the final report prior to consideration by the Civil Works Review Board. The PDT consistently provided input and guidance on technical issues throughout the study process. The method for calculating ICUs was developed by a working group comprised of regional experts and representatives from academic institutions and research organizations that were specifically selected because of their local knowledge and experience. The Engineer Research and Development Center (ERDC) conducted lifecycle analysis of the perimeter dike design and reviewed the hydrodynamic modeling, and Value Engineering (VE) was conducted from July 18 to 20, 2006. The Planning Center of Expertise (PcX) for Ecosystem Restoration (Mississippi Valley Division) reviewed the document in April through June 2007. This review included quality assurance of the ITR done by USACE- Philadelphia District on the draft report, assurance of adequate external peer review and quality assurance of the micro-computer automated cost engineering system (M-CACES) cost estimate by the Civil Works Cost Estimating Center of Expertise at the Walla Walla District. An external peer review (EPR) process was completed by the PcX to complement the independent technical review (EC 1105-2-408). The EPR process as well as reviewer comments and USACE responses are provided in Appendix N, Attachment A. The PcX also conducted review of the Island Community Model, used to evaluate and compare project alternatives. Rigorous Independent Technical Review of the model was conducted in accordance with EC 1105-2-407 and the Protocols for Certification of Planning Models (July 2007). Discussion of the process, reviewer comments, and responses are available in Appendix N, Attachment B.

Project Costs.

TABLE 2
PROJECT FIRST COSTS
Mid-Chesapeake Bay Island Ecosystem Restoration
(Baseline Costs, Fiscal Year 2009 Price Levels)

	Cost
James Island **	
Navigation, Ports, and Harbors	$1,456,934,000
Pre-construction, Engineering, and Design*	$58,196,000
Construction Management	$26,996,000
Barren Island	
Navigation, Ports, and Harbors	$38,251,000
Planting	$5,295,000
Lands and easements (LERRD)	$71,000
Pre-construction, Engineering, and Design	$290,000
Construction Management	$1,178,000
Operations and Maintenance	$24,364,000
Total Project Costs	**$1,611,575,000**

* Includes PED efforts before construction in addition to engineering and design during construction
** Costs shown are above the cost of dredging to the Federal Standard, which is funded through the Federal Operations and Maintenance Program annually.

Equivalent Annual Costs and Benefits. Because the Mid-Bay Island study is an EQ project, an assessment of NED equivalent annual benefits and costs was not required. EQ costs are shown in Table 3. Ecosystem benefits are displayed in ICUs, which were developed for use in determining the ecosystem benefits of island restoration projects in the Mid-Chesapeake Bay region. Costs have been annualized over the life of the project, from initiation of Pre-Construction, Engineering, and Design (PED) for Barren Island in 2009 to project completion in 2060. Of the 813 total annual ICUs, the James Island component will produce 492 and Barren will produce 321. This yields an annual cost per ICU of $66,630 for the James Island component and $7,267 for Barren Island. The projects will not only restore valuable island habitat, but they will also protect the existing island remnants and the shallow water habitat in the lee of the restored landmasses. Whereas the James Island project component will restore 2,072 acres of habitat, it will protect another 80 acres of existing island and 23 acres of potential SAV habitat for a total of 2,175 acres. The Barren Island project will restore 72 acres, but will protect an additional 197 acres of island and 1,325 acres of extremely valuable SAV habitat. When taken in total, the cost per acre of benefit for James Island is $720,147 and for Barren Island it is $28,391.

Cost Sharing. The baseline cost estimate, including contingencies, for implementing the recommended plan is $1.612 billion with $1.566 billion allocated to James Island, and $45 million allocated to Barren Island. The estimate includes the costs for planning, engineering and design; construction; O&M during construction; construction management; monitoring; and contingencies. The estimate does not include the cost of dredging 3.2 mcy of material annually for an estimated 30 years and placement of that material at the Federal Standard. Those costs will continue to be borne through the Federal Operations and Maintenance Program. The recommended plan for James Island will be cost shared at $1.015 billion (65 percent, except for recreation, 50/50, and operation, maintenance, repair, replacement and rehabilitation [OMRR&R], 100 percent non-Federal) for the Federal government and $551 million (35 percent, except for recreation, 50/50, and OMRR&R, 100 percent) for the non-Federal sponsor. Prior to the Water Resources Development Act (WRDA) of 2007, specifically changes mandated by Section 2037, the James Island component was recommended for implementation under Section 207 (Beneficial Use of Dredged Material) of WRDA 1996. Section 207 projects were cost-shared 75% Federal and 25% non-Federal. Allowing for 50/50 cost share for recreational features, and 100 percent non-Federal OMRR&R, prior to WRDA 2007 the James Island project component would have been cost-shared $1.171 billion Federal and $395 million non-Federal. The recommended plan for Barren Island will be cost shared at $29.4 million (65 percent for construction, 75 percent for PED) for the Federal government and $15.8 million (35 percent for construction, 25 percent for PED) for the non-Federal sponsor. The cost sharing for both components are now in accordance with Section 210 (Ecosystem Restoration) of the WRDA of 1996. Total baseline costs for the Mid-Bay Island project are $1.045 billion for the Federal government and $567 million for the non-Federal sponsor.

Project Implementation. Whereas, prior to WRDA 2007, two separate authorizations were to be pursued for this project, the changes to Section 207, specifically a per project funding cap limitation, now obviate this strategy. As a beneficial use of dredged material project, James Island had been eligible for authorization under Section 204 of WRDA 1992, as amended by Section 207 of WRDA 1996. Beneficial use of dredged material projects under Section 207 were cost-shared 75 percent Federal and 25 percent non-Federal. Due to changes in the Section 207 authority, both James and Barren Islands will be authorized under Section 103 (c) of WRDA 1986, as amended by Section 210 of WRDA 1996. The entire project will be cost shared 65 percent Federal and 35 percent non-Federal. For the recreational components, economically justified facilities will be cost shared 50 percent Federal and 50 percent non-Federal.

TABLE 3
ECONOMIC COSTS AND BENEFITS OF PROJECT[1] ($1,000)
Mid-Chesapeake Bay Island Ecosystem Restoration
Integrated Feasibility Report and Environmental Impact Statement (EIS)

Item	Ecosystem		Recreation		Total	
	Allocated Costs	Benefits	Allocated Costs	Benefits	Allocated Costs	Benefits
Investment Cost						
First Cost	$1,611,576		$210		$1,611,786	
Interest During Construction	$49,174		$2		$49,176	
Total	$1,660,750		$212		$1,660,962	
Avg Annual Cost[2]						
Interest and Amortization	$34,721		$12		$34,733	
OMRR&R[3]	$391				$391	
Subtotal	$35,112		$12		$35,124	
Annual Benefits **Non-monetary (Ecosystem)**		813 ICUs (492 for James, 321 for Barren)		$176		$176 and 813 ICUs

[1]Based on October 2009 price levels, 4.625 percent rate of interest, and a 52-year period of analysis per project Planning Guidance Memorandum.
[2]See Tables D-14 and D-15 in Appendix B – Plan Formulation
[3]Operation, Maintenance, Repair, Replacement, and Rehabilitation: Includes all Operations and Maintenance during construction of the project, both cost shared and non-Federal.

The MPA, the non-Federal sponsor, will provide 35 percent of the cost associated with construction of the James Island project component and the Barren Island project component, including provision of all lands, easements, rights-of-way, and necessary relocations (LERRD); and will pay 100 percent of the OMRR&R costs associated with the project.

Environmental monitoring needs for the project will be identified by a multi-disciplinary group of State and Federal regulatory and resource agencies, and will be based on site-specific concerns and lessons learned from the existing PIERP project. Environmental monitoring needs for the Mid-Bay Island project will be managed through an annual monitoring framework, habitat development framework, and an adaptive management plan that will document progress in meeting the project's habitat restoration goals.

Operation, Maintenance, Repair, Rehabilitation, and Replacement (OMRR&R). As each functional component of the project is completed and determined to be functioning as intended, it will become the responsibility of MPA to operate, maintain, repair, replace, and rehabilitate as needed. Such functional components could include the containment dikes, internal dikes, breakwaters, sills, spillways, service structures, access channels, and each of the constructed wetland and upland habitat cells. For this report, the assumption has been made for the James Island component that bulkheads, piers and operations facilities could be turned over to the MPA shortly after completion of those features at the beginning of construction of the island. The exterior containment dikes could be turned over after stability is assured and upland and wetland cells could be turned over after they are developed and found to be stable. It should be noted that at the date of this report, no components had yet been turned over to the MPA on Poplar Island. More detailed design during PED may yield better estimates of OMRR&R; however, it will not be until construction that the ultimate determinations of what components can be turned over and when can be made. The estimates made during this study effort are reflected in the ultimate project cost and in the cost sharing breakdown presented herein. Based on experience at the PIERP, operations and maintenance costs at the time of project completion are projected to be less than 2 percent of the total project cost.

Key social and environmental factors. The Mid-Bay Island project will meet the annual and long term dredged material capacity need by restoring approximately 2,144 acres (2,072 ac at James Island and 72 ac at Barren) of remote island habitat consisting of wetlands and uplands in the Chesapeake Bay. Restoration efforts at Barren Island were designed to provide direct protection to extensive SAV beds located east of the project. Increased wetland areas, protection of the SAV beds, and dike (acts similarly to a reef) construction are anticipated to enhance aquatic recreational and commercial species. The interaction and trophic exchange in the wetlands is expected to result in a beneficial impact to avian, fish, and wildlife species, including commercially important species, blue crabs, and juvenile estuarine fish. The recommended plan will provide additional protection to the Eastern Shore of Maryland from erosion by reducing wave heights. The project will also meet the long term dredged material capacity need in the Federal DMMP and will allow the deep-draft shipping channels to the Port of Baltimore to remain open and navigable.

The recommended plan would prevent disruption of the growth of the Port of Baltimore due to a lack of dredged material placement capacity to keep its channels clear. Maryland's Port of Baltimore is a major economic engine for the State of Maryland. In 2006, the Port of Baltimore was responsible for $1.9 billion in direct business revenues and $3.6 billion in personal wage and salary income. The Port generates approximately 50,200 jobs in Maryland. The total value of foreign cargo moving through the Port in 2007 was $41.9 billion. General cargo handled at state terminals exceeded 8.7 million tons, which was the sixth straight record year.

The recommended plan will result in a loss of approximately 2,172 acres of Chesapeake Bay bottom within the project footprint, including open-water habitat, shallow water habitat, and benthic habitat. An additional 101 acres of shallow water habitat will be disturbed and deepened to construct the access channel at James Island. The loss of this regionally important habitat was a critical component in the selection of the recommended plan, which was specifically chosen to minimize impacts by reducing the size of the footprint at Barren Island. Finfish, blue crabs, and avian species that utilize the area within the footprint will be displaced, but comparable habitat is located adjacent to the project area. Non-mobile benthic communities within the footprint will eventually be buried. The benthic community is anticipated to recolonize the access channel area after dredging, but increased water depths and the exposure of a different bottom substrate may result in the recolonization of a different type of benthic community. Recreational and commercial fisheries within the project footprint will be displaced. The project will result in the hardening of approximately 43,350 linear ft of armored shoreline, which are anticipated to be off-set in the long term by the protection afforded to the existing SAV beds and the use of the perimeter dikes as epibenthic habitat and food source for juvenile finfish. The recommended plan will create a permanent viewshed change from the adjacent Eastern Shore of Maryland; and increases in noise and light levels will impact residents, primarily during the initial construction seasons when the exterior dikes are constructed and during subsequent dredged material inflow operations.

In combination with other proposed restoration and/or protection projects in the Mid-Chesapeake Bay (i.e., the existing PIERP, the expansion of PIERP, and ecosystem restoration projects at Smith and Taylors Islands), the Mid-Bay Island restoration project will contribute to a restoration potential totaling approximately 3,565 acres of remote island habitat, including 1,872 ac of wetlands and 1,693 ac of uplands. The proposed Dorchester County wetland restoration at Blackwater National Wildlife Refuge could provide an opportunity to restore thousands of more wetland acres within a region where over 10,000 acres of remote island habitat have been lost.

Stakeholder perspectives and differences. Coordination with agencies and technical experts from academic institutions was an integral and continuous part of the Mid-Bay Island study. The PDT was directed by the USACE-Baltimore District (lead agency) and by the MPA (non-Federal sponsor), and included personnel from agencies including Maryland Department of the Environment (MDE), Maryland Department of Natural Resources (MDNR), Maryland Environmental Services (MES), National Oceanic and Atmospheric Administration (NOAA) National Marine Fisheries Service, NOAA Chesapeake Bay Field Office, USEPA Region 3, USFWS Chesapeake Bay Field Office, and USFWS Blackwater National Wildlife Refuge. In addition, various other private-interest groups and organizations that are stakeholders in the Bay, such as the Dorchester County Shoreline Erosion Group, Dorchester County Commissioner and County Council, MPA's Citizen's Advisory Committee (CAC), conservation groups, sportsmen, boaters, and watermen were also involved in the development of the recommended plan.

Throughout the study process public outreach has been, and continues to be, a high priority. Generally, public support for this project is strong. A *Notice of Intent* was published in the Federal Register on January 17, 2003, and two public scoping meetings were held in February and March 2003. Between March 2004 and May 2005, several additional informal meetings were held with interest groups and civic organizations with particular interest in the project and local watermen were specifically targeted for involvement in the process and significant efforts were made to accommodate their concerns. The *Notice of Availability* for the Draft Integrated Feasibility Study/EIS was published in the Federal Register on September 8, 2006, and the Draft report was issued to almost 850 participants, including Federal, State and local agencies, local libraries, and private citizens. Two public meetings for the Draft Integrated Feasibility Study/EIS were held in October 2006.

Agency and public comments received during the public comment period generally expressed strong support for the project. The DEIS received a rating of 'LO' (lack of objections) from USEPA, and the USFWS, MDNR and NMFS service expressed general support of the project. At the public meetings, the project received support from Maryland State delegates) and county representatives (Dorchester County Council), in addition to the Dorchester County Shoreline Erosion Group, the Dorchester Citizens for Planned Growth, and the Dorchester County Seafood Harvesters Association. These groups expressed support for the project because of the potential for shoreline protection, reduction in local erosion and water turbidity, and potential economic boom to both the local economy and to the Port of Baltimore, a vital economic component to the State of Maryland.

Concerns about the project were raised by MDNR and the Sierra Club. MDNR expressed concerns that the construction of the toe dike at James Island would be constructed within 500 yards of a designated natural oyster bar (NOB) with the potential to entrain and destroy oyster larvae during spawning and resuspend sediment that may bury the oysters. Because of these potential impacts, a time of year restriction would be in place for charted NOBs and oyster restoration sites such that no excavation of material or placement of unconfined material would occur between December 16 and March 14 or June 1 through September 30 of any year. MDNR also requested the incorporation of one or more small (1-5 acre) islands into the breakwater design for Barren Island as nesting habitat for colonial waterbirds. This design modification will be further evaluated by USACE-Baltimore District during the PED phase of the project.

The Sierra Club expressed concern that implementation of the James Island project is a solution to the dredged material capacity issue that may not be ecologically or scientifically justified. In addition, the Sierra Club thought that the DEIS should use multiple techniques to completely characterize the importance of the shallow water habitats that would be lost in the construction of James Island – habitats that are productive and serve a vital ecosystem role, despite their classification as "stressed" under the classification system of the Chesapeake Bay Benthic Index of Biotic Integrity (B-IBI). USACE-Baltimore District addressed the concerns of the Sierra Club by clarifying the explanation of the site selection process and updating text in the report accordingly.

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APPENDICES

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List of Abbreviations, Acronyms & Units

Ac	Acre
ACES	Automated Coastal Engineering System
ACRE	Applied Coastal Research and Engineering
AMP	Adaptive Management Plan
ASA(CW)	Assistant Secretary of the Army of Civil Works
AVS	Acid Volatile Sulfides
AWOIS	Automated Wreck and Obstruction Information System
B-IBI	Benthic Index of Biotic Integrity
BBL	Blasland, Bouck, and Lee
BEWG	Bay Enhancement Working Group
BOD	Biochemical Oxygen Demand
BWI	Baltimore/Washington International Thurgood Marshall Airport
CAC	Citizens' Advisory Committee
CBBMP	Chesapeake Bay Benthic Monitoring Program
CBFO	Chesapeake Bay Field Office
CBIA	Coastal Barrier Improvement Act
CBP	Chesapeake Bay Program
CBRA	Coastal Barrier Resources Act
CBWQM	Chesapeake Bay Water Quality Monitoring Program
CCA	Coastal Conservation Association
C&D	Chesapeake and Delaware
CDF	Confined Disposal Facility
CE/ICA	Cost Effectiveness/Incremental Cost Analysis
CEQ	Council of Environmental Quality
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
CHESFIMS	Chesapeake Bay Fishery-Independent Multi-species Survey
CHESMAP	Chesapeake Bay Multi-species Monitoring and Assessment Program
cm	Centimeter
COL	Cooperative Oxford Laboratory
COMAR	Code of Maryland Regulations
CVM	Contingent Valuation Method
cy	Cubic Yard
C2K	Chesapeake Bay 2000 Agreement
dB	Decibel
dBA	A-Weighted Decibel
DE	Delaware
DMCF	Dredged Material Containment Facility
DO	Dissolved Oxygen
DPR	Detailed Project Report
DPW	Department of Public Works
E	East
EA	EA Engineering, Science, and Technology

EFH	Essential Fish Habitat
EIS	Environmental Impact Statement
EO	Executive Order
ER	Engineering Regulation
ERDC	Engineer Research and Development Center
ESA	Endangered Species Act
°F	Degrees Fahrenheit
Federal DMMP	Federal Dredged Material Management Plan
FEIS	Final Environmental Impact Statement
FEMA	Federal Emergency Management Agency
FMP	Fisheries Management Plan
ft	Foot/Feet
ft/s	Feet per Second
FTE	Full Time Equivalent
FY	Fiscal Year
GBA	Gahagan, Bryant & Associates
GIS	Geographic Information System
GRR	General Reevaluation Report
H&H	Hydrologic and Hydrodynamic
HAPC	Habitat Areas of Particular Concern
HDF	Habitat Development Framework
HEP	Habitat Evaluation Procedure
HMI	Hart-Miller Island
HSI	Habitat Suitability Index
HT	Harbor Team
HTRW	Hazardous Toxic Radioactive Wastes
HUC	Hydrologic Unit Code
HUD	Department of Housing and Urban Development
ICI	Island Community Index
ICU	Island Community Unit
in	Inches
ITR	Independent Technical Review
km	Kilometer
lbs	Pounds
LF	Linear Feet
LRR	Limited Reevaluation Report
m	Meter(s)
MAFMC	Mid-Atlantic Fisheries Management Council
mcy	Million Cubic Yards
mcy/yr	Million Cubic Yards per Year
MCACES	Micro-Computer Aided Cost Engineering System
MD	Maryland
MCAC	Maryland Critical Areas Commission

MDE	Maryland Department of the Environment
MDNR	Maryland Department of Natural Resources
MDOT	Maryland Department of Transportation
MDP	Maryland Department of Planning
MEC	Munitions and explosives of concern
MES	Maryland Environmental Service
MGS	Maryland Geological Survey
mg/l	Milligrams per Liter
MHHW	Mean Higher High Water
MHT	Maryland Historical Trust
MHW	Mean High Water
mi	Mile(s)
Mid-Bay	Mid-Chesapeake Bay
MLLW	Mean Lower Low Water
MIRC	Maryland Intergovernmental Review and Coordination
MLW	Mean Low Water
MNE	Moffat & Nichol Engineers
MNRP	Maryland Natural Resources Police
MPA	Maryland Port Administration
MSFCMA	Magnuson-Stevens Fisheries Conservation & Management Act
MSL	Mean Sea Level
MSSA	Maryland Saltwater Sport Fishermen's Association
MWA	Maryland's Waterman's Association
N	North
NAAQS	National Ambient Air Quality Standards
NAD	North American Datum
NCDC	National Climatic Data Center
NE	Northeast
NED	National Economic Development
NEPA	National Environmental Policy Act
NER	National Ecosystem Restoration
NESCA	Maryland Nongame and Endangered Species Conservation Act
NHPA	National Historic Preservation Act
nm	Nautical Mile
NMFS	National Marine Fisheries Service
NNW	North-Northwest
NOS	National Ocean Service
NOAA	National Oceanic and Atmospheric Administration
NOB	Natural Oyster Bar
NOI	Notice of Intent
NPS	National Park Service
NRCS	Natural Resources Conservation Service
NRHP	National Register of Historic Places
NTU	Nephelometric Turbidity Units
NWR	National Wildlife Refuge
OMB	Office of Management and Budget
OPA	Otherwise Protected Area
OSHA	Occupational Safety and Health Administration

PAH	Polynuclear Aromatic Hydrocarbons
PCA	Project Coordination Agreement
PCB	Polychlorinated Biphenyl
PCI	Panamerican Consultants, Inc.
PDT	Project Delivery Team
PED	Preconstruction, Engineering, and Design
PEL	Probable Effects Level
PIERP	Paul S. Sarbanes Ecosystem Restoration Project at Poplar Island
PIT	Passive Integrated Transponder
PL	Public Law
PMP	Project Management Plan
ppm	Parts Per Million
ppt	Parts Per Thousand
QA	Quality Assurance
QC	Quality Control
ROD	Record of Decision
RTE	Rare, Threatened, and Endangered
S	South
SAFMC	South Atlantic Fisheries Management Council
SAV	Submerged Aquatic Vegetation
SEIS	Supplemental Environmental Impact Statement
SHA	State Highway Administration
SHPO	State Historic Preservation Office
SNS	Shortnose Sturgeon
SOW	Scope of Work
SSE	South-Southeast
SSPRA	Sensitive Species Project Review Area
State DMMP	State of Maryland's Dredged Material Management Program
SW	Southwest
SWH	Shallow Water Habitat
TCM	Travel Cost Method
TDN	Total Dissolved Nitrogen
TDP	Total Dissolved Phosphorus
TEL	Threshold Effects Level
TMDL	Total Maximum Daily Load
TOC	Total Organic Carbon
TOY	Time of Year
TSS	Total Suspended Solids
UDV	Unit Day Value
UMCES	University of Maryland Center for Environmental Science
USACE	United States Army Corps of Engineers (A city listed in text after USACE designates a particular District office.)
USDA	United State Department of Agriculture
USEPA	United States Environmental Protection Agency

USFWS	United States Fish and Wildlife Service
USGS	United States Geological Survey
VA	Virginia
VIMS	Virginia Institute of Marine Sciences
W	West
WNW	West-Northwest
WRDA	Water Resources Development Act
ybp	Years Before Present
yr	Year

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1 INTRODUCTION

Two primary missions of the U.S. Army Corps of Engineers (USACE) Civil Works program are navigation and ecosystem protection/restoration. For navigation, USACE provides safe, reliable, and efficient waterborne transportation systems (channels, harbors, and waterways) for movement of commerce, national security needs, and recreation requiring the dredging of channels and placement and/or management of dredged material. One method authorized for managing this dredged material is through the beneficial use to implement projects for the protection, restoration and creation of aquatic ecosystems, including wetlands. These ecosystem restoration efforts must focus on ecosystem functions, versus single species habitat or improvements that are primarily of economic or commercial importance.

In November 2002, the USACE-Baltimore District and the Maryland Port Administration initiated the Mid-Chesapeake Bay Island Ecosystem Restoration Study to address the problems and opportunities outlined in the Federal Dredged Material Management Plan (USACE, 2005). The integrated feasibility report documents the planning process for this study, with the intent of meeting these two primary Civil Works missions by restoring thousands of acres of valuable island habitat in the Mid-Chesapeake Bay region through the beneficial use of dredged material from the Upper Chesapeake Bay Approach Channels to the Port of Baltimore in Maryland.

1.1 *BACKGROUND

Engineering Regulation (ER) 1105-2-100 requires dredged material management planning for all Federal navigation projects to ensure that sufficient dredged material placement capacity is available during the life of a navigation project. This regulation protects the Federal investment and ensures that dredging and placement activities are performed in an environmentally acceptable manner, use sound engineering techniques, and are economically warranted. The USACE Baltimore District and USACE Philadelphia District are responsible for operating and maintaining approximately 130 miles of dredged Federal navigation channels that serve the Port of Baltimore.

The Federal Dredged Material Management Plan (Federal DMMP) covers the dredging of the channels from the mouth of the Chesapeake Bay in Virginia (VA) to and including the Port of Baltimore, and the southern approach channels to the Chesapeake and Delaware (C&D) Canal as far north as the Sassafras River. The Federal DMMP addresses dredging needs, annual placement capabilities, existing capacity of placement areas, placement site management practices, environmental compliance requirements, potential beneficial use of dredged materials and includes an economic justification for continued channels and anchorages maintenance. The Federal DMMP identified, evaluated, screened, prioritized, and ultimately optimized such alternatives resulting in the recommendation of a plan of action for the placement of dredged materials over the next 20 years. The plan also considered non-Federal, permitted dredging within the related Port of Baltimore geographic area, as placement of material from these sources will affect the size and capacity of placement areas required for the Federal project.

In the first phase of the Federal DMMP effort, the *Baltimore Harbor and Channels, Dredged Material Management Plan, Preliminary Assessment*, dated July 2001, approved by USACE's

North Atlantic Division in September 2001, concluded that (1) there is insufficient capacity for dredged material placement over the next 20 years, with approximately 8-10 years of existing placement capacity available; (2) there is insufficient time to develop new placement site(s) before existing sites are filled (implementation would take approximately 9-12 years); (3) existing sites will not be efficiently managed due to the dredging demand and insufficient placement capacity (overloading sites reduces capacity/increases costs); and consequently, (4) a DMMP study is warranted.

Based on the conclusions of the Preliminary Assessment, the report recommended (1) commencing a Phase I Scope of Work (SOW) or Project Management Plan (PMP) that identifies the scope, resources, and schedule for conducting a management plan; (2) conducting the Phase II - Baltimore Harbor and Channels DMMP following approval of the PMP; and (3) beginning concurrent investigations of placement options at Poplar Island, Mid-Chesapeake Bay Islands, and Eastern Neck utilizing existing authorities. The Federal DMMP Study was initiated in January 2003 and completed in December of 2005. This report implements the third recommendation of the 2001 preliminary assessment.

The Federal DMMP considered 79 alternatives ranging from existing placement sites, new placement sites, beneficial use sites, and innovative use sites. The 79 alternatives were combined into groups, or suites of alternatives. Each suite was a combination of alternatives that together met the dredged placement capacity need for one or more geographic subarea. The suites covered an evaluation of restoration at all islands in the Chesapeake Bay. Over 14,000 suites were considered.

Through a rigorous and systematic process, dredged material placement alternatives were compared for capacity, cost, ecosystem benefit and/or impact, and implementation risk, resulting in the selection of a recommended plan. One of the generic options analyzed during the Federal DMMP process was restoration of island habitat. Remote island habitat is critical to the Chesapeake Bay ecosystem. In the last 150 years, it has been estimated that 10,500 ac have been lost in the middle-eastern portion of Chesapeake Bay due to erosion and sea-level rise. Most island habitats will likely be completely eroded and lost to the Chesapeake Bay in the next 10 to 20 years (Leatherman, S. et al, 1995). These islands provide a uniquely isolated nesting and foraging habitat to a diverse assemblage of wildlife. Section 2 of this report provides more detail on the loss of habitat in the Chesapeake Bay and the significance of this valuable resource.

The DMMP's recommended plan consists of six dredged material placement alternatives that together will provide sufficient dredged material placement capacity through the next 20 years, with some capacity remaining for out-year use. These six placement alternatives are continued use of the open water placement sites in Virginia; optimized use of existing dredged material management sites including Pooles Island Open Water Site, Hart-Miller Island Dredged Material Containment Facility (DMCF), Cox Creek Confined Disposal Facility (CDF), and The Paul S. Sarbanes Ecosystem Restoration Project at Poplar Island (PIERP); wetland restoration in Dorchester County, MD, at Blackwater National Wildlife Refuge; large island restoration in the Middle Bay; construction of multiple CDFs in the Patapsco River, MD; and expansion of the currently authorized PIERP restoration project. These alternatives were determined to have little adverse impact on the quality of the environment and have the potential to provide ecosystem benefit by restoring critical habitat and protecting the existing habitat from further degradation (USACE, 2005). Only dredged material from the Chesapeake Bay approach channels and the C& D lower approach channels were considered for island restoration options in this report (Figures 1-2 and 1-3), which includes the placement alternatives accepting material. The DMMP also defined the Federal Standard, or base plan, option for cost-sharing purposes for each channel reach. For the Chesapeake Bay approach channels to the Port of Baltimore, the Federal Standard is overboard placement in a deep-water area of the Bay known as the Deep Trough. For the C&D Canal southern approach channels, the current Federal Standard is overboard placement near Pooles Island.

1.2 *STUDY AUTHORIZATION

In accordance with Section 905(b) of the Water Resources Development Act (WRDA) of 1996, USACE conducted a reconnaissance study of the Maryland and Delaware portions of the Delmarva Peninsula lying within the Chesapeake Bay watershed. USACE received the authority to pursue the study under the resolution of the Senate Committee on Environment and Public Works on 5 June 1997, which reads:

> *Resolved by the Committee on Environment and Public Works of the United States Senate, That the Secretary of the Army is requested to review the report of the Chief of Engineers on the Chesapeake Bay, Maryland and Virginia, published as House Document 176, Eighty-eighth Congress, First Session, and other pertinent reports with a view to conducting watershed management studies, in cooperation with other Federal agencies, the State of Maryland and the State of Delaware, their political subdivisions and agencies and instrumentalities thereof, of water resources improvements in the interest of navigation, flood control, hurricane protection, erosion control, environmental restoration, wetlands protection, and other allied purposes in watersheds of the Eastern Shore, Maryland and Delaware.*

Subsequently, a Section 905(b) Analysis (dated 31 July 1999) was prepared that assessed the water resources problems and needs of the watershed areas. According to the 905(b) report, one of the most significant indicators of degradation within the study area was wetland loss. The Eastern Shore, MD and DE Section 905(b) Analysis (i.e. Eastern Shore study) was conducted within an ecosystem management framework and considered aquatic and riparian habitat restoration; dredged material management; wetland restoration, creation, and protection; navigation; shoreline and streambank erosion control; flood control; water quality improvements; and hurricane protection for the Eastern Shore, MD and DE (USACE, 1999). Beneficial use of dredged material is one alternative that could address the significant loss of aquatic ecosystem habitat within the study area.

Based on the findings of the Eastern Shore study, the preliminary assessment, and recommendations of the Federal DMMP study, the Mid-Chesapeake Bay study was initiated in November 2002 by the USACE-Baltimore District and the Maryland Port Administration (MPA). While numerous opportunities to restore habitat exist within the study area, this feasibility study addresses the specific recommendation of the Eastern Shore study to replace aquatic ecosystem habitats lost through development and erosion activities within the study area through the beneficial use of dredged material, focusing on the loss of island habitat consisting of both wetlands and uplands.

1.3 *STUDY PURPOSE AND NEED

This study builds upon the Federal and State's DMMP planning efforts to identify beneficial use sites. The purpose of this study is to determine the technical, economic, and environmental feasibility of protecting, restoring, and creating aquatic, intertidal wetland, and upland habitat for fish and wildlife within the Mid-Chesapeake Bay Islands study area (Figure 1-1) using clean dredged material from the Baltimore Harbor and Channels Federal navigation project (Figures 1-2 and 1-3). To meet the needs identified by the Federal DMMP, the proposed project should provide the capability of receiving 30 to 70 mcy of clean dredged material over a 20-year period (3.2 mcy/y). Although 'restoration' implies a focus on historic island sites, areas that once supported islands also provide a preferred geotechnical base for island habitat versus creating islands in areas where islands never existed. Areas that once supported islands have been previously loaded are are, therefore, less likely to have soft, compressible materials for a substrate.

Specifically, this feasibility study will (1) examine and evaluate the problems and opportunities related to the restoration of island habitat through the beneficial use of dredged material; (2) formulate plans to address these problems and opportunities; and (3) recommend cost-effective solutions for implementing a project, or projects, that will restore island ecosystem habitat and address dredged material management options recommended in the Federal DMMP.

1.4 *PLANNING AREA

1.4.1 Study area

As described in the Eastern Shore Authority, the Mid-Chesapeake Bay study area includes the eastern half of the Chesapeake Bay, from the Chester River to the MD/VA state line (Figure 1-1). This area is consistent with those geographical areas outlined in the Federal DMMP, which broke the Chesapeake Bay into following four regions:

- Upper Bay—The region of the Bay and its tributaries above the Chesapeake Bay Bridge.
- Baltimore Harbor—The Patapsco River and its tributaries west of the North Point -Rock Point Line.
- Middle Bay—The region of the Bay and its tributaries from the Chesapeake Bay Bridge south to the Virginia state line.
- Lower Bay—The region of the Bay and its tributaries south of the Virginia state line.

To remain consistent with the initial intention of this study outlined in the preliminary DMMP, potential beneficial use sites were inventoried within the Middle Bay region using the Maryland Department of Natural Resources (MDNR) database of natural resources. According to this database, 105 named islands are present within the study area, all of which were considered in the study scoping process described in Section 4.2 of this report.

1.4.2 Project Area

Due to the large number of potential island restoration sites and the many requirements needed for successful large-scale restoration using dredged material, an initial screening of these islands was conducted to refine the project area. The purpose of the initial screening was to eliminate sites that could not accommodate a large-scale restoration project, minimize the scope of the study, and allow for the determination of existing conditions for only those sites selected for detailed alternative formulation. The initial screening resulted in the selection of James and Barren Islands as potential island restoration sites for further study (Figure 1-4). The scoping process undertaken as part of this study confirms earlier results of the State's Dredged Material Management Plan, which prioritized potential beneficial use sites of dredged material throughout the Bay. A detailed discussion of this screening process can be found in Section 4.3. Detailed information on existing conditions at both of these islands is provided in Section 3.

1.4.3 Affected Area

To ensure the recommendations of this study are consistent with on-going studies within the study area, an inventory of on-going projects and studies was conducted at the beginning of the study process. Section 1.5 provides an overview of the on-going projects within the study area. The Federal and State DMMPs are described in more detail Sections 2.1 and 4.1. This inventory influenced the development of objectives and identification of constraints, as outlined in Section 2. The portions of the Bay most likely to be impacted from placement would encompass the entire study area. These impacts are outlined in the Federal DMMP and cited in this report when appropriate. Local impacts focus on areas within the vicinity of James and Barren Islands, including the adjacent shorelines on the mainland that could be impacted by the further loss of existing islands and would benefit from an island restoration project (Figure 1-4).

1.5 ONGOING AND PRIOR STUDIES

1.5.1 Navigation Projects

1.5.1.a Baltimore Harbor and Channels Federal Navigation Project

The Baltimore Harbor and Channels Federal navigation project was authorized by the River and Harbor Act of August 8, 1917, and modified by the River and Harbor Acts of January 21, 1927; July 3, 1930; October 7, 1940; March 2, 1945; July 3, 1958; and December 31, 1970.

The existing navigation project includes a main channel, 50 ft deep, between Cape Henry, VA, and Fort McHenry at Baltimore. The authorized dimensions of the channels are as follows:

1. Cape Henry Channel (Figure 1-5): The Cape Henry Channel is authorized to a depth of 50 ft mean lower low water (MLLW) and a width of 1,000 ft from the 50-ft depth curve in the Atlantic Ocean to that depth in the Chesapeake Bay. The Cape Henry Channel is approximately three miles long.

2. York Spit Channel (Figure 1-5): The York Spit Channel is authorized to a depth of 50 ft MLLW and a width of 1,000 ft, connecting the 50-foot depth curves in the Chesapeake

Bay opposite the York River near York Spit. The York Spit Channel is constructed to a width of 800 ft and is 18.4 miles long.

3. Rappahannock Shoal Channel (Figure 1-5): The Rappahannock Shoal Channel is authorized to a depth of 50 ft MLLW and a width of 1,000 ft, connecting the 50-foot depth curves in the Chesapeake Bay opposite the Rappahannock River. The Rappahannock Shoal Channel is constructed to a width of 800 ft and is 10.3 miles long.

4. Craighill Approach Channel to Fort McHenry (Figure 1-3): This series of channels is authorized to a depth of 50 ft MLLW and a width of 800 ft. However, the channels are constructed to 700 ft wide, widened at the entrance and bends, from the 50-foot depth curve in the Chesapeake Bay opposite the mouth of the Magothy River to Fort McHenry on the Patapsco River, a distance of 20.7 miles.

   (a) Craighill Entrance (Figure 1-3): The Craighill Entrance Channel is 3.6 miles long, 700 ft wide, and authorized to a depth of 50 ft MLLW.
   (b) Craighill Channel (Figure 1-3): The Craighill Channel connects the Craighill Entrance with Craighill Angle, and is approximately 3.2 miles long, 700 ft wide, and authorized to a depth of 50 ft MLLW.
   (c) Craighill Angle (Figure 1-3): The Craighill Angle is approximately 1.8 miles long, ranges in width from 700 to 1,830 ft, and is authorized to a depth of 50 ft MLLW.
   (d) Craighill Upper Range (Figure 1-3): The Craighill Upper Range is approximately 2.4 miles long, 700 ft wide, and authorized to a depth of 50 ft MLLW.
   (e) Cutoff Angle (Figure 1-3): The Cutoff Angle connects the Craighill Upper Range to Brewerton Channel, and is approximately 1.1 miles long, ranges in width from 700 to 1,650 ft, and is authorized to a depth of 50 ft MLLW.
   (f) Brewerton Channel (Figure 1-6): The Brewerton Channel is located within the Patapsco River and is approximately 3.4 miles long, 700 ft wide, and authorized to a depth of 50 ft MLLW.
   (g) Brewerton Angle (Figure 1-6): Brewerton Angle connects the Brewerton Channel and the Fort McHenry Channel, and is approximately 1.0 mile long, ranges in width from 700 to 1,375 ft, and is authorized to a depth of 50 ft MLLW.
   (h) Fort McHenry Channel (Figure 1-6): The Fort McHenry Channel is approximately 4.2 miles long, 700 ft wide, and authorized to a depth of 50 ft MLLW. The Fort McHenry Channel is the main channel in the Patapsco River.

The existing navigation project also authorizes a series of branch channels that provide access to the various public and private terminals serving the Port of Baltimore and that connect the main channel with the C&D Canal and approach channels. The dimensions of the branch channels are as follows:

1. Connecting Channel to C&D Canal Approach Channel (Figure 1-3): This series of channels are authorized to a depth of 35-ft MLLW, a width of 600-ft, and are approximately 15.6 miles long from the Cutoff Angle in the main channel to the 35-foot depth curves in the natural channel on the east side of the Chesapeake Bay, which is part of the Inland Waterway from the Delaware River to the Chesapeake Bay. The connecting

channel includes the Brewerton Channel Eastern Extension, and the Swan Point and Tolchester Channels.

(a) Brewerton Channel Eastern Extension: The Brewerton Channel Eastern Extension is approximately 6.3 miles long, 600 ft wide and 35 ft deep, MLLW.
(b) Swan Point Channel: Swan Point Channel is approximately 2.8 miles long, 600 ft wide and 35 ft deep, MLLW.
(c) Tolchester Channel: Tolchester Channel connects with the Brewerton Channel Eastern Extension, and is approximately 7.2 miles long, 600 ft wide, and is 35 ft deep, MLLW.

2. Curtis Bay Channel (Figure 1-6): Curtis Bay Channel is authorized to 600 ft wide (constructed to 400 ft wide), 50-ft deep, and 2.2 miles long from the main channel to, and including, a 1,275-foot wide turning basin at the head of Curtis Bay.

3. Curtis Creek Channel (Figure 1-6): Curtis Creek Channel is a total of approximately 2.3 miles long, and includes three channel reaches and two basins, as described below:

(a) The lower reach of the Curtis Creek Channel is authorized to a depth of 35 ft MLLW and a width of 200 ft, from the 50-foot channel in Curtis Bay to 750 ft downstream of the Pennington Avenue Bridge, a distance of 0.9 mile.
(b) The middle reach of the Curtis Creek Channel is authorized to a depth of 22 ft MLLW and a width of 200 ft from the 35-foot channel to, and along, the marginal wharf of the Curtis Bay Ordnance Depot.
(c) An irregularly shaped basin 18 ft deep and 320 ft wide, adjacent to the head of the 22-foot channel, a distance of 600 ft.
(d) A basin 15 ft deep and 450 ft wide, from the end of the 22-foot channel to the end of the marginal wharf, a distance of 0.2 mile.
(e) The upper reach of the Curtis Creek Channel is authorized to a depth of 22 ft MLLW and a width of 200 ft, from the 22-foot channel of the CSX Rail Transport bridge to the vicinity of Arundel Cove, a distance of 2,800 ft, then 100 ft wide in Arundel Cove for a distance of 2,100 ft, with an anchorage basin 700-ft square adjacent to the channel and southwest of the wharf of the Coast Guard Depot at Curtis Bay.

4. Middle Branch (Ferry Bar East Section) (Figure 1-6): The Ferry Bar East Section of the Middle Branch is authorized to a depth of 42 ft MLLW and width of 600 ft , from the main channel at Fort McHenry to Ferry Bar, a distance of 1.4 miles. NOTE: The West Ferry Bar and Spring Garden Sections of the existing project were deauthorized by Section 1001 of WRDA of 1986, Public Law (PL) 99-662.

5. Northwest Branch (Figure 1-6):

(a) East Channel: The East Channel connects to the Fort McHenry Channel and is authorized to a depth of 49 ft MLLW, a width of 600 ft, and is 1.3 miles long with a 950-foot-wide turning basin at the head of the channel.

(b) West Channel: The West Channel is authorized to a depth of 40 ft MLLW, a width of 600 ft, and is 1.3 miles long, with a 1,050-foot-wide turning basin at the head of the channel.

1.5.1.b Baltimore Harbor Anchorages and Channels Project

The Baltimore Harbor Anchorages and Channels Project (Figure 1-6) was authorized by Section 101a (22), WRDA of 1999, and provides for:

1. The Dundalk West Channel: The Dundalk West Channel is authorized to a depth of 42 ft MLLW, a width of 500 ft, and is approximately 3,800 ft long, with widening at the bends and entrances.

2. The Seagirt West Channel: The Seagirt West Channel is authorized to a depth of 42 ft MLLW, a width of 500 ft, and is approximately 5,600 ft long, with widening at the bends and entrances.

3. The Dundalk- Seagirt Connecting Channel: The Dundalk- Seagirt Connecting Channel is authorized to a depth of 42 ft MLLW, a width of 500 ft, and is approximately 2,500 ft long, with widening at both ends;

4. The East Dundalk Channel: The Dundalk East Channel is authorized to a depth of 38 ft MLLW, a width of 400 ft, and is approximately 3,800 ft long, with widening at the bends and entrances.

5. The South Locust Point Channel: The South Locust Point Channel is authorized to a depth of 36 ft MLLW, a width of 400 ft, and is approximately 5,600 ft long, with widening at the bends and entrances.

6. Deepening of Anchorage #3 to 42 ft MLLW for a width of 2,200 ft and a length of 2,200 ft, and an additional length of 1,800 ft and width of 1,800 ft. The remaining portion of Anchorage #3, just west of the improved areas, will remain at its currently authorized depth of 35 ft MLLW, for a width of 1,500 ft and a length of 300 ft;

7. Deepening of Anchorage #4 to 35-ft MLLW for a width of 1,800 ft and a length of 1,800 ft;

8. A turning basin at the head of the Fort McHenry Channel, 1,200 ft wide by 1,200 ft long, and a depth of 50 ft MLLW.

9. Deauthorization of Anchorage #1.

10. Federal assumption of maintenance of the existing Seagirt Marine Terminal, Dundalk Marine Terminal, and South Locust Point Marine Terminal channels, exclusive of berthing areas, and Federal maintenance of a 42-foot depth (MLLW) in the area between the Connecting Channel and the proposed Seagirt Marine Terminal Berth 4 upon completion of dredging to that depth by the State of Maryland.

1.5.1.c Inland Waterway, Delaware River to Chesapeake Bay, Delaware and Maryland, Chesapeake and Delaware Canal Project

The C&D Canal Project authorizes maintenance of the approach channels to the C&D Canal. The C&D Canal Project is under the jurisdiction of USACE-Philadelphia District, and was adopted as House Document 63-196 in 1919 and modified by Section 3 of the River and Harbor Act of 1927, by River and Harbor Committee Document 71-41 and Senate Document 71-151 in 1930, by House Document 72-201, House Document 73-18, and House Document 73-24 in 1935, and Senate Document 83-123 in 1954.

The approach channels to the C&D Canal extend approximately 30 miles from Town Point near the western end of the C&D Canal southwest to the vicinity of Pooles Island. The project provides a channel 35-ft deep (MLLW) and 450-ft wide from the Delaware River through Elk River and the Chesapeake Bay, to water of natural 35-ft depth in the Chesapeake Bay. The southern approach channels to the C&D Canal extend approximately 15 nautical miles from the mouth of the Sassafras River southwest to the natural 35-ft contour of the Chesapeake Bay (Figure 1-7) near Pooles Island.

1.5.1.d Other Federal Navigation Channels

Other Federal navigation channels that require periodic maintenance dredging, which are located between the William Preston Lane, Jr. Memorial Bridge (Bay Bridge) and the State of Maryland and Commonwealth of Virginia border are listed below. The numbers after each channel project correspond with the map as shown on Figure 1-7.

1.5.1.d.1 Eastern Side of the Chesapeake Bay

1) Black Walnut Harbor, MD (8): The project provides for a channel 6 feet deep and 60 feet, with an anchorage basin 6 feet deep, 400 feet long, and 400 feet wide. The project length is 4,530 feet.

2) Broad Creek, MD (36): The project provides for a channel 6 feet deep and 100 feet wide. The project length is 3.2 miles.

3) Broad Creek River, DE (25): The project provides for a channel 8 feet deep and 70 feet wide, with a turning basin 8 feet deep. The project length is 4.5 miles.

4) Cambridge Harbor, MD (18): The project provides for a channel 25 feet deep and 150 feet wide, with a turning basin 25 feet deep, 1,400 feet long, and 750 feet wide; a channel 14 feet deep and 150 feet wide; a channel 14 feet deep and 100 feet wide, with a turning basin 14 feet deep; an anchorage basin 10 feet deep, 400 feet long, and 175 feet wide; an anchorage basin 10 feet deep, 225 feet long, and 200 feet wide; and a channel 7 feet deep and 60 feet wide.

5) Chester River, MD (51): The project provides for a channel 6 feet deep and 60 feet wide from Crumpton to Jones Landing; a channel 7 feet deep and 75 feet wide from Chester River through Kent Island Narrows to Prospect Bay; and a channel 7 feet deep, 75 feet

wide, and 800 feet long into Wells Cove, with a turning basin 7 feet deep, 300 feet long, and 300 feet wide.

6) Choptank River, MD (15): The project provides for a channel 8 feet deep and 75 feet wide. The project length is 8.25 miles.

7) Claiborne Harbor, MD (5): The project provides for a channel 14 feet deep and 100 to 150 feet wide. The project length is 1.2 miles. The project is currently maintained to 6 feet deep, commensurate with navigation needs.

8) Corsica River, MD (1): The project provides for a channel 8 feet deep and 100 feet, with a turning basin 8 feet deep, 300 feet long, and 200 feet wide. The project length is 5 miles.

9) Crisfield Harbor, MD (35): The project provides for a channel 12 feet deep and 425 feet wide; a channel 12 feet deep and 226 feet wide; a channel 10 feet deep and 100 feet wide; a channel 10 feet deep and 60 feet wide, with an anchorage basin 10 feet deep, 1,000 feet long, and 600 feet wide; a channel 7 feet deep and 100 feet wide; a channel 7 feet deep and 60 feet wide; and a mooring basin 7 feet deep, 875 feet long, and 160 feet wide. The project length is 6 miles.

10) Duck Point Cove (Hearns Creek), MD (22): The project provides for a channel 6 feet deep and 60 feet wide, with a mooring basin 6 feet deep, 300 feet long, and 100 feet wide. The project length is 4,405 feet.

11) Fishing Bay, MD (23): The project provides for channels 6 feet deep and 60 feet wide in McCreadys Creek, Farm Creek, and Goose Creek. The total project length is 16,200 feet.

12) Goose Creek, MD (33): The project provides for a channel 6 feet deep and 60 feet wide, with an anchorage basin 6 feet deep, 170 feet long, and 120 feet wide. The project length is 3,900 feet.

13) Honga River and Tar Bay, MD (20): The project provides for channels 7 feet deep and 60 feet wide and a turning basin 7 feet deep, 200 feet long, and 150 feet wide. The project length is 5.8 miles.

14) Island Creek, MD (13): The project provides for a channel 8 feet deep and 75 feet wide. The project length is 1,400 feet.

15) Knapps Narrows, MD (7): The project provides for a channel 9 feet deep and 75 feet wide. The project length is 9,000 feet.

16) La Trappe River, MD (14): The project provides for a channel 11 feet deep and 150 feet wide and a channel 8 feet deep and 75 feet wide, with a turning basin 8 feet deep. The project length is 1.2 miles.

17) Little Creek, Kent Island, MD (3): The project provides for a channel 7 feet deep and 60 feet wide, with a turning basin 7 feet deep, 250 feet long, and 150 feet wide. The project length is 1,850 feet.

18) Lower Thorofare, MD (31): The project provides for a channel 7 feet deep and 60 feet wide, with a mooring basin 7 feet deep, 300 feet long, and 100 feet wide. The project length is 4,700 feet.

19) Lowes Wharf, MD (6): The project provides for a channel 7 feet deep and 60 feet wide, with a turning basin 7 feet deep, 300 feet long, and 200 feet wide. The project length is 1,500 feet.

20) Madison Bay, MD (50): The project provides for a channel 6 feet deep and 60 feet wide, with a turning basin 6 feet deep, 100 feet long, and 75 feet wide and an anchorage basin 6 feet deep, 150 feet long, and 100 feet wide. The project length is 3,000 feet.

21) Manokin River, MD (32): The project provides for a channel 6 feet deep and 100 feet wide. The project length is 3 miles.

22) Muddy Hook and Tyler Coves, MD (21): The Muddy Hook Cove project provides for a channel 60 feet deep and 60 feet wide, with an anchorage basin 6 feet deep, 400 feet long, and 160 feet wide. The project length is 3,000 feet. The Tyler Cove project provides for a channel 6 feet deep and 60 feet wide, with an anchorage basin 6 feet deep, 250 feet long, and 200 feet wide. The project length is 750 feet.

23) Nanticoke River at Bivalve, MD (27): The project provides for a channel 7 feet deep and 60 feet wide, with an anchorage basin 7 feet deep, 350 feet long, and 150 feet wide. The project length is 1,950 feet.

24) Nanticoke River at Nanticoke, MD (28): The project provides for a channel 7 feet deep and 60 feet wide, with a basin 7 feet deep, 400 feet long, and 120 feet wide.

25) Nanticoke River, DE & MD (24): The project provides for a channel 12 feet deep and 100 feet wide, with a turning basin 12 feet deep and a channel 6 feet deep and 60 feet wide, with a turning basin 6 feet deep. The project length is 8 miles.

26) Neavitt Harbor, MD (10): The project provides for a channel 6 feet deep and 60 feet wide, with an anchorage basin 6 feet deep, 370 feet long, and 270 feet wide.

27) Pocomoke River, MD (37): The project provides for a channel 9 feet deep and 100 to 130 feet wide and a channel 7 feet deep and 100 feet wide. The project length is 5.4 miles.

28) Queenstown Harbor, MD (2): The project provides for a channel 10 feet deep and 200 feet wide and a channel 7 feet deep and 75 feet wide, with a turning basin 7 feet deep, 300 feet long, and 300 feet wide. The project length is 1.2 miles.

29) <u>Rhodes Point to Tylerton, MD</u> (40): The project provides for a channel 10 feet deep and 200 feet wide and a channel 7 feet deep and 75 feet wide, with a turning basin 7 feet deep, 300 feet long, and 300 feet wide. The project length is 1.2 miles.

30) <u>Shad Landing State Park, MD</u> (38): The project provides for a channel 6 feet deep and 60 feet wide, with a turning basin 6 feet deep, 575 feet long, and 000 feet wide. The project length is 1,575 feet.

31) <u>Slaughter Creek, MD</u> (19): The project provides for a channel 7 feet deep and 100 feet wide. The project length is 1,740 feet.

32) <u>St. Michaels, MD</u> (4): The project provides for a channel 6 feet deep and 50 feet wide, with a turning basin 6 feet deep, 200 feet long, and 100 feet wide. The project length is 650 feet.

33) <u>St. Peters Creek, MD</u> (34): The project provides for a channel 6 feet deep and 60 feet wide, with a turning basin 6 feet deep, 500 feet long, and 150 feet wide. The project length is 7,400 feet.

34) <u>Tilghman Island Harbor (Dogwood Harbor), MD</u> (9): The project provides for a channel 6 feet deep and 60 feet wide, with an anchorage basin 6 feet deep, 500 feet long, and 200 feet wide. The project length is 2,080 feet.

35) <u>Town Creek, MD</u> (12): The project provides for a channel 10 feet deep and 100 feet wide, with an anchorage basin 10 feet deep, 300 feet long, and 300 feet wide; a channel 8 feet deep and 100 feet wide, with an anchorage basin 8 feet deep, 300 feet long, and 300 feet wide; and a channel 7 feet deep and 60 feet wide, with a turning basin 7 feet deep, 200 feet long, and 100 feet wide. The project length is 4,800 feet.

36) <u>Tred Avon River, MD</u> (11): The project provides for a channel 12 feet deep and 150 feet wide, with a turning basin 12 feet deep, 600 feet long, and 250 feet wide. The project length is 2 miles.

37) <u>Tuckahoe River, MD</u> (16): The project provides for a channel 8 feet deep and 150 feet wide. The project length is 5,600 feet.

38) <u>Twitch Cove and Big Thorofare River, MD</u> (39): The project provides for channels 7 feet deep and 60 and 100 feet wide, with an anchorage basin 7 feet deep, 700 feet long, and 100 feet wide; a channel 6 feet deep and 60 feet wide; and a channel 4 feet deep and 25 feet wide.

39) <u>Tyaskin Creek, MD</u> (26): The project provides for a channel 9 feet deep and 120 feet wide, with a turning basin 9 feet deep. The project length is 3,500 feet.

40) Upper Thorofare, MD (30): The project provides for a channel 9 feet deep and 100 feet wide; a turning basin 9 feet deep; and anchorage basin 9 feet deep, 650 feet long, and 300 feet wide; and an anchorage basin 6 feet deep. The project length is 3,300 feet.

41) Warwick River, MD (17): The project provides for a channel 10 feet deep and 100 feet wide, with a turning basin. The project length is 1.5 miles.

42) Wicomico River, MD (29): The project provides for a channel 14 feet deep and 150 feet wide; a channel 14 feet deep and 100 feet wide, with turning basins 14 feet deep; and a channel 6 feet deep and 60 feet wide, with a turning basin 6 feet deep, 400 feet long, and 100 feet wide and two basins 6 feet deep, 200 feet long and 100 feet wide. The project length is 37 miles.

1.5.1.d.2 Western Side of the Chesapeake Bay

1) Annapolis Harbor, MD (48): The project provides for a channel 15 feet deep and 100 feet, with an anchorage basin 12 feet deep. The project length is 4,000 feet.

2) Back Creek, MD (47): The project provides for a channel 8 feet deep and 100 feet wide. The project length is 900 feet.

3) Cypress Creek, MD (49): The project provides for a channel 7 feet deep and 75 feet wide. The project length is 300 feet.

4) Fishing Creek, MD (44): The project provides for a channel 7 feet deep and 100 and 60 feet wide, with an anchorage basin 7 feet deep, 400 feet long, and 120 feet wide. The project length is 4,200 feet.

5) Herring Bay and Rockhold Creek, MD (45): The project provides for a channel 7 feet deep and 60 feet wide, with a turning basin 7 feet deep, 150 feet long, and 100 feet wide. The project length is 7,300 feet.

6) Nan Cove, MD (43): The project provides for a channel 6 feet deep and 40 feet wide, with an anchorage basin 6 feet deep, 190 feet long, and 150 feet wide. The project length is 2,195 feet.

7) Parish Creek, MD (46): The project provides for a channel 8 feet deep and 50 feet wide, with an anchorage basin 6 feet deep, 425 feet long, and 150 feet wide. The project length is 4,010 feet.

8) Patuxent River, MD (42): The project provides for a channel 10 feet deep and 100 feet wide, with a turning basin 10 feet deep, 350 feet long, and 240 feet wide. The project length is 750 feet.

9) St. Jerome Creek, MD (41): The project provides for a channel 7 feet deep and 100 feet wide and a channel 7 feet deep and 60 feet wide, with a turning basin 7 feet deep, 300 feet long, and 200 feet wide. The project length is 4,900 feet.

1.5.1.e Federal Navigation Channels in the Vicinity of James Island

While the Federal navigation projects listed in paragraph 1.5.1.d above require periodic maintenance dredging and could potentially use James Island as a placement site, the Cambridge Harbor (4), Madison Bay (20), and Slaughter Creek (31), Federal navigation projects are located in the vicinity of James Island and would be the projects most likely to use the site (Figure 1-7). Dredged material placement sites for these projects are developed on a case-by-case basis due to the limited funding available to dredge these projects and the infrequent dredging requirements of the projects. Table 1-1 provides information on the more recent maintenance dredging episodes. These projects are anticipated to contribute an insignificant amount of dredged material to the James Island project. Any additional costs to use the James Island site beyond the Federal standard or base plan for the navigation projects would be expected to be small and would be funded by the James Island project and cost-shared between the Federal Government (65 percent) and the MPA (35 percent).

1.5.1.f Federal Navigation Channels in the Vicinity of Barren Island

While the Federal navigation projects listed in paragraph 1.5.1.d above require periodic maintenance dredging and could potentially use Barren Island as a placement site, the Duck Point Cove (10), Honga River and Tar Bay (13), and Muddy Hook and Tyler Coves (22) Federal navigation projects are located in the vicinity of Barren Island and would be the projects most likely to use the site (Figure 1-7). Dredged material placement sites for these projects are developed on a case-by-case basis due to the limited funding available to dredge these projects and the infrequent dredging requirements of the projects. Dredged material from the Honga River and Tar Bay and Muddy Hook and Tyler Coves projects has been used beneficially in the past to create island and wetland habitat nearby and along the shoreline of Barren Island. Table 1-2 provides information on the more recent maintenance dredging episodes. Since the Barren Island project is in the vicinity of these channels, costs for providing the necessary containment structures, wetland planting, etc. will be funded under the existing Barren Island project and cost-shared between the Federal Government (65 percent) and the MPA (35 percent), the use of the Barren Island site will be considered comparable to the Federal standard or base plan for the channels. Therefore, the Barren Island project would not fund any additional dredging costs for these projects to use the Barren Island site.

1.5.2 Beneficial Use of Dredged Material

1.5.2.a Paul S. Sarbanes Ecosystem Restoration Project at Poplar Island

The Paul S. Sarbanes Ecosystem Restoration at Poplar Island is an ecosystem restoration project located in the Chesapeake Bay, Talbot County, MD; 39 miles (34 nautical miles) south-southeast of the Port of Baltimore, and two miles northwest of Tilghman Island. Dredged material from the Upper Chesapeake Bay Approach Channels to the Port of Baltimore is being beneficially used to restore 1,140 ac of wetland and upland habitat. The PIERP is planned to create approximately 570 ac of wetland and 570 ac of upland habitat, and it is estimated that by 2014

PIERP will provide up to 40 million cubic yards (mcy) of dredged material placement capacity. The island restoration will resemble the approximate 1847 footprint, which, as of 1996, had eroded to three separate islands with an area of less than 3 ac. To date, approximately 15 mcy of dredged material has been placed at the site.

1.5.2.b Poplar Island Expansion

Due to dredged placement capacity projected shortfalls within the next 20 years, USACE guidance specifies that the expansion of existing sites should be considered for placement capacity before new placement sites are proposed. The General Reevaluation Report and Supplemental Environmental Impact Statement for PIERP investigated the opportunities for expanding PIERP. The study was completed in September 2005, and recommends the construction of a northern lateral expansion of approximately 575 ac, consisting of 29% wetland, 47% upland, and 24% open water embayment habitat. In addition, vertical expansion of five feet was recommended for two existing upland cells. The final study was publicly released in September 2005. The Chief's report was completed 31 March 2006. The Poplar Island project authorization was modified to include the expansion by Section 3087 of WRDA 2007.

1.5.3 Ecosystem Restoration Projects

1.5.3.a Wetland Restoration in Dorchester County (Blackwater Wildlife Refuge)

Wetland restoration in Dorchester County, MD is one of the seven alternatives recommended for additional study by the Federal DMMP (USACE, 2005a). Blackwater National Wildlife Refuge (Blackwater NWR) is a 28,000 ac complex, consisting of 1/3 wetland, 1/3 forest, and 1/3 open water. More than 7,000 ac of tidal marsh in Blackwater NWR have drowned in place or have been lost to erosion since 1940 as a result of sea level rise, hydrologic changes, wildlife damage, and vegetation management practices (USACE, 2002a). The importance of Blackwater NWR has been recognized nationally and internationally. Blackwater NWR wetlands are designated as wetlands of international importance. Blackwater NWR is one of six priority wetland areas identified by the North American Waterfowl Management Plan. Further, The Nature Conservancy has named Blackwater NWR one of the 'Last Great Places'. In 2001, USACE, US Fish and Wildlife Service (USFWS), and MDNR began investigations under Section 206 Aquatic Ecosystem Restoration of the Continuing Authorities Program to assess the feasibility of restoring several hundred acres of brackish marsh in the Blackwater NWR. The MDNR, the study sponsor of that effort, has been involved in further Blackwater restoration studies under the auspices of the Maryland Marsh Restoration and Nutria Control Project, PL 105-322.

As part of the Section 206 feasibility assessment (2001), USACE-Baltimore District conducted a demonstration project using thin-layer spraying and conventional dredged material placement techniques on approximately 15 to 20 ac of degraded marsh at Blackwater NWR. Dredged material was used to increase the surface elevation in areas where the marsh was failing or had recently failed. The raised areas were then planted with wetland flora (USACE, 2002a and 2004). Monitoring studies indicated that the marsh plants performed well during their first summer of growth (USACE, 2004). The National Aquarium in Baltimore is continuing to monitor plant performance and site elevations in the restoration demonstration areas.

Future ecosystem restoration efforts at Blackwater NWR are necessary and important for several reasons: the Blackwater marsh system is of great regional ecological significance; tidal marsh losses have been extensive and are likely to have regional ecologically detrimental consequences; human activities have contributed to marsh losses; and the tidal marshes will not recover without human intervention. The project proposed in the Federal DMMP consists of placement of approximately 2 feet of dredged material (totaling approximately six mcy) over approximately 2,000 ac of degraded wetlands in Dorchester County. The dredged material would be hydraulically pumped into temporary containment (earthen berms) in the areas proposed for restoration. The proposed wetland restoration in Dorchester County would create positive impacts to wetlands, water birds, and water quality. USACE was appropriated funds in the fiscal year 2008 budget to investigate restoration of the Dorchester County wetlands under the General Investigations Program.

1.5.3.b Smith Island (MD) Environmental Restoration and Protection Project

Smith Island is located in Somerset County, MD. In its entirety, Smith Island has lost over 3,300 ac of wetlands in the last 150 years, and, in the identified project areas alone, it lost almost 2,400 ac of submerged aquatic vegetation (SAV) between 1992 and 1998. The recommended project consists of constructing a total of 19,000 ft of offshore, segmented breakwaters to protect and recreate the strategic areas along the western and northern shorelines of the Martin NWR. The project is estimated to protect 216 ac of wetlands and 540 ac of SAV over a 50-year lifespan, while creating or restoring 24 ac of wetlands and 1,440 ac of SAV. A reconnaissance study was completed in May 1997 and a feasibility study was completed in May 2001. The plans and specifications were completed in July 2003 (100 % design). The project was authorized for construction by Section 1001(26) of WRDA 2007.

1.5.3.c Tangier Island (VA) Aquatic Ecosystem Restoration Study

Tangier Island is located in the Chesapeake Bay approximately 90 miles southeast of Washington, D.C., and is located in Accomack County on Virginia's Eastern Shore (Figure 1-1). The waters in the vicinity of the Tangier formerly had among the most extensive and dense SAV in the entire Chesapeake Bay. Today, these waters still have considerable SAV, but losses have been severe. SAV is the primary nursery habitat for blue crabs (*Callinectes sapidus*) in the Chesapeake Bay and is an important nursery and foraging habitat for a variety of finfish and shellfish species. Authorized under Section 206,of WRDA 1996, as amended, the first part of the feasibility phase, culminating with the Preliminary Restoration Plan, was approved in October 2001. The second part of the feasibility phase, resulting in the Detailed Project Report (DPR), was initiated in March 2002. The Draft DPR was submitted in September 2004 and included a tentatively selected plan consisting of six offshore breakwaters along the western side of the northern half of the island and one offshore breakwater at the northern tip of the island. The primary benefits of the project would be to protect about 359 ac of wetland and 196 ac of SAV beds, and restore about 3 ac of wetland and 178 ac of SAV beds. It is expected that the additional SAV beds would increase both blue crab juveniles and adults by approximately 47.5 % when compared to the current population. There would also be benefits to the finfish, shellfish, and waterfowl populations. This study is currently on hold pending additional funds.

1.5.3.d Taylors Island Aquatic Ecosystem Restoration Study

Taylors Island is in Dorchester County on Maryland's Eastern Shore at the mouth of the Little Choptank River in the Chesapeake Bay. Authorized by Section 510, WRDA 1996, the project intent is to protect approximately 150 acres of tidal wetlands that are adjacent to the Taylors Island Wildlife Management Area from erosion; stabilize the shoreline along Punch Island Road; and use dredged material to create approximately 1 ac of wetland on the northwest shoreline of Barren Island. The recommended plan is to construct a stone revetment along Punch Island Road and up to 12 breakwaters to protect a total of approximately 4,700 linear feet of shoreline.

1.5.4 Reconnaissance Studies

1.5.4.a Eastern Shore Reconnaissance Study

In accordance with Section 905(b), WRDA of 1996, USACE-Baltimore District conducted a reconnaissance study of the MD and DE portions of the Delmarva Peninsula lying within the Chesapeake Bay watershed. Subsequently a Section 905(b) Analysis (dated 31 July 1999) was prepared that assessed the water resources problems and needs of the watershed areas. The Eastern Shore, MD and DE Section 905(b) Analysis was conducted within an ecosystem management framework and considered aquatic and riparian habitat restoration; dredged material management; wetland restoration, creation, and protection; navigation; shoreline and streambank erosion control; flood control; water quality improvements; and hurricane protection for the Eastern Shore, MD and DE (USACE, 1999). The study determined that the regional large-scale loss of wetlands to agriculture and development was among the paramount water resources issues within the study area. The study identified several projects that were within the Federal interest and were, thus, recommended for further detailed feasibility-level study, including the identification of potential projects for the beneficial use of dredged material.

1.5.4.b Shoreline Erosion Study

The Chesapeake Bay Shoreline Erosion Reconnaissance Report Part I was completed in December 2002. The first part of the report focused on the Susquehanna River and sediment accumulating behind the hydropower dams across the river below Harrisburg, PA. The Chesapeake Bay Shoreline Erosion Reconnaissance Report--Part II was completed in July 2003 and certified by U.S. Army Corps of Engineers Headquarters (USACE HQ) in May 2004. This report concluded that restoration of near-shore habitats, protection of publicly-owned infrastructure, and development of plans to manage for shoreline erosion and sea-level rise in an environmentally-sensitive manner within the Chesapeake Bay watershed were necessary to maintain and restore shoreline fish and wildlife habitat. A feasibility study was initiated in September 2004 with the MDNR. This proposed work is being conducted under USACE's ecosystem restoration mission and hurricane and storm damage prevention mission. Incidental benefits from aquatic, estuarine, and riparian restoration projects and management plans may include recreation, storm and flood damage reduction on public and private land, and improved public awareness and education. As part of this effort, USACE-Baltimore District is currently developing a shoreline master plan, designed to help identify and protect key reaches of shorelines within the Maryland coastal zone. The project is producing revised guidance for individual property owners, that focuses on innovative technology and living shoreline approaches. The project is emphasizing Geographic Information System (GIS) based decision making, multi-purpose shoreline protection and restoration projects, and improved recreational access to the shoreline.

1.6 STUDY PROCESS

The Mid-Chesapeake Bay feasibility study followed a process that integrated the National Environmental Policy Act (NEPA) process into the USACE's six-step planning process (ER 1105-2-100), as described below. The steps in the planning process usually occur iteratively, and sometimes concurrently, in order to formulate efficient, effective, complete, and acceptable alternative plans.

1.6.1 USACE Six-Step Planning Process

Step 1: Identify problems and opportunities (project scoping)

Problems and opportunities are defined in order to consider all potential alternatives to solve the problems and achieve the opportunities. Once the problems and opportunities are properly defined, the study planning objectives and constraints can be clearly defined. Project constraints are known limitations in the planning process, and can be associated with resources (limitations on knowledge, expertise, experience, ability, data, information, money, and time) or with legal and policy limits (as defined by law, USACE policy and guidance). The information on problems and opportunities will help to identify primary issues that need to be addressed in subsequent stages of the planning process.

Specific to this study, Step 1 of the planning process was combined with the NEPA scoping process, which determines the scope of issues to be addressed and identifies the significant issues related to a proposed action. Public participation is an integral part of the scoping process. The proposed project is announced to the public by issuing a Notice of Intent in the Federal Register and press releases. Public comments are solicited about details that should be included in the study. One or more public meetings in the local communities that might be affected by the proposed action are normally scheduled (but not required) to solicit additional comments about the project. The purpose of soliciting public input is to properly identify relevant issues, alternatives, and mitigation measures, such that these issues, concerns, or needs can be incorporated and addressed in the Environmental Impact Statement/Supplemental Environmental Impact Statement (EIS/SEIS).

Interested parties solicited for input include:

- Citizens who live or work in the area of the proposed project;
- Public interest groups and communities that have concerns about possible impacts to ecosystem or socioeconomic resources;
- Federal, State, and local government agencies that have responsibilities for managing public resources or services; and
- Scientists and other technical experts with knowledge of the area's natural resources and the possible impacts of the proposed project.

An important objective of the scoping process is to identify specific elements of the environment that might be affected if the proposed project is carried out. If impacts are associated with a concern that is raised during scoping, these concerns are analyzed in detail as part of the NEPA process.

Step 2: Inventory and forecast conditions
A quantitative and qualitative inventory and forecast of critical resources (i.e., physical, demographic, economic, and social) relevant to the problems and opportunities under consideration is used to define existing and future without-project conditions. Existing conditions are those at the time the study is conducted. The future without-project condition reflects the conditions expected during the period of analysis, and provides the basis from which alternative plans are formulated and impacts are assessed.

Step 3: Formulate alternative plans
Alternative plans, including a no-action (no build) alternative, are formulated to identify specific ways to achieve planning objectives within the constraints. In addition to the alternatives that can be directly implemented by the USACE under current authorities, alternatives that could be implemented under the authorities of other Federal agencies, State and local entities, and non-government interests should also be considered. The public is invited to participate in the development of alternatives in the form of public meetings and/or public workshops. Agency coordination meetings may also occur when developing alternatives for the project.

Step 4: Evaluate alternative plans
The evaluation of effects is a comparison of the with-project and without-project conditions, and includes identifying the most likely with-project condition for each alternative, comparing each alternative to the no-action alternative, and characterizing the beneficial and adverse effects of each alternative.

Step 5: Compare alternatives (impacts analysis)
The potential ecosystem and socioeconomic adverse and beneficial impacts of all alternatives, including the no-action alternative, developed in the previous steps are analyzed and compared. The objective of the analysis is to estimate the direct, indirect, and cumulative impacts that might occur, and to compare the impacts of the proposed action with each of the alternatives. The alternatives impact analysis may require collection of scientific or economic data from the region of influence, or the area potentially impacted by the proposed project.

Step 6: Select and describe the recommended plan
A single alternative plan is selected as the recommended plan from the alternatives that were considered. The recommended plan is the alternative that is preferable to taking no action or implementing any of the other alternatives considered during the planning process.

1.6.2 Report Content

This report includes an integrated EIS to satisfy NEPA. Sections required for compliance with NEPA are noted by an asterisk (*) in the table of contents. Supporting documentation is presented in the appendices, which include a technical engineering appendix for the recommended plan, incremental analysis/benefits calculations, real estate requirements, regulatory compliance issues, feasibility-level cost estimates, an adaptive management plan

(AMP), cost risk analysis, external peer review (EPR), planning model independent technical review (ITR), and detailed information on potential impacts of the recommended plan.

1.7 STUDY TEAM

USACE-Baltimore District and the MPA formed a partnership to utilize their diverse expertise as well as to expedite the completion of the feasibility study given the limited remaining capacity at the current dredged material placement sites available to accommodate material from the Baltimore Harbor and Channels Project. This partnership resulted in the establishment of a study team, the PDT, which was comprised of an interdisciplinary professional staff from the technical disciplines necessary to accomplish the study. These individuals included civil, hydraulic, geotechnical and cost engineers, biologists, environmental scientists, archaeologists, marine operations specialists, public involvement specialists, real estate specialists, lawyers, and technicians. In an effort to optimize the ecosystem restoration alternatives developed through this study and to ensure that the final plan recommended reflects input from other resource agencies, a multi-agency approach was developed to complete the formation of the study team. Multi-agency staffing was essential to facilitate the flow of needed information among agencies, and more importantly, to achieve buy-in and ownership by the key public agencies including: MDNR; Maryland Department of the Environment (MDE); United States Environmental Protection Agency, Region III (USEPA); National Oceanic Atmospheric Administration, National Marine Fisheries (NOAA NMFS); NOAA Chesapeake Bay Field Office (CBFO); USFWS CBFO; and USFWS Blackwater NWR. USACE team members were drawn from the staff of USACE-Baltimore District and included representatives from the Programs and Project Management Division, Planning Division, Operations Division, Engineering Division, Real Estate Division, and Office of Counsel. MPA team members were drawn from the staffs of the Harbor Development Branch of the MPA and Maryland Environmental Service (MES), which was under contract to the MPA to provide environmental, dredged material management, and project management expertise. ITR team members were pulled from staff of the USACE-Philadelphia District. The final report ITR was lead by the Ecosystem Restoration Planning Center of Expertise in the Mississippi Valley Division (MVD).

1.7.1 Coordination with On-going Efforts

This feasibility study builds upon on-going efforts by MPA, USACE-Baltimore District, local, state, and Federal natural resources agencies to identify restoration opportunities using dredged material generated from maintenance activities within the Port of Baltimore shipping channels. The State of Maryland's Dredged Material Management Program (State DMMP) is a process used to establish long-term dredging placement plans and to identify potential new sites. This program is one based on sound science and input from various stakeholders, ranging from citizens to environmental groups and state and Federal agencies. Stakeholders are organized into three committees – the Executive Committee, the Management Committee, and the CAC – and are supported by several technical working groups, including the Bay Enhancement Work Group (BEWG) and the Harbor Team (HT) that are tasked with identifying, studying, reviewing, and prioritizing potential dredged material placement sites. Over 100 individuals are included in the committee structure - the Executive Committee meets bi-annually, the Management Committee meets quarterly, the BEWG meets monthly, the CAC meets bimonthly, and the Harbor Team meets quarterly, although the committees have met more regularly when necessary.

Executive Committee - Comprised of eight members, this committee oversees the development and operation of the DMMP and reports directly to the Governor. Members include Secretaries from MDNR, Environment and Transportation, a representative from the Management Committee, and the USACE District Commanders from Baltimore and Philadelphia. A representative from the Chesapeake Bay Foundation and a Governor-appointed citizen complete the panel.

Management Committee - Representatives from any and all state and Federal agencies responsible for reviewing a proposed dredging or site placement project sit on this committee. In addition, several conservation groups and maritime organizations participate. This committee is responsible for recommending reports or decisions to be presented to the Executive Committee, as well as provide directions to various working groups.

Citizens Advisory Committee (CAC) - Members of this committee work hand-in-hand with the Management Committee to develop dredging-related recommendations that are then taken to the Executive Committee. CAC members include representatives from all counties, conservation associations, civic associations, community associations and organizations, Chambers of Commerce, and watermen associations that may be impacted by a proposed site or program.

Working Groups - Ad hoc working groups design and participate in a series of science-based studies on each location, and define the scope and direction of potential site locations. The working groups include technical experts such as engineers, biologists, geologists, oceanographers and chemists from the various organizations and agencies that comprise the management committee. Working groups make recommendations to the Citizens and Management Committee. One that has been actively involved with this study is the BEWG, the activities of which are described in more detail in the plan formulation discussion in Section 4 of this report. The BEWG, an advisory group initially formed to support the State DMMP process, consists of technical personnel from Federal agencies (USACE-Baltimore, USACE-Philadelphia, USACE-Norfolk, USFWS CBFO, and NOAA NMFS), state and local agencies (MPA, Maryland Geological Survey (MGS), MDNR, MDE) and other organizations with expertise in the environmental issues of the Chesapeake Bay region. The BEWG is the primary group tasked with evaluating management options for dredged material. Towards this effort, the BEWG has created a technical matrix within which management options can be scored to assess ecosystem impacts or benefits and ranked relative to one another. The BEWG worked closely with the Federal DMMP study to identify, study, review, and prioritize potential dredged material placement sites. As such, the BEWG was well equipped to provide input and guidance to the Mid-Chesapeake Bay Islands PDT.

1.8 INDEPENDENT TECHNICAL REVIEW

In response to USACE policy, a number of independent technical reviews were conducted. In order to strengthen quality control processes and help ensure that the Mid-Chesapeake Bay Island Ecosystem Restoration Project (Mid-Bay) is supported by the best scientific and technical information, an external peer review (EPR) process was completed by USACE to complement the internal technical review (EC 1105-2-408). The EPR process as well as reviewer comments and USACE responses are provided in Appendix N, Attachment A. The USACE Ecosystem Restoration Planning Center of Expertise (PCX) conducted review of the planning model used to quantify ecosystem outputs for the Middle Chesapeake Bay Island Restoration Project. Rigorous ITR of the model was conducted in accordance with EC 1105-2-407 and the Protocols for Certification of Planning Models (July 2007). The model ITR documentation is provided in Appendix N, Attachment B.

SECTION 1

FIGURES

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3 **Figure 1-1: Mid-Chesapeake Bay Study Area**
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1 **Figure 1-4: Location of James and Barren Island**

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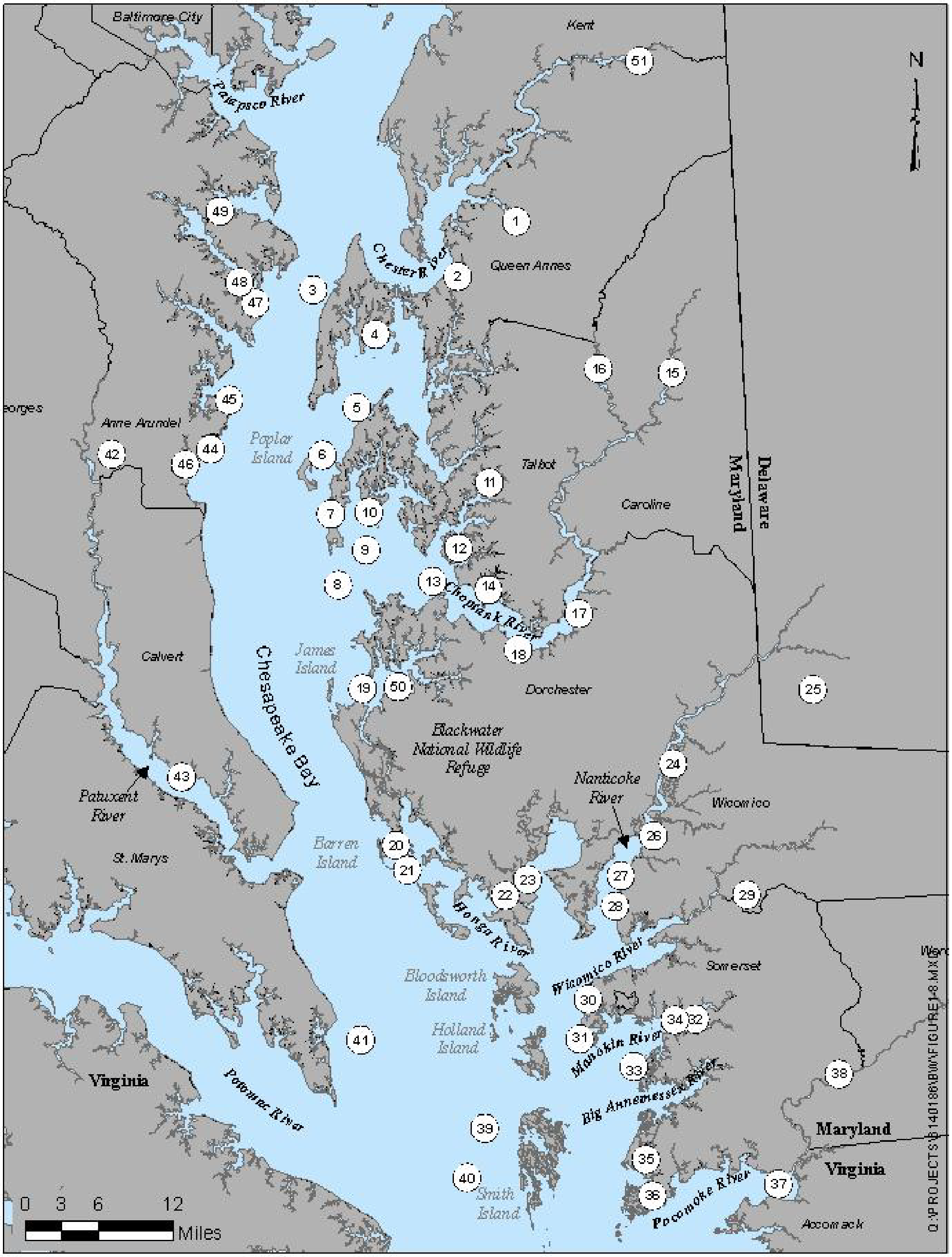

Figure 1-7: Other Federal Navigation Channels

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SECTION 1

TABLES

Table 1-1: Recent Maintenance Dredging of Federal Channels in the Vicinity of James Island			
PROJECT	YEAR DREDGED	QUANTITY (Cubic Yards)	PLACEMENT SITE
Cambridge Harbor	1979	92,000	Upland
Cambridge Harbor	1988	36,000	Upland
Madison Bay	1976	40,000	Upland
Slaughter Creek	1974	16,100	Wetland Creation
Slaughter Creek	1981	36956	Upland
Slaughter Creek	1987	15,000	Oyster Bar Creation

Table 1-2: Recent Maintenance Dredging of Federal Channels in the Vicinity of Barren Island			
PROJECT	YEAR DREDGED	QUANTITY (Cubic Yards)	PLACEMENT SITE
Duck Point Cove	1966	19,300	
Duck Point Cove	1982	36,956	Upland
Honga River and Tar Bay	1970	17,765	
Honga River and Tar Bay	1974	107,279	
Honga River and Tar Bay	1982	137,628	Island Creation near Barren Island
Honga River and Tar Bay	1985	155,600	Island Creation near Barren Island
Honga River and Tar Bay	1990	155,770	Wetland Creation at Barren Island
Honga River and Tar Bay	1996	161,777	Wetland Creation at Barren Island
Honga River and Tar Bay	2000	138,392	Wetland Creation at Barren Island
Honga River and Tar Bay	2004	273,346	Wetland Creation at Barren Island
Muddy Hook and Tyler Coves	1982 (Tyler)	17,000	Upland
Muddy Hook and Tyler Coves	1983 (Muddy)	25,537	Upland
Muddy Hook and Tyler Coves	1990 (Tyler)	3,100	
Muddy Hook and Tyler Coves	2004 (Tyler)	5,049	Wetland Creation at Barren Island

2 PROBLEMS, NEEDS AND OPPORTUNITIES

The first step of the USACE planning process is to identify problems, needs and opportunities as expressed by Federal, State, and local partners and the study planning objectives. To complete this step of the process, the Mid-Bay Island Study took a comprehensive approach, building upon the dredged material management plans developed by the state and USACE, and within the context of Chesapeake Bay restoration goals. Specifically, Section 2 outlines the problems facing Chesapeake Bay remote island habitat and current needs outlined in the Federal DMMP, projected over the next 20 years.

2.1 *PROBLEMS AND NEEDS

2.1.1 *Habitat Loss

Offshore islands are a critical ecosystem component in the Chesapeake Bay watershed. Isolation, lack of human disturbance, and fewer predators, particularly on islands smaller than 25 acres, make islands desirable as nesting and resting sites for colonial waterbirds including some endangered species. Island habitats within the Chesapeake Bay have historically supported, and on remaining islands and remnant islands continue to support, numerous avian species including ospreys, canvasback, black and redhead ducks, egrets, terns, cormorants, great blue herons, little blue herons, green backed herons, black skimmers, pelicans and the threatened bald eagle. Diamondback terrapins nest on the beaches of remnant islands in the Chesapeake Bay. Finfish such as bluefish, summer flounder, menhaden, shad, striped bass, and bass frequent the shallow waters adjacent to the Mid-Chesapeake Bay islands.

Extensive island habitat losses within the Mid-Chesapeake Bay study area were identified in the Eastern Shore reconnaissance study (see Section 1.5). Erosion, due to natural processes and anthropogenic effects, is a major factor contributing to these losses. Specifically, land subsidence, rising sea level, and wave action are causing valuable island habitats to be lost due to erosion throughout the Chesapeake Bay. In the last 150 years, it has been estimated that 10,500 ac of remote island habitat have been lost in the middle-eastern portion of Chesapeake Bay alone. If the present rate of land loss continues unabated, unprotected island habitats will probably disappear within 10 to 20 years. Table 2.1 provides examples of lost island habitat throughout the Chesapeake Bay.

The erosion of these island habitats has contributed sediment and nutrients to shallow water habitat, likely impacting SAV resources, and leads to the eventual loss of physical barriers that provide shelter from wave and storm forces for SAV beds. Shoreline erosion alone has accounted for more than half the sediment in the Chesapeake Bay (Leatherman, 1995). SAV declines began in the 1930s and continued through the 1990s, with a large-scale Chesapeake Bay wide decrease occurring in the 1960s/1970s. Small gains in SAV beds, largely associated with reduced annual precipitation levels, were evident in the 1980s and early 2000s. Research shows that, although SAV acreages are affected by many factors, the localized effect of erosion on water clarity can be the over-riding impediment. Furthermore, the reduced amount of SAV means that the wave attenuating properties of the SAV beds are lost, causing yet more erosion.

In addition to remote island habitat, wetlands are a quickly diminishing and highly valuable resource in the study area. The Maryland Clean Water Action Plan, which was Maryland's response to President Clinton's Clean Water Initiative, examined the condition of Maryland's watersheds by conducting a Unified Watershed Assessment of the state's 138 watersheds, based on the US Geological Survey's 8 digit hydrologic unit codes (HUC). Within the study area, 57% of the sub-watersheds had sustained wetland losses in excess of 15,000 ac, and 21% had lost more than 40,000 ac each. In all, the study area has lost more than one million acres of wetlands, which amounts to an average of more than 24,000 ac per watershed. According to the Unified Watershed Assessment, more than 57% of the 1.8 million historic wetland ac that have been lost in Maryland can be attributed to losses within the Mid-Chesapeake Bay study area as described in Section 1.4 (USACE, 1999).

2.1.2 *Dredged Material Placement Needs

The MPA and USACE-Baltimore District continually assess the dredging needs of the Port of Baltimore, taking into consideration dredged material resulting from both new Federal and non-Federal construction and maintenance dredging, and current available placement capacity. Although the MPA currently has active dredged material placement sites, each site has a limited life span. Since sedimentation, and therefore dredging, is a continuous process, USACE-Baltimore District and MPA must frequently look at additional placement options and evaluate the status of existing placement sites as part of the five year DMMP planning process. To define the scope for the Federal DMMP, an assessment of the remaining capacity at the existing dredged material placement sites was conducted to quantify the magnitude of the dredged material shortfall predicted in the Preliminary Assessment (USACE, 2001a). This assessment formed the basis of the "No-Action Alternative" for the Federal DMMP and assumed the continuation of the current maintenance dredging at the currently maintained channel dimensions and placement of the dredged material at the existing placement sites as currently constructed (USACE, 2005). Results of the placement capacity assessment for the 20-year planning period indicated:

- For the Baltimore Harbor Channels and Anchorages, the two existing placement sites – Hart-Miller Island Dredged Material Containment Facility and Cox Creek Confined Disposal Facility – have an estimated remaining capacity of 10 and 6 mcy, respectively. The projected dredging need for the Harbor Channels and Anchorages is estimated to be 33 mcy, resulting in a capacity shortfall of 17 mcy.

- For the Upper Chesapeake Bay Approach Channels in Maryland, the PIERP is the only existing placement site. The PIERP is estimated to have a remaining placement capacity of 22 mcy. The projected dredging need for the Upper Chesapeake Bay Approach Channels is estimated to be 38 mcy, resulting in a capacity shortfall of 16 mcy.

- For the southern approach channels to the C&D Canal, the existing placement site is the Pooles Island Open Water Site, with an estimated remaining capacity of 6 mcy. The projected dredging need for the southern approach channels to the C&D Canal is estimated to be 30 mcy (approximately 1.2 mcy per year), resulting in a capacity shortfall of 24 mcy.

- For the Virginia Chesapeake Bay approach channels in Virginia, the four existing placement sites – Rappahannock Shoal Deep Alternate Open Water Site, Wolf Trap Alternate Open Water Site, Norfolk Ocean Open Water Site, and Dam Neck Ocean Open Water Site – have sufficient capacity to handle the projected quantity of dredged material from the Virginia channels.

The Mid-Chesapeake Bay study does not include dredging needs west of the North Point-Rock Point Line (Figure 1-3). State of Maryland law prohibits the placement of this harbor material in open waters of the Chesapeake Bay (effectively, east of the North Point-Rock Point Line). The average quantities of material dredged for the upper Chesapeake Bay approach channels and southern approach channels to the C&D Canal are summarized in Table 2-2.

At present filling rates, the Federal DMMP estimates that the current dredged material placement areas will run out of space by 2014. The inability to maintain authorized navigation depths would have detrimental implications to shipping that calls on Baltimore as vessel draft (and carrying capacity) would be reduced (see table 2-2 for specifics on channel dimensions). These shortfalls are a result of a State law mandating that the Hart-Miller Island Containment Facility stop accepting dredged material by December 31, 2009 (see section 1.5 for description of Hart-Miller project). Open water placement in the Pooles Island open water placement areas is required by state law to cease no later than December 31, 2010, or sooner if the sites reach their legislated upper capacity of 7.4 mcy. Due to the amount of time required to identify and develop a placement site, the material accumulated from required maintenance dredging prior to new placement site development would be taken to Poole's Island open water placement site and Poplar Island as long as there is sufficient capacity. For cost-sharing purposes, the Federal Standard, or base plan placement option, remains open water placement for the C&D Canal Approach Channels (Pooles Island) and the Maryland Chesapeake Bay Approach Channels to the Port of Baltimore (Deep Trough).

The current shortfall through 2025 for the C&D Canal Approach Channels and Maryland's Chesapeake Bay approach channels is 57 mcy. Poplar Island is projected to be filled by 2014 without expansion. Including the expansion project that provides 575 ac of placement, dredged placement at PIERP could continue until 2021. To ensure efficient management of dredged material, an additional site would need to be on line by 2018 to avoid overfilling and reduce the placement capacity of Poplar Expansion project. To meet the needs identified by the Federal DMMP, the proposed project should provide the capability of receiving 30 to 70 mcy of clean dredged material over a 20-year period (3.2 mcy/y).

2.2 OPPORTUNITIES

2.2.1 Beneficial Use of Dredged Material

The Federal DMMP considered 79 alternatives ranging from existing placement sites, new placement sites, beneficial use sites, and innovative use sites. The 79 alternatives were combined into groups, or suites of alternatives. Each suite was a combination of alternatives that together met the dredged placement capacity need for one or more geographic subarea. The suites covered an evaluation of restoration at all islands in the Chesapeake Bay. Over 14,000 suites were considered.

Through a rigorous and systematic process, dredged material placement alternatives were compared for capacity, cost, environmental benefit and/or impact, and implementation risk, resulting in the selection of a recommended plan. The recommended plan consists of six dredged material placement alternatives that together will provide sufficient dredged material placement capacity through the next 20 years, with some capacity remaining for out-year use. Of these six placement alternatives, three are opportunities for the beneficial use of dredged material. They are: 1) wetland restoration in Dorchester County, Maryland, at Blackwater National Wildlife Refuge; 2) large island restoration in the Middle Bay; construction of multiple CDFs in the Patapsco River, MD; and 3) expansion of the currently authorized PIERP restoration project. These alternatives were determined to have little adverse impact on the quality of the environment and have the potential to provide environmental benefit by restoring critical habitat and protecting the environment from further degradation (Weston, 2005).

2.2.2 Restoration of Island Habitat

The restoration of island habitat through the beneficial use of dredged material provides multiple opportunities to address the problems identified in 2.1.1.

- Within the Chesapeake Bay, isolated island habitat is used by many species of migratory birds, as well as fish and other wildlife species, as resting/nesting/foraging/production areas. Even though similar vegetative communities may occur on the mainland, isolation, lack of human disturbance, and fewer predators, particularly on wetland islands with hummocks of 5 ac or less, make islands more attractive.

- Reducing the rate of further island loss within the Chesapeake Bay locally decreases sediment inputs from erosion and can substantially improve local water clarity, promoting conditions that are conducive to restoration/protection of SAV.

- The restoration of wetland and shallow water areas provides spawning and sheltered habitat for juvenile and forage fish species, epibenthic invertebrates, and benthic infauna.

- Shallow water areas, i.e. habitat suitable for the sustainable growth of SAV, will be provided protection from storm and wave forces.

- Wetland and shallow water habitat, essential nursery and foraging habitat for numerous fish, will be restored.

- Environmentally, historically, and culturally significant remnant island habitat will be protected.

- Shoreline for avian, reptilian, and mammalian species resting/nesting/foraging areas will be protected.

- Federal DMMP identified a need to place 30 to 70 million cubic yards of material over a 20 year period.

- Restoration of historically footprints would provide shoreline protection of the mainland, and reduce impacts from storms.

2.2.3 Cooperative Conservation

Cooperative conservation refers to actions specific to the use, enhancement, and enjoyment of natural resources, protection of the environment, or both, and that involve collaborative activity among Federal, State, local, and tribal governments, private for-profit and non-profit institutions, other nongovernmental entities and individuals. Executive Order Facilitation of Cooperative Conservation (EO 13352), signed 26 August 2004, mandates that 'that the Departments of the Interior, Agriculture, Commerce, and Defense and the USEPA implement laws relating to the environment and natural resources in a manner that promotes cooperative conservation, with an emphasis on appropriate inclusion of local participation in Federal decision making, in accordance with their respective agency missions, policies, and regulations.' Engineering Circular Planning in a Collaborative Environment (EC 1105-2-409), 31 May 2005, followed the Executive Order on Cooperative Conservation and required USACE to 'move beyond the Corps interest and embrace solutions that reflect the full range of the national Federal interest (the collection of all responsibilities assigned to Federal agencies)'. In this spirit, many Federal agencies involved with restoration activities in the Chesapeake Bay including the Assistant Secretary of the Army for Civil Works (ASA (CW)) (on behalf of USACE) signed the Resolution on Cooperative Conservation. This agreement rededicates USACE to work collaboratively with other Federal agencies to help restore the Chesapeake Bay and meet the goals of the Chesapeake Bay 2000 Agreement (C2K) (C2K will be detailed in the following Section 2.3.1). Consistent with the intentions of collaborative conservation, the Mid-Chesapeake Bay Islands Restoration Project provides an opportunity to support this commitment.

2.3 RESOURCE SIGNIFICANCE

2.3.1 Chesapeake Bay Aquatic Resources

The significance of the fish and wildlife resources of the Chesapeake Bay is widely recognized by the institutional, public, and technical sectors. As the largest of 130 U.S. estuaries, the Chesapeake Bay watershed extends into six states (Delaware, Maryland, New York, Pennsylvania, Virginia, and West Virginia) and encompasses all of the District of Columbia. There are 150 major rivers and streams included in the 100,000 plus streams and rivers in the Chesapeake drainage basin. The Chesapeake supports greater than 3,600 species of plants, fish, and animals, including 348 species of finfish, 173 species of shellfish, and greater than 2,700 plant species. As home to 29 species of waterfowl and a major resting ground along the Atlantic Migratory Bird Flyway, roughly 1,000,000 waterfowl winter in the Chesapeake Bay's basin each year. The Chesapeake Bay also provides recreational opportunities to more than 15,000,000 citizens living in the watershed and produces greater than 500 million pounds of seafood per year (CBP, 2005).

Extensive efforts have been expended to support natural resources management and restoration plans in the Chesapeake Bay region. The Chesapeake Bay was the first estuary in the nation to be targeted for restoration as an integrated watershed and ecosystem (CBP, 2005). Congress first funded scientific and estuarine research of the Chesapeake Bay in the late 1970s and early 1980s and identified three problem areas: nutrient over-enrichment, dwindling underwater Chesapeake Bay grasses, and toxic pollution. These findings led to the formation of the Chesapeake Bay Program (CBP) and subsequently the signing of the 1983 Chesapeake Bay Agreement by the State of Maryland, the Commonwealths of Pennsylvania and Virginia, the District of Columbia, and the USEPA. The signatories recognized the need for a coordinated effort to address pollutants in the Chesapeake Bay that were causing well recognized declines in living resources. With the signing of the 1987 Chesapeake Bay Agreement by the State of Maryland, Commonwealth of Pennsylvania, Commonwealth of Virginia, District of Columbia, and USEPA specific goals were established to reduce the amount of nutrients-primarily nitrogen and phosphorous-that enter the Chesapeake Bay by 40% by 2000. The culmination of this effort has resulted in a modified agreement, C2K, aimed at guiding restoration activities in the Chesapeake watershed through 2010. The C2K is a comprehensive blueprint for restoring the Chesapeake Bay and its living resources over the next decade, identifying more than 90 specific goals that are grouped into the following 5 major areas:

- Living Resources Protection and Restoration
- Vital Habitat Protection and Restoration
- Water Quality Protection and Restoration
- Sound Land Use
- Stewardship and Community Engagement

The restoration of island ecosystem habitat in the Chesapeake Bay would assist in meeting the restoration goals for Chesapeake Bay wetlands and would protect and restore habitat vital to the survival and diversity of the living resources of the Bay. The C2K goals for these resources are:

- Achieve a no-net loss of existing wetlands acreage and function in regulatory programs in the states of Maryland, Pennsylvania, and Virginia.
- By 2010, achieve a net resource gain by restoring 25,000 ac of tidal and non-tidal wetlands. To do this, the partners are committed to achieving and maintaining an average restoration rate of 2,500 ac per year basin wide by 2005 and beyond.
- Provide information and assistance to local governments and community groups for the development and implementation of wetlands preservation plans as a component of a locally based integrated watershed management plan. Establish a goal of implementing the wetlands plan component in 25% of the land area of each state's Chesapeake Bay watershed by 2010. The plans would preserve key wetlands while addressing surrounding land use so as to preserve wetland functions.
- Evaluate the potential impact of climate change on the Chesapeake Bay watershed, particularly with respect to its wetlands, and consider potential management options.

C2K also states that 'the signatories will continue efforts to improve water clarity in order to meet light requirements necessary to support SAV. The signatories will expand efforts to reduce sediments and airborne pollution, and ensure that the Chesapeake Bay is free from *toxic effects* *on living resources and human health.'* Island restoration efforts are expected to contribute to reducing sediment levels in the local water column by reducing local shoreline erosion. Finally, C2K provides a forum for the headwater states of New York, Delaware, and West Virginia, although not signatories, to become actively involved in restoration activities with Chesapeake Bay Program.

The coastal wetlands of Dorchester County and adjacent areas are internationally and nationally recognized to be of ecological significance. The Dorchester County wetlands are contained within a larger region of coastal wetlands on the lower Eastern Shore of Maryland and Virginia identified as "wetlands of international importance" during the Ramsar Convention on Wetlands, primarily because of their importance as a staging and wintering ground for waterbirds and waterfowl. Through international cooperation, the Ramsar Convention has identified wetlands recognized to be of great ecological significance throughout the world, and obliged signatories to undertake conservation measures to ensure that these sites would continue to perform the vital ecological functions for which they were recognized. Dorchester County's coastal wetlands are listed as a "priority wetland" by USEPA, are identified by USFWS as a "unique ecosystem," and are a "focus area" of the North American Waterfowl Management Plan Atlantic Coast Joint Venture Report. Their ecological significance extends beyond birds to include estuarine foodweb support, water quality maintenance, and other functions.

Further, James Island and Barren Island are designated as Resource Conservation Areas under the Critical Area Law (MDNR, 2004e). Rare, threatened, and endangered species utilizing James and Barren Islands are documented in Section 3.1.10 and both islands are within waterfowl concentration and staging areas that are protected under critical area law (MDNR, 2004e). Habitat utilized by rare, threatened or endangered species can be protected under critical area regulations (MDNR, 2004a). The habitat on Barren Island designated as colonial waterbird nesting, as discussed in Section 3.1.9.d, may also be afforded protection under critical area regulations.

Tables 3-41 and 3-42 provide a listing of the RTE species observed in the vicinity of James and Barren Islands, respectively, their Federal and state status, and the time period they were observed. There are currently no Federally listed species on either island. However, the American bald eagle (*Haliaeetus leucocephalus)*, observed on both islands, was delisted in 2007, and is within the five year monitoring period following delisting. There are a number of state rare, threatened, and endangered species identified on the two islands including plants, invertebrates, amphibians, and birds.

2.3.2 Island Habitat

The value of island habitat is defined by an islands' isolation from typical stressors and the diversity of habitat types available within a small area. The habitats comprised on an island provide a number of edge areas where two or more ecosystems interact. Edge systems are known to have higher species diversity and more productivity than independent systems. Chesapeake Bay island habitat contains shallow water, SAV, mudflats, emergent marsh, and uplands. At the juncture of each habitat, species are able to interact and draw on the resources from the other habitat.

Islands provide a measure of protection from predators and human development, typical stressors on aquatic and terrestrial species. Indirect impacts from development and disturbance are minimized, allowing for large, unbroken habitat areas. Black ducks and colonial waterbirds, in particular, require isolated, protected islands for breeding. Neo-tropical migratory birds also use islands as stop-over sites on their biannual migrations along the Atlantic Seaboard.

Uplands are part of the Chesapeake Bay island ecosystem and provide critical nesting habitat for many bird species. Upland habitat on islands is preferentially selected for nesting because the isolated habitats minimize the pressure from typical mainland activities such as development, human disturbance, cultivation, and exposure to predation by wild and domestic animals. Upland rookery surveys have identified the following species as having sizable breeding populations on Mid-Chesapeake Bay islands: black-crowned night heron, great black-backed gull, yellow-crowned night heron, glossy ibis, tri-colored heron, great egret, great-blue heron, herring gull, cattle egret, little blue heron, and snowy egret. The State of Maryland lists the glossy ibis and little blue heron as rare species. The USFWS identifies isolated hummocks surrounded by marsh as important colonial waterbird nesting sites.

Mudflats and sandy shores provide extremely diverse and productive habitat for a variety of organisms. Sandy shores and mud flats provide invertebrate habitat for fiddler and hermit crabs, clams, crayfish, mud snails, and dozens of worm species. These species provide an exceptional food source for the numerous colonial nesting birds and avian species. Sandy beaches also provide terrapin nesting habitat.

Another ecologically significant feature of islands is the habitat connectivity provided by the existing island chain. The chain of islands along the Eastern Shore of the Chesapeake Bay offer a regional network of island resources available to resident and migratory birds and aquatic species. The islands, which span a large salinity range, are available foraging, resting, nesting, and refuge habitat as species move up and down the Bay. Maintaining a healthy island network provides resiliency to the system. Restoration efforts have spanned the entire chain and highlight the importance of the islands as a regional resource. Smith, Poplar, Taylors, Barren, and Tangiers Islands have all undergone or are in the planning stage of restoration.

The restoration of vital habitat and living resources through the restoration of island habitat is a unique opportunity to meet several key C2K goals. Through the beneficial use of dredged material, a restored island can be constructed to replace hundreds of acres of lost wetland and upland habitat. This habitat will afford improved productivity to the surrounding area, while providing an environmentally sound method for the use of dredged material from the Chesapeake Bay approach channels to the Port of Baltimore.

PIERP is evidence of the value provided by island restoration in the Chesapeake Bay. Data from PEIRP has indicated that habitat can be quickly developed and utilized. Fish and bird utilization usually occurs within one year of habitat creation. In many instances habitat that has not been finally developed is utilized. Monthly averages of birds observed at Poplar use ranges from approximately 2,000 individuals to approximately 15,300 individuals. Monitoring by NOAA has indicated that the forage fish utilizing the created marshes are comparable to those found in the more mature reference marshes and the created marshes at PEIRP have comparable amounts of invertebrates such as grass shrimp when compared to reference marshes. Some striking examples of habitat development at PIERP is the nesting of the entire Maryland Chesapeake Bay colony of Common Terns and the nesting of Least Tern, as well as the nesting of the northernmost Chesapeake Bay pair of Oystercatcher. Additionally, the project has the most successful nesting population of Diamondback terrapins in the mid-Bay region. This PIERP monitoring data is identifying significant habitat utilization creation considering that the dikes were not completed until 2002 and the created wetlands are only a few years old.

The vulnerability of these islands to sea level rise is being recognized by the State of Maryland. Bay island restoration is identified as a recommendation by the Maryland Commission on Climate Change. *The Climate Action Plan: Interim Report to the Governor and the Maryland General Assembly* (January 14, 2008) suggests inclusion of Bay island restoration as a component of plans to adapt to and respond to sea level rise.

2.3.3 Atlantic Flyway

The Chesapeake Bay is critical habitat for a number of migratory birds. For some birds, the Chesapeake Bay is their winter destination while others use the Bay as fueling grounds. About 1 million swans, geese and ducks winter on the Bay, roughly one third of all waterfowl wintering along the Atlantic Coast (USFWS, 2008). Many migratory songbirds, shorebirds and raptors rest and refuel here during their spring and fall migrations. Still others winter south and return to the Chesapeake Bay watershed each spring to breed (USFWS, 2008).

Birds migrate along four main routes or flyways: the Atlantic, Central, Mississippi and Pacific. The Atlantic Flyway may be described as extending from the offshore waters of the Atlantic Coast west to the Allegheny Mountains where, curving northwestward across northern West Virginia and northeastern Ohio, it continues in that direction across the prairie provinces of Canada and the Northwest Territories to the Arctic Coast of Alaska (See Figure 2-1). The Atlantic Flyway route from the northwest is of great importance to migratory waterfowl and other birds some of which are flocks of Canvasbacks, Redheads and Lesser Scaups that winter on the waters and marshes south of Delaware Bay, including those of the Chesapeake. As is evident from Figure 2-1, the Chesapeake Bay is an area where many migratory routes converge. Specifically, the Chesapeake Bay is an important wintering area for the Canada Goose, three scoter species and the long-tailed duck.

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SECTION 2

FIGURES

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Atlantic Flyway

Figure 2-1: Map of Atlantic Flyway.
Produced by U.S. Fish and Wildlife Service.
(http://library.fws.gov/Pubs/atlantic_flywaymap%20_bw.pdf)

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SECTION 2

TABLES

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Table 2-1: Loss of Island Habitat in Chesapeake Bay **(Leatherman et al, 1995)**

Island	Historic Acreage (date)	Recent Acreage (date)	Percent Lost	Comments
Poplar	1400 (1670)	125 (1990)	91	Abandoned in 1930
Sharps	890 (1660)	0	100	Drowned in 1962
St. Clements	400 (1634)	40 (1990)	90	Abandoned in 1920's
James	1350 (1680's)	269 (1980) <100 (2002)**	80	Abandoned in 1920's
Barren	700 (1664)	250 (1990) 180 (2005)***	64	Abandoned in 1916
Hoopers	3928 (1848)	3085 (1942)	21	Submerging
Bloodsworth	5683 (1849)	4700* (1973)	17	Submerging
Holland	217 (1668)	140* (1990)	35	Abandoned in 1922
Smith	11033 (1849)	7825* (1987)	29	Submerging
*Note: Mostly marshy land ** Updated by Maryland Environmental Services, et.al. *** Updated by Maryland Port Administration				

Table 2-2: Federally Authorized Maintenance Dredging Under Consideration for Mid-Chesapeake Bay Island Restoration **(USACE, 2005)**

Channel Section	Length (nm)	Authorized/ Constructed Width (ft)	Authorized Depth (ft)	Maintenance Dredging Annual Quantity (cy)
C&D Canal Approach	15	450/450	35	875,000
Chesapeake Bay Approach Channel (MD)				
Craighill Entrance	3.1	800/700	50	193,983
Craighill Channel	2.8	800/700	50	100,668
Craighill Angle	1.6	800-1880/ 700-1830	50	396,742
Craighill Upper Range	2.1	800/700	50	56,889
Cutoff Angle	0.9	800-1700/ 700-1650	50	188,855
Brewerton Eastern Extension	5	600/600	35	439,906
Swan Point	1.7	600/600	35	103,465
Tolchester	6.5	600/600	35	208,787

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3 *EXISTING RESOURCES

A summary of the existing environmental resources is an integral part of the planning process, as this provides the basis for inventorying and forecasting future with and without project conditions, as well as the context for developing alternatives for consideration. The significance of these environmental resources is critical to the health of the Chesapeake Bay, and are also intricately linked to numerous socioeconomics and most recreational opportunities. This information is also important to address NEPA requirements for any proposed action to restore island habitat, as recommended by the Federal and State DMMPs. Further, a construction project similar in magnitude to the existing PIERP has the potential to influence and be influenced by regional environmental conditions. The following description provides a basis to measure impacts associated with the restoration of island habitat through the beneficial use of dredged material from the navigation channels in the Upper Chesapeake Bay.

The Mid-Chesapeake Bay study area described in Section 1.4 extends over the eastern half of the Chesapeake Bay, from the Chester River to the Maryland/Virginia state line and includes 105 named islands that could potentially be restored using dredged material. These islands were screened as described in Sections 1.4 and 4.3 to: eliminate sites based on the recommendation of the Federal DMMP; minimize the scope of the study; and allow for the determination of detailed existing conditions for only those sites selected for alternative formulation. Because James and Barren Islands were ranked the highest as potential sites for beneficial use of dredged material by the PDT as part of the USACE plan formulation process, as well as by the BEWG, detailed information on existing conditions was collected in the vicinity of these islands.

Based on this scoping process, the existing conditions specific to James and Barren Islands with respect to environmental, cultural, socioeconomic, and recreational resources are presented in more detail in this Section within the context of the larger Chesapeake Bay watershed. Environmental sampling was conducted at James and Barren Islands for a variety of parameters during four seasonal studies to provide this baseline information on existing conditions. Additional studies requested by the resource agencies and were conducted during the 2003 to 2004 timeframe. These studies included crab pot surveys, clam surveys, beach seining, and SAV surveys, as well as, a pound net fishermen phone survey conducted by MDNR. A supplemental study report was written for James Island (MPA, 2004i) and Barren Island (MPA, 2004c) to summarize these studies and the results. The executive summaries of all studies conducted during the feasibility phase are included in Appendix I.

3.1 ENVIRONMENTAL RESOURCES

3.1.1 Setting

Lying between latitudes 39° 45’N and 36° 50’N on the mid-Atlantic coast of the United States, the Chesapeake Bay is a partially-mixed estuary and the largest estuary in the United States. The Chesapeake Bay watershed stretches over six states and encompasses an area of 165,760 square kilometers (km^2). The estuary reached its present configuration approximately 6,000 years before present (ybp) as sea level rose after the last glacial retreat 10,000 to 12,000 ybp.

The Chesapeake Bay is approximately 200 miles (mi) long from Havre de Grace, MD, to Norfolk, VA. The width of the Chesapeake Bay ranges from slightly more than 3 miles near Aberdeen, MD, to 35 miles near the mouth of the Potomac River. The average water depth of the Chesapeake Bay is approximately 6.4 meters (m) with some deep troughs, which traverse much of the Chesapeake Bay's length, at depths of up to 53.3 m.

The Chesapeake Bay can be divided into three regions based on salinity: the oligohaline portion is characterized by salinities from 0 to 5 parts per thousand (ppt); the mesohaline portion ranges from 5 to 18 ppt; and the polyhaline encompasses waters greater than 18 ppt (Stroup and Lynn 1963). The mesohaline portion comprises 48% of the total surface area (5.98×10^9 m^2) and 47% of the total volume (3.63×10^{10} m^3) of the Chesapeake Bay. Although, fluctuations occur seasonally, mesohaline waters extend roughly from the Chester River south, nearly to the Chesapeake Bay mouth, at its greatest extent (Lippson and Lippson, 1997). Both James and Barren Islands, proposed for restoration, lie adjacent to Maryland's Eastern Shore of the Chesapeake Bay, within mesohaline waters.

James Island is a privately-owned uninhabited island, located in the Chesapeake Bay in Dorchester County, Maryland. James Island is situated near the mouth of the Little Choptank River, about one mile north of Taylors Island (Figure 3-1). The island is located at approximately 38^o 31' N latitude and 76^o 20' W longitude (Maryland State Plane Coordinates N 310,000 E 1,503,000) (Figure 3-1). Since 1847, over 800 ac have eroded from the privately owned island, approximately 89% of its historical acreage (MES *et al*., 2002). Currently, James Island consists of three eroding island remnants totaling less than 100 ac (MES *et al*., 2002). All three remnants have areas of high and low salt marsh along with upland and depressional wetlands. The interior of the island is dominated by mixed forest stands of loblolly pine. The northern and western shorelines of each remnant show the greatest erosion and there are many downed trees in the water in these areas. Erosion is exacerbated in some portions of the islands due to an apparently recent fire that has killed vegetation on both the northern and southern remnants (MPA, 2003e; MPA, 2003f). Given its current long-term erosion rate of 13 ft per year, James Island is expected to be substantially eroded in 26 years.

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 (Figure 3-2)**.** This island is located at approximately 38^o 20.4' N latitude and 76^o 15.7' W longitude (Maryland State Plane Coordinates N 246,000 E 1,524,000) (Figure 3-2). There are conflicting reports about the historical acreage of Barren Island. Kearney and Stevenson (1991) report Barren to be approximately 700 ac in 1660. A State of Maryland study (1949) set the Island at 839 ac in 1848, while Wray et al. (1995) proposed that Barren Island was 754 ac during the same time. Given these discrepancies, Barren Island has lost between 74 and 78% of its historical acreage to erosion. Currently, Barren Island consists of three eroding island remnants totaling about 180 ac in size (MPA, 2005a) (197 ac including tidal flats). The island is Federally-owned and managed by the USFWS as a satellite refuge area to Blackwater NWR. Barren Island consists of several different types of high quality habitat including low and high salt marsh, tidal flats, and forested upland habitat. Barren Island could be substantially eroded in 69 years, given its current long-term erosion rate of 14 ft per year.

Although geotubes have been installed and some wetland restoration has occurred along the northern and western shorelines, the island continues to erode. MPA (2004c) notes that relatively little upland areas remain on Barren Island, and what does remain is being continually eroded, as indicated by steep banks and fallen trees. Western shorelines that are unprotected by geotubes appear to be the most effected by erosion (MPA, 2005a).

3.1.1.a Climate

The study area lies in a temperate climate. Mild winters and warm summers are characteristic of the Mid-Chesapeake Bay region and Dorchester County. Weather data collected from the Vienna Station, Dorchester County, between 1971 and 2001 show a mean annual high temperature of 19.8˚C (67.6 ˚F) and mean minimum temperature of 8.2 ˚C (46.8 ˚F). Mean temperature in July, the warmest month, is 25.6˚C (78.1 ˚F) and mean temperature in January, the coldest month, is 2.3˚C (36.1 ˚F). Mean precipitation is 116.8 cm [43.0 inches (in)] annually, with the heaviest rainfall during March and August (Maryland State Climatologist Office, 2005).

Thunderstorms occur on approximately 28 days per year in Dorchester County, the majority of which are observed during July (USDA, 1998). Three hurricanes and two tropical storms have significantly affected Dorchester County between January 1, 1993 and April 30, 2005. The severity of these storms within Dorchester County has resulted in a total of $3.94 million in property damage and $590,000 in crop damage (NCDC, 2005).

3.1.2 Physiography, Geology, Soils, and Groundwater

3.1.2.a Geology

The geologic history of the Chesapeake Bay is dominated primarily by the changes in sea level that occurred throughout the Pleistocene epoch from 1.65 million to 6,000 ybp. Sea level rose as glaciers retreated and fell while they advanced during this time period. Based on oxygen isotope data, there were at least nine glacial advances during the Pleistocene (Messina, 1999).

The present Chesapeake Bay evolved as river valleys became entrenched during the last Pleistocene lowstand of sea level and were drowned as the Holocene transgression progressed. During the last (Wisconsin) glaciation, sea level was ~300 ft below present sea level and the shoreline was ~80 miles east of Ocean City, MD (Wolman, 1968). This resulted in downcutting of the rivers and increased erosion of the Piedmont uplands, with subsequent deposition near the edge of the Continental Shelf. The end of the Wisconsin glaciation about 10,000 ybp resulted in sea level rise, causing an increased base level for streams in the Chesapeake Bay region and subsequent aggradation in the stream valleys. Sea level continued to rise through approximately 6,000 ybp, drowning stream valleys and forming the Chesapeake Bay. Thus, the deep portions of the Chesapeake Bay are the incised channels that flooded during the period of rapid sea level rise and the shallower margins are areas that have been eroded, filled, or flooded since then.

The shallow stratigraphy (Miocene Epoch to Recent, beginning approximately 23.8 million years ago) of the Chesapeake Bay is a result of the geomorphic processes that have acted upon the area during the glacial periods. Coastal plain sediments of the Chesapeake Bay were deposited in marine, estuarine, and fluvial environments during alternately high and low stands of the sea.

The coastal plain sediments range in thickness, from 0 at the fall line to 8,000 ft on Maryland's Atlantic Coast.

James and Barren Islands are comprised of Holocene Tidal Marsh Deposits and the Kent Island Formation (Middle Wisconsin or Upper Sangamon) primarily consisting of silt and clay with thin beds of sand. Together these units have a thickness of approximately 10 ft to 25 ft. This formation consists of interbedded silt, sand, and clay. Holocene Tidal Marsh Deposits are considered to be relatively recent deposits that offer minimal resistance to erosion compared to older deposits that tend to be more compact and have a lower water content. Underlying this is the Chesapeake Group Formation (older Miocene). This formation consists of interbedded micaceous sand, silt, and clay (MPA, 2002a).

Soil borings at James Island indicated that the subsurface conditions consist of three strata. Stratum 1 is a silty clay, generally composed of soft dark gray strata. Stratum 1 is discontinuous and occurs at a depth of up to 15 ft thick. Stratum 2 is a slightly silty to silty sand, generally composed of loose to dense gray, brown strata. Stratum 2 varies in thickness from 0 to 40 ft. Stratum 3 underlies the entire site and consists of greenish gray silty clay with layers of green gray and light gray silty sand (MPA, 2002a).

Barren Island soil borings indicated that the subsurface conditions consist of three strata. Stratum 1 is gray silty clay with layers of silt and sand. Stratum 1 varies in thickness from 5 to 15 ft. Stratum 2 is silty sand, generally composed of very loose to dense gray, brown strata. Stratum 2 has pockets of silty clay and varies in thickness from 10 to 30 ft. Stratum 3 underlies the entire site and consists of greenish gray, soft to stiff silty clay with layers of silty sand (MPA, 2002b).

3.1.2.b Physiography

The study area lies within the Mid-Atlantic Coastal Plain Physiographic Province. The land surface of this province is characterized by low-rolling terrain with a maximum elevation of approximately 300 ft above mean sea level (msl). The Coastal Plain consists of layers of unconsolidated sediments including gravel, sand, silt, and clay composed in a wedge-shape beneath the surface. Boulders occur locally in some deposits. Fossil plants and animals are abundant in some layers. The surface consists of sand or silt that has low topographic relief. Embayments, such as the Chesapeake Bay, divide the Coastal Plain into low-lying peninsula tracts (NRCS, 1998). The Atlantic Coastal Plain is separated from the adjacent Piedmont Physiographic Province to the west by the Fall Zone (Fall Line), a 'line of falls' in the streams that feed into the Chesapeake Bay. This Fall Zone represents the maximum penetration of tidal influence from the Chesapeake Bay.

The rate of sea level rise in the Chesapeake Bay, and the entire Mid-Atlantic area, is twice the worldwide average, likely due to isostatic adjustment from the last glacial retreat and land subsidence (USGS, 1998). Sea level is rising at a rate of 0.16 inches/year (1.3 ft/century) near the mouth of the Chesapeake Bay; this rate decreases northward, possibly due to lesser isostatic rebound (USGS, 1998). As a consequence of erosion and land-inundation**,** the Chesapeake Bay grows by several hundred acres per year. Land losses occur Baywide, but are concentrated in the low-lying lower Eastern Shore (USACE, 1990).

The Chesapeake Bay floor is generally flat with broad terraces cut into pre-Holocene sediments, especially along the eastern margin (Nichols and Biggs, 1985). There are local large-scale sand wave fields, but the shallow terraces are generally surfaced with thin, coarse lag deposits. Extensive salt marsh deposits are abundant where the surface is relatively flat and where sedimentation has exceeded the local rate of sea level rise. Most of the Chesapeake Bay floor is covered with silts and clays with rare shell or sand layers and laminations (Nichols and Biggs, 1985). Islands occur in the Chesapeake Bay where erosion and inundation from rising sea level have isolated what were formerly areas connected to the mainland. These processes cause gradual loss of existing islands as well as continued formation of new islands. Existing islands are currently being lost at a more rapid rate than new islands are being created (Wray et al., 1995).

James Island was historically a peninsula, consisting of uplands, connected to Taylors Island. James and Taylors Island together made up a several thousand-acre landmass. In 1847, James Island consisted of approximately 976 ac. As shoreline erosion continued, the connection between James Island and Taylors Island breached. An 1862 nautical chart showed James Island separated by a small creek from Taylors Island. In 1942, the connection was completely breached. As shoreline erosion continued to occur, James Island became fragmented into three island remnants. In 1994, the three remnants that make up James Island totaled 92 ac. The MDNR estimated that erosion caused James Island to lose approximately 884 ac at a rate of 6 ac per year between 1847 and 1994 (MES *et al*., 2002). Figure 3-3 illustrates the historic footprints of James Island.

Barren Island has a very low topographic relief with a maximum elevation of 6 feet above mean high tide (MHT) (MPA, 2002c). Shoreline erosion has caused Barren Island to lose approximately 74 to 78% of its historical acreage, roughly 520 to 660 ac. As inundation progressed, Barren Island became fragmented into three remnants by shoreline erosion. Currently, the three remnants that make up Barren Island total 180 ac. The USFWS estimates that Barren Island is eroding along its western shore at a rate of approximately 10 to 14 feet per year, which is about equal to a loss rate of 2.4 to 3.4 ac per year. Figure 3-4 illustrates the historic footprints of Barren Island

3.1.2.c Soils

The land surface surrounding the Chesapeake Bay ranges from level, low-lying areas adjacent to the Chesapeake Bay and tributary rivers to inland undulating, rolling hills. Particular soil types characterize each of the geomorphic areas in the vicinity of the Chesapeake Bay. These soils are described in the following paragraphs.

<u>Adjacent to the Chesapeake Bay</u>. The soils in areas adjacent to the Chesapeake Bay consist primarily of two soil types; both types are subject to tidal flooding.

1. Marshland: organic material with sand, silt, and clay. These are deep, poorly drained soils with a mixed sandy, loamy, and clayey substrate.

2. Well drained, nearly level, sandy coastal beaches.

Low Flats and Terraces. Located adjacent to the marshes, these are deep, loamy soils that can be poorly or moderately well drained, depending on the substrate. The land surface in these areas is nearly level.

Broad, Low-Lying Flats. This geomorphic area is nearly level and is found at elevations of less than 20 ft above mean sea level (ft msl). The very poorly to well-drained soils are deep loams and silt loams with loamy to clayey subsoil. The subsoil is underlain by loam or sand.

Broad, Flat Necklands. These poorly to moderately well-drained soils are found on nearly level, narrow bands of land that are situated between bodies of water. The soils range from sand or silt to fine sandy loam, and are formed on Coastal Plain sediments.

Broad Land Areas. This geomorphic area is found on level to moderate slopes, and consists of well and poorly drained clayey and silty soil.

Along Tributary Rivers. The land surface in this geomorphic area is nearly level to steeply sloping. The soils are very poorly to well-drained alluvial soils that formed in loamy sediments.

Broad, Smooth Uplands. These poorly to well-drained, sand, silt, or clay loams are found on nearly level to gently sloping land at elevation from 20 to 50 ft msl. They are deep soils formed on silty or clayey sand or on a mixture of sand, silt, and clay.

Broad Ridges. This geomorphic area is found at elevations from 20 to 50 ft msl with slopes ranging from nearly level to very steep. The soils consist of well-drained sand to loamy sand with loamy subsoil.

Uplands and Terraces. The soils in this geomorphic area consist of poorly to well-drained silt and loam formed on Coastal Plain sediments or on basic rocks. The slopes range from nearly level to steep.

Higher Elevations. The land surface in this geomorphic area is gently sloping to steep, with fairly narrow, rounded, sloping ridgetops and more strongly sloping, irregular upper slopes. The area is moderately to severely eroded and strongly dissected by steep-walled, mostly sandy ravines. Soils are coarse-textured and porous and moderately well drained. There are some loamy fine sands to sandy clay loams with loam subsoil.

Soils originally formed on James Island include some from the Elkton, Honga, Sunken, and Keyport series. These soils are predominately deep, slowly permeable, and poorly drained soils, however a small patch of soils on the northern remnant in the Keyport series are moderately well drained. These soils developed on fluviomarine sediments and consist primarily of silt loams and peat that retain moisture and are well suited for vegetative growth. These soils are typical of the surrounding area in Dorchester County (NRCS, 1998).

Soils originally formed on Barren Island include some from the Honga, Sunken, and Mettapex series. These soils are predominately deep, slowly permeable, and poorly drained soils, however soils towards the southern end of the island in the Mettapex series are moderately well drained.

These soils developed on fluviomarine sediments and consist primarily of silt loams, peat, and gravelly sand that retain moisture and are well suited for vegetative growth. These soils are typical of the surrounding area in Dorchester County (NRCS, 1998).

3.1.2.d Groundwater

The unconsolidated sediments of the Chesapeake Bay are divided into numerous aquifer systems, aquifers, and confining units. The distribution of aquifer sediments and corresponding groundwater flow patterns vary across the Chesapeake Bay. Sand and gravel deposits comprising surficial aquifers likely discharge groundwater directly to the Chesapeake Bay. Deeper confined aquifers, which may be vertically stacked and hydraulically connected, are likely part of the regional flow system and may flow under the Chesapeake Bay or a portion of the Chesapeake Bay. Groundwater recharge is influenced by stream flow, which carries nutrients, sediment, and contaminants into the Chesapeake Bay.

Dorchester County relies on groundwater in aquifers as a main source of drinking water, as well as for agriculture. The Piney Point aquifer, a sub-aquifer in the Aquia Group, is the primary groundwater source for James and Barren Islands. Generally, confining layers, typically of clay, separate these aquifers (MPA, 2003d). This aquifer is found at depths between 91.4 m (300 ft) and 121.9 m (400 ft) and yields approximately 0.0076 cubic meters per second (m^3/s) (18.7 gallons per second), however during the last 20 years, the water level has been declining, due to increased pumping. In tidal areas, especially near the Choptank River, high levels of hydrogen sulfides may be present and treatment is required prior to use as potable water, however, other areas may not need any treatment (NRCS, 1998).

3.1.3 Hydrology/Hydrodynamics

There are over 50 tributaries delivering freshwater directly into the Chesapeake Bay. Eighty-five to 90% of the freshwater input is derived from tributaries entering the Chesapeake Bay on the north and west and the remaining 10 to 15% is from Eastern Shore tributaries. The Susquehanna River to the north supplies approximately 50% of the freshwater delivery [annual average of 1098 m^3/s)]. Together, the Susquehanna, Potomac, Rappahannock, York, and James Rivers provide 90% of the freshwater to the Chesapeake Bay. A nearly equal volume of saltwater enters from the ocean at the mouth of the Chesapeake Bay (George Mason University, 1995). Thus, the salinity of Chesapeake Bay water varies from 3.5% (seawater, 18 ppt) at the mouth, to freshwater (0 ppt) north of Baltimore, MD.

Hydrographic data in the vicinity of James and Barren Islands were obtained from NOAA, National Ocean Service (NOS) charts 12230 and 12263 and documented in the Moffatt and Nichol Engineers Hydrodynamics and Modeling Report for both islands found in Attachments H and G of the Engineering Appendix (MNE 2002b, MNE 2004). Vertical and horizontal data were referenced to MLLW based on the 1960 to 1978 tidal epoch and the Maryland State Plane, North American Datum of 1983.

3.1.3.a Bathymetry

The average water depth of the Chesapeake Bay is approximately 6.4 m (21 ft) with some deep troughs, which traverse much of the Chesapeake Bay's length, at depths of up to 53.3 m (174.9

ft). The width/depth ratio is approximately 3,000/1. The Chesapeake Bay, therefore, is a shallow pan creased by a narrow channel, the ancestral Susquehanna River.

The Deep Trough defines the deepest water in the Mid-Bay and runs through the middle of the Chesapeake Bay, meandering slightly. Several access channels branch from the Federal channels and are generally shallower than the Federal channel but deeper than natural depths surrounding them. The remaining bathymetry in the Mid-Bay is generally shallow with gradual depth transitions except near natural or dredged channels, where some steeper gradients exist. Depths in the undeveloped margins of the Chesapeake Bay are shallow with gradual slopes ending in wetlands, or SAV.

A bathymetric map of James Island is shown in Figure 3-1. Water depths within the James Island project area vary from -0.6 to -3.7 m (–2 ft to –12 ft) MLLW. About a mile west of James Island in the Chesapeake Bay, water depths are as great as -28.3 m (–93 ft) MLLW (MNE, 2002b). A bathymetric map of Barren Island is shown in Figure 3-2. Water depths within the Barren Island project vicinity vary from approximately -0.3 m (–1 ft) MLLW along the east side to more than -2.7 m (–9 ft) MLLW along the west side. About 1 to 2 miles west of Barren Island in the Chesapeake Bay, water depths are in excess of -30.5 m (-100 ft) MLLW. In general, the local bathymetric conditions are shallower to the east and south of the island (ACRE, 2002).

3.1.3.b Water Levels

Current tide gauge records around the Chesapeake Bay show that the rate of sea-level rise during the 20th century has not been constant and that modern rates are more rapid than those determined by geologic studies conducted two decades ago. The current rate of sea-level rise at the mouth of the Chesapeake Bay is about 1.3 feet per century and decreases northward (USGS, 1998).

Water level in Chesapeake Bay is susceptible to weather conditions such as the strength and duration of wind speed and direction, and barometric pressure changes; tidal changes; runoff; and freshwater stream flow from the Susquehanna River basin, which typically contributes approximately 50% of the flow to the Chesapeake Bay. Higher water level can be produced by decreased barometric pressure and changing wind direction to the orientation of the basin during a meteorological event. For example, a local squall line may cause significant changes in local water level for a short duration, whereas a large-scale storm can alter the water level in the entire Bay for several days. In the Chesapeake Bay, relatively frequent meteorological patterns are also seen to significantly alter the water level. A moderate seasonal variation in water level, higher in the summer and lower in the winter, is usually observed in the Bay. Therefore, non-astronomical factors, such as the configuration of the shoreline, local bathymetry, and meteorological influences all contribute in altering the water level.

Normal water levels at James and Barren Islands are dictated by astronomical tides, although other factors like wind and freshwater inflow can be important influences. Extreme water levels, on the other hand, are dictated by storm tides (ACRE, 2002; MNE, 2002b). Wind events can initiate a “non-tidal” water level response in the Chesapeake Bay, as water tends to “pile” against windward shorelines. Strong winds from the northwestern, northern, or northeastern directions are expected to lower water levels in the northern portion of the Chesapeake Bay, and southwestern, southern, or southeastern wind is expected to raise water levels in the northern Chesapeake Bay. The change in water level is also related to fetch, therefore, winds traveling along the longer north and south axis of the Chesapeake Bay should alter water levels to a greater degree than east-west winds of similar strength traveling across the Chesapeake Bay. Changes in water levels caused by wind influences in the Mid-Bay are expected to be less than the northern Chesapeake Bay due to smaller fetches (NOAA, 2005).

3.1.3.b.1 Astronomical Tides

Astronomical tides are defined as the tidal levels and character that would result from gravitational effects due to the earth, sun, and moon without atmospheric influences (MNE, 2002b). Astronomical tides dictate the size and period of inundation of the intertidal zone, which is an important and often highly productive area within an estuary. In the Chesapeake Bay, astronomical tides are semi-diurnal (having two high and two low waters each day). The Chesapeake Bay is microtidal [spring tide < 2 m (6.5 ft)], with a tidal range of 0.2 to 0.9 m (0.66 to 2.95 ft). The tides are greater at the mouth of the Chesapeake Bay [0.9 m (2.95 ft)] and decrease northward to ~0.3 m (1 ft) near the Fall Zone at the head of the Chesapeake Bay. The mean tidal range is ~0.8 m (2.6 ft). The tide takes a little over 12 hours to migrate from the mouth to the head; therefore, the Chesapeake Bay has two high tides along its length at the same time. According to 1997 NOS data, in the vicinities of James and Barren Islands, the mean tide level is about 0.3 m (1 ft) above MLLW. The astronomical tidal datum characteristics from NOS for the James Island vicinity (Hoopers Island) and Barren Island are presented in Table 3-1.

3.1.3.b.2 Storm Surge

Storm surge is defined as a temporary rise in water level created by either large-scale extra tropical storms known as northeasters, or by hurricanes. The rise in water level results from wind action, the low pressure of the storm disturbance, and the Coriolis force. As part of the Federal Flood Insurance Program, the Virginia Institute of Marine Science (VIMS) conducted a comprehensive evaluation of storm-induced water levels for several Chesapeake Bay locations. Data from the VIMS study were taken from Hoopers Island, which is approximately 18 miles south of James Island and thus is the station most representative for the James Island area. The data were used to create the water-level vs. return period curve shown in Figure 3-5. Figure 3-5 indicates that the storm tide elevations for a 35- and 100-year return period are 1.4 m (4.5 ft) MLLW and 1.7 m (5.6 ft) MLLW, respectively for the James Island vicinity. Data from the VIMS study were also taken from the Solomons Island site, which is the closest station at approximately 8 miles west of Barren Island, to create the water-level vs. return period curve shown in Figure 3-6. Figure 3-6 indicates that the storm tide elevations for a 35-year and 100-year return period in the vicinity of Barren Island are about 1.3 m (4.3 ft) MLLW and about 1.6 m (5.4 ft) MLLW, respectively (ACRE, 2002).

In addition, the USACE-Engineer Research and Development Center (USACE-ERDC) estimated storm surge levels using simulations of 95 historical storms that traversed the Chesapeake Bay region (USACE-ERDC, 2005c). Fifty-two hurricanes and forty-three northeasters were selected for simulation. Maximum water levels for the 52 hurricanes ranged from 1.08 to 8 ft above mean sea level (MSL). For northeasters, maximum waterlevels ranged from 0.62 to 3.22 ft above MSL. When water depth around the island is increased because of storm surge or tide, the island may be exposed to larger waves (USACE-ERDC, 2005c).

3.1.3.c Wind Conditions

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

Wind data from 1951 to 1982 were taken from NCDC for the Baltimore-Washington International Thurgood Marshall (BWI) Airport, to estimate wind conditions for both study areas (MNE, 2002a; ACRE, 2002). The design wind speed data for a 35-year return period storm ranges from 51 mph for the east direction to 76 mph for the southwest direction as depicted in Table 3-2. The design wind speeds presented in this table have been used to design wave conditions for both study areas.

3.1.3.d Tidal Currents

Tidal currents are defined as the alternating horizontal movement of water associated with the rise and fall of the tide caused by the astronomical tide-producing forces (MNE, 2002b). Currents speeds within the Chesapeake Bay waters are generally slow, mostly < 0.5 m/s (1.6 ft/s) (Nichols and Biggs, 1985). The ranges for the velocity of the flood and ebb currents are 0.3 to 0.5 m/s and 0.4 to 0.8 m/s (1.0 to 1.6 ft/s and 1.2 to 2.5 ft/s), respectively, with higher velocities occurring near the mouth of the Chesapeake Bay near Cape Henry (USACE-Baltimore, 1981).

Approximately 2.5 miles west of James Island, peak tidal current velocities are approximately 0.3 m/s (1.0 ft/s) for flood currents and 0.24 m/s (0.8 ft/s) for ebb currents. In the vicinity of Barren Island, peak flood currents are approximately 0.21 m/s (0.7 ft/s) and 0.1 m/s (0.4 ft/s) for peak ebb currents (MNE, 2004). ADCIRC modeling for James and Barren Islands determined that the current magnitude is generally small, with a maximum speed of 0.27 m/s (0.9 ft/s) for both islands.

3.1.3.e Sedimentation

Changes in tidal current velocities, along with wind induced wave conditions can influence sedimentation patterns and rates. Sediment sources are discussed in Section 3.1.5. Sedimentation modeling (Upper Chesapeake Bay-Finite Element Model) was used to examine the transport of sand (non-cohesive) and clay (cohesive) in the vicinity of James and Barren Islands under existing conditions. The results of the model for both non-cohesive and cohesive sediments indicate that normal tidal currents are inadequate to directly cause sediment suspension and transport. The results also showed that a minimum wind speed of 16-mph caused sediment suspension and transport for non-cohesive sediments and 13-mph wind speed was the minimum needed to cause substantial sediment suspension and transport for cohesive sediments. It was determined through a comparison of sedimentation patterns with bathymetry that areas of erosion correspond to shallow water depths and deposition occurs in adjacent deep-water areas in the vicinity of both islands. (MNE, 2002b; MNE, 2004).

3.1.3.f Wave Conditions

The Mid-Bay region is impacted primarily by wind-generated waves in the Chesapeake Bay. Historical wind data is available from BWI. James Island is exposed to wind-generated waves approaching from all directions. The longest fetch distances to which James Island is exposed correspond to the north and south. In accordance with the recommended procedures from the U.S. Army Corps of Engineers Shore Protection Manual (USACE, 1984), a radially averaged fetch distance was computed for each of the eight wind directions (north, northeast, east, southeast, south, southwest, west and northwest). The radially averaged fetch distance and mean water depths are found in Table 3-3. Wave conditions were hindcast along each fetch condition for the design winds found in Table 3-2 (adjusted appropriately for duration) and the water levels found in Figure 3-5. Specifically, waves were hindcast for each directional design wind speed (i.e. the design windspeeds computed for each individual direction) using the methods found in the Shore Protection Manual (USACE, 1984). Wave hindcast results for offshore significant wave height from the north and south range from 5.4 feet for a 5-year storm to 10.1 feet for a 100-year storm and from 5.3 feet for a 5-year storm to 10.4 feet for a 100-year storm, respectively. Results for peak spectral wave period range from 4.9 seconds for a 5-year storm to 6.4 seconds for a 100-year storm for both the north and south (MNE, 2002a).

Barren Island is also exposed to wind-generated waves from all directions. Radially-averaged fetch distances were computed for each wind direction using the U.S. Army Corps of Engineers computer application Automated Coastal Engineering System (ACES)[1]. The radially averaged fetch distance and mean water depth for Barren Island are found in Table 3-4. Wave conditions were hindcast along each fetch condition for the design winds found in Table 3-2 (adjusted appropriately for duration) and the water levels found in Figure 3-6. Wave hindcast results for offshore significant wave height from the south (largest fetch) range from 6.7 feet for a 5-year storm to 11.3 feet for a 100-year storm. Results for peak spectral wave period range from 5.7 seconds for a 5-year storm to 7.3 seconds for a 100-year storm for the south.

3.1.4 Water Quality

Water quality issues in the Chesapeake Bay range from variation in physical properties, such as temperature, salinity, dissolved oxygen (DO), and water clarity (sediment) to loadings of chemical inputs, such as nutrients and toxics. Excessive nutrients, such as nitrogen and phosphorus, and sediment cause the greatest impairments of water quality in the Chesapeake Bay (CBP, 2004i). Other pollutants include toxic chemicals, heavy metals, pesticides, and sewage. A discussion of water quality specific to the James Island and Barren Island vicinity (Section 3.1.4b) follows a characterization of general Chesapeake Bay water quality as discussed below.

Chesapeake Bay water quality varies spatially, temporally, seasonally, and annually. Water quality variations result from climatic conditions such as precipitation and temperature, and increased freshwater runoff associated with land use. Regionally, spatial variance is driven by proximity to the Chesapeake Bay mouth (oceanic inputs) and the mouths of major rivers, the greatest being the Susquehanna River. Upper Chesapeake Bay waters are largely controlled by Susquehanna River inputs, while Lower Chesapeake Bay water quality is heavily influenced by

[1] Two different contractors were used to collect modeling data for each island and thus a different method was used to compute radially-averaged fetch distances.

oceanic inputs. Waters of the middle portions of the Chesapeake Bay, including those surrounding James and Barren Islands, reflect a mixing of riverine and oceanic inputs.

Land and water within the Chesapeake Bay watershed are intricately connected by an extensive shoreline. As a result, land use has a significant effect on local water quality and in shaping the current state of Chesapeake Bay waters. Nutrients enter through both point and non-point source pathways from anthropogenic sources, including agricultural activities, wastewater treatment plants, urban runoff, septic systems, and deposition from car exhaust and power plants. Physical mixing and biological processes play a role on the ultimate fate and impact of pollutants. Rates of nutrient pollutant delivery to the Chesapeake Bay increased explosively following World War II (Boesch, 2002). Nitrogen inputs from anthropogenic sources currently enter the Chesapeake Bay at about 7 times greater than natural levels (Howarth et al., 2002). In addition to nitrogen, phosphorus inputs from anthropogenic sources enter the Chesapeake Bay at a rate 16.5 times greater than natural levels (Seagle et al., 1999).

Water quality has a direct impact on the distribution and abundance of aquatic plants and organisms that utilize the Chesapeake Bay. Temperature greatly affects Chesapeake Bay waters as many biological, physical, and chemical processes are temperature dependent, including the distribution, abundance, and growth of living resources; the solubility of compounds; rates of chemical reactions; density; mixing; and current movements. The Chesapeake Bay is characterized as a shallow estuary, and as a result, water temperature fluctuates considerably on an annual basis. Water temperature patterns in the Chesapeake Bay are mainly driven by seasonal changes.

Large freshwater inputs from snow melt and spring rains occur in late winter/early spring. The freshwater inputs are laden with nitrogen and phosphorus, nutrients that help plants grow, especially phytoplankton (microscopic floating plants; also called algae). Excess nutrients, called eutrophication, cause phytoplankton growth. The nutrient rich run-off results in a large phytoplankton bloom in the Upper Chesapeake Bay in the spring. As the phytoplankton die, they settle to the bottom, where they are naturally decomposed by bacteria. Nutrients released during the decomposition produce a second phytoplankton bloom in the summer. When there is too much phytoplankton, the water becomes cloudy and blocks the light needed by SAV. Phytoplankton can also coat the leaves of the SAV, further reducing the amount of light received by the plants. SAV are very important to many aquatic species, such as blue crabs, because they provide food, shelter, and nursery areas. Research has shown that the density of juvenile crabs is 10 times greater in areas of the Chesapeake Bay vegetated with SAV beds, compared to non-vegetated areas.

An excess amount of phytoplankton can cause other problems. Sufficient DO throughout the water column is essential to the health and survival of aquatic organisms. During the decompositional process, the bacteria use DO from the Chesapeake Bay's bottom waters. When large amounts of phytoplankton are decomposed by bacteria, as occurs during the summer, the removal of DO is substantially increased. This DO is needed by many organisms living on and near the Bay bottom. Blue crabs, hard clams, summer flounder, bay anchovies, and worms are some of the organisms affected by low DO levels. For example, the resulting low DO concentrations caused by decomposing phytoplankton drive blue crabs from their preferred habitat and kill many of the small, bottom organisms on which the blue crabs feed. This situation worsens in the summer, when several natural factors act to further lower the amount of DO in the Chesapeake Bay's water.

The low DO conditions caused by excess nutrients are the primary reason large bottom sections of the Chesapeake Bay are unsuitable for bottom-dwelling organisms (including oysters, crabs, etc.) (MDNR, 2004j). DO concentrations below 5 milligrams per liter (mg/L) are stressful to the growth, reproduction, and survival of the Chesapeake Bay's fish, shellfish, and bottom-dwelling organisms. DO concentrations below 2 mg/L are severely stressful and potentially lethal (CBP, 2004b). DO levels in the Chesapeake Bay vary according to season and depth. In summer, anoxic waters typically extend from the vicinity of the Chesapeake Bay Bridge south to the Maryland/Virginia border.

Salinity and temperature are important factors to the mixing of oxygen-rich surface water with the oxygen-depleted bottom waters (CPB, 2004b). The mixing zone at the boundary between the upper fresher layer of the water column and the lower saltier layer of the water column is called the pycnocline. Chesapeake Bay waters are stratified during warmer months and partial stratification may persist for most of the year. Since DO is more soluble in cold water, Chesapeake Bay waters have higher DO levels in winter than in summer. DO levels decrease at greater depths despite the cooler temperatures because of the increased oxygen demand of benthic organisms and decaying organic matter. In warmer weather months, water below the pycnocline usually becomes oxygen deficient (Kemp et al., 1999). In the fall and winter, the surface waters cool and sink, mixing the oxygen content to an almost uniform state (USACE-Baltimore, 1981). Massive onset of low DO conditions in the Chesapeake Bay occurred following World War II (Karlsen et al., 2000). This change correlates with the onset of massive inputs of anthropogenic driven nutrients to the Chesapeake Bay following World War II, in large part related to the increased availability and use of fertilizers. Recently, Chesapeake Bay DO has been particularly poor in high-precipitation years when delivery of nutrients from anthropogenic sources to the Chesapeake Bay from the watershed is also elevated (CBP, 2003).

The clarity of the water column affects the survival of SAV and other photosynthetic organisms in the Chesapeake Bay. Clear water allows more light energy to reach primary producers like SAV and phytoplankton. The health of SAV is important because it provides habitat for numerous organisms and oxygenates the water. The health of phytoplankton is essential because phytoplankton form the base of the food chain for the entire ecosystem and oxygenates the water. Elevated levels of total suspended solids (TSS) result in high turbidity levels, reducing the depth of light penetration in the water. Elevated TSS levels also negatively affect the feeding ability of filtering organisms, such as oysters. Water clarity can be qualitatively measured using Secchi depth. The Secchi depth is the depth at which a white and black disc, when lowered into the water, is last visible. Clear water adsorbs less light than turbid water; thus the less turbid the water, the greater the Secchi depth. Therefore, Secchi depths are normally the lowest in summer months.

The impacts of increased nutrient loadings to the Chesapeake Bay water quality have been compounded by loss of productive oyster bars. Oyster populations in the Chesapeake Bay have declined by more than 99% from historic levels as a consequence of impacts of parasites/diseases and overfishing (CBP, 2004j). Oysters formerly filtered much higher volumes and suspended sediments and plankton containing nutrients from the water column (Newell and Ott, 1999). Regional poor water clarity from eutrophication and loss of oysters decrease light availability to SAV. As a consequence, SAV only occupies about 30% of historic beds (Orth et al, 1983). Wave action causing resuspension of bottom sediments and shoreline erosion are natural causes of poor water clarity that can limit SAV.

3.1.4.a Chesapeake Bay Water Quality Monitoring

Water quality is 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, salinity, DO, and turbidity are recorded using a water quality instrument placed directly in the water body. Samples are also analyzed in a laboratory for chemical constituents such as nitrogen, phosphorus, and carbon.

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. Scientists collect data from 22 stations in Maryland's Chesapeake Bay mainstem, from 55 stations in the Chesapeake Bay tidal tributaries, and from 45 stations in the Coastal Bays (MDNR, 2004b). Five years of water quality data (1999 to 2003) from the CBWQM were summarized for the fixed monitoring stations closest to James and Barren Islands (stations EE2.2 and CB5.1, respectively). Station EE2.2 is located in approximately 12.5 m (41 ft) of water, near the mouth of the Little Choptank River about one mile northeast of James Island. Station CB5.1 is located in the Mid-Chesapeake Bay, west of Barren Island in approximately 34.7 m (114 ft) of water (Figure 3-7). The most recent five years of surface (14 ft) water quality data at stations EE2.2 and CB5.1 were chosen as a representative comparison to existing seasonal conditions at both islands. For the CBWQM comparison, the mid-depth water quality data for the upper 4.3 m (14 ft) of the water column were used because these samples most closely resemble the conditions of the sampling locations conducted at James Island and Barren Island. Means and ranges for physical parameters and ranges for nutrients for these two stations are presented in Tables 3-5 through 3-8 and are used for comparisons to the existing conditions at both islands (CBP, 2004f).

Total Maximum Daily Load (TMDL) limits are a tool for implementing Maryland State water quality standards for water bodies that have been classified as "impaired" by the state. TMDLs establish the maximum limit for input of the identified contaminant into the specified water body. James Island is located at the mouth of the Little Choptank River, and MDE has identified the Little Choptank River as an impaired water body due to nutrient loads. No TMDLs establishing the maximum nutrient limits for the Little Choptank have been released as of December 2004 (MDE, 2004c). MDE has also identified Church Creek, a tributary of the Little Choptank River, as an impaired water body due to fecal coliform. The draft TMDL for fecal coliform input into Church Creek was developed in September 2004, and submitted to EPA for evaluation (MDE, 2004a).

MDE has also identified the Honga River as an impaired water body due to nutrients and sediments. Back Creek, a tributary to the Honga River has also been identified as an impaired water body due to fecal coliform. Barren Island is located off of the western shore of Hoopers Island, and the Honga River is located on the eastern (opposite) side of Hoopers Island. No TMDLs for nutrients or sediments for the Honga River have been released as of December 2004. No TMDLs for fecal coliform limits have been released for Back Creek as of December 2004 (MDE, 2004c).

3.1.4.b Existing Seasonal Conditions at James and Barren Island

Quarterly *in situ* water quality sampling was conducted in the vicinity of James and Barren Islands in the Summer 2002, Fall 2002, Winter 2003 and Spring 2003 in association with all biological collections at stations JAM 001-010 and BAR 1-10 located in the vicinity of the proposed footprints (Figures 3-8 and 3-9). Water samples were collected from the same locations as the benthic samples during each quarter and were were analyzed for the following physical *in situ* water quality parameters: temperature, pH, salinity, DO, and turbidity. In addition, nutrient parameter analyses were performed at 10 locations in the Summer of 2002 (except James Island which was not sampled at all), Fall 2002, Spring 2003 and Winter 2003. A complete description of sampling station locations, dates, methods and measured constituents is provided in the quarterly sampling reports (MPA, 2003e; MPA, 2003f; MPA, 2003g; MPA, 2003h; MPA, 2004g; MPA, 2004h; MPA, 2003a; MPA, 2004b). Means and ranges of the water quality and chemical variables at the islands are presented in Tables 3-9, 3-10, and 3-11.

During the James Island spring sampling, one of the water quality stations (JAM-001) was slightly off course and the sample collection occurred over a ledge into deeper waters [6.7 m (22 ft)]. The depth of water recorded at this off-course location was the deepest compared to all other sampling locations which were 4.3 m (14 ft) or less. Therefore, for the CBWQM comparison, the mid-depth water quality data for the upper 4.3 m of the water column were used because they most closely resemble the conditions of all the other sampling locations at the islands.

In general, the *in situ* seasonal physical water quality and nutrient data collected mid-depth at James and Barren Islands during the quarterly surveys were within the expected seasonal ranges that are representative of the middle portion of the Chesapeake Bay (MPA, 2005a; MPA, 2005b). Water temperatures exhibited typical seasonal trends. For the most part, seasonal mean water temperatures measured during the quarterly sampling were within the range of values reported at both CBWQM stations. At James and Barren Islands, the average warmer water temperatures were generally recorded during the spring [17.1°C and 19.9 °C (62.8°F and 67.8°F), respectively] and summer [24.6°C (76.3°F) for both islands] (Table 3-9). At some shallow sampling locations, the fall/winter water temperatures recorded were lower than the values recorded at the CBWQM stations. This is typical of areas sampled nearshore as they have a tendency to freeze first in cold weather conditions; therefore these temperatures are not unusual. On the other hand at some deeper sampling locations in the spring and summer, the water temperatures were colder compared to the fall and winter. These findings are typical during the spring and summer when surface and shallow waters are warmer than deeper waters, and thus creating two distinct temperature layers (CBP, 2004d).

Salinity at each island was generally within the range of values reported at each corresponding CBWQM station. Typically for James and Barren, the highest average salinities occurred during the fall (19.5 ppt and 17.3 ppt, respectively), and the lowest average salinities occurred during the spring (11.1 ppt and 10.0 ppt, respectively) (Table 3-9), which was consistent with the mesohaline salinity regime (Section 3.1.1). Within the Chesapeake Bay, salinity levels vary widely from season to season and year to year, depending on the amount of freshwater input into the Chesapeake Bay. During spring rains, the salinity is usually lower compared to the drier fall months, when the salinity is usually higher (CBP, 2004d). During the spring and summer of 2003, the Chesapeake Bay area experienced near-record levels of persistent and heavy precipitation, thus contributing to lower salinity levels (CBP, 2004b).

Overall, the DO concentrations at both islands varied seasonally and were within the range of values reported at the CBWQM stations (Table 3-5 and 3-6). Because warm water has less ability to hold DO than cold water, DO concentrations tend to be lower in the summer compared to winter. Chesapeake Bay bathymetry and biological activity also influence depressed summertime DO. Deep waters can become further oxygen deprived in the summertime, if the pycnocline prevents mixing with oxygenated surface waters. When water temperatures cool in the fall, deeper waters become re-oxygenated. Freshwater entering the Chesapeake Bay is also associated with greater DO levels than saline water (CBP, 2004d). Increasing phytoplankton growth as Chesapeake Bay waters warm can lead to “algae blooms” and a subsequent heavy die-off of phytoplankton. Decaying phytoplankton on the bottom consumes oxygen, which also contributes to low DO during warm months. At James and Barren Islands, the lowest average DO levels recorded during the summer were, 5.5 mg/L and 7.4 mg/L, respectively (Table 3-9).

In general, the pH measurements at the islands were very similar to each other and fell within the seasonal ranges reported at the CBWQM stations. The range of pH values recorded at James Island was from 7.3 to a high of 9.0, which occurred during the spring season (Table 3-9). The range of pH values recorded at Barren was from 7.5 to a high of 8.8, which also occurred during the spring season (Table 3-9). According to MDNR, high pH values are often associated with algal photosynthesis and low salinity environments (MDNR, 2004c).

Secchi depth was recorded at both islands during the winter and spring. The measurements were generally similar among stations at each island as well as the CBWQM stations. The stations generally exhibited the greatest clarity during the winter, which is to be expected. At James and Barren Islands, the greatest Secchi depth reading taken during the winter was 2.0 m (6.6 ft) and 2.1 m (6.9 ft), respectively (Table 3-9).

Water clarity or turbidity can also be measured using a transmissometer. Turbidity values are recorded in Nephelometric Turbidity Units (NTUs). At James and Barren Islands, turbidity readings were not recorded at the majority of locations due to possible equipment inaccuracies. When recorded, the highest NTUs were found at the James Island beach seine locations, where extensive shoreline erosion has been documented (MPA, 2003g). At both CBWQM stations, turbidity measurements were not taken during the dates that coincide with the quarterly sampling at the islands, so comparisons to this data are not possible.

Seasonal patterns of chemical constituents and nutrient parameters measured at James and Barren Islands were similar to seasonal distributions at the CBWQM stations. Excess nitrate levels are one of the most significant factors affecting the Chesapeake Bay (Radcliffe, 2001)**.**

The growth of phytoplankton is dependent on the essential nutrients, such as nitrates and phosphates in the Chesapeake Bay (Radcliffe, 2001). The greatest nitrate and total dissolved phosphorus values were found during the winter and spring at both islands when the growth of phytoplankton is limited. Concentrations of chlorophyll *a* are another indicator of phytoplankton abundance (Moss et al., 2003). At James and Barren Islands, the highest levels of chlorophyll *a* were recorded during the spring sampling event with an average of 31.81 microgram per liter (*u*g/L) and 33 *u*g/L, respectively (Tables 3-10 and 3-11).

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. 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 (CBP 2004c).

3.1.5 Sediment Quality

Delivery of excess sediments to the Chesapeake Bay is of concern. Eroded sediments from upland and riverine sources enter the Chesapeake Bay in quantities considerably greater than natural levels as a consequence of human activities and landscape alterations. Accumulating sediments shoal navigation channels. Nutrients adsorbed to fine-grained sediments derived from eroded topsoil contribute to eutrophication. Contaminants harmful or toxic to aquatic life bind to fine-grained sediments in urban and industrial areas. Fine-grained sediments can remain suspended in Chesapeake Bay waters for extended periods of time. This reduces water clarity, limiting growth of SAV. Wave resuspension of bottom sediments and shoreline erosion are a major source of suspended sediments in shallow water areas. Generally, wave energies can move bottom sediments down to about 6-ft depth.

There are four primary sources of sediments entering the Chesapeake Bay with the relative importance of each varying throughout the watershed:

- Input from main rivers, smaller tributaries, and streams in the watershed (watershed sources).
- Erosion from shorelines and coastal marshes (shoreline erosion).
- Ocean input at the mouth of the Chesapeake Bay.
- Internal biogenic production of skeletal and organic material (minor source).

The two most important watershed sources of sediment are: (1) erosion from upland land surfaces and (2) erosion of stream corridors (banks and channels) (USGS, 2003). Sediment erosion is a natural process influenced by geology, soil characteristics, land cover, topography, and climate. Natural sediment transport processes can be affected by anthropogenic land disturbances. Agriculture and timber production can cause increased upland erosion and delivery of sediments to streams. Urbanization promotes increased runoff, which causes stream bank and channel erosion to increase. Sediments eroded from the land surface are transported downstream or are stored in the watershed for an undetermined time before making their way to the Chesapeake Bay.

Sediment inputs to the rivers of the Chesapeake Bay watershed from agriculture and forestry sources peaked in the late 1800s through early 1900s and have since declined substantially as a consequence of natural forest recovery and implementation of soil conservation management practices (Curtin et al., 2001). Monitoring data from major rivers entering tidal waters of Chesapeake Bay show that sediment loads have not changed over the period of the 1980s through 2001 (CBP, 2004h).

Shoreline erosion of the banks and coastal marshes of the Chesapeake Bay is also a large source of fine-grained sediment, particularly in the Mid-Bay. It is likely that shoreline erosion will become an increasing source of sediment given that sea level is currently rising and is expected to continue to rise (USGS, 2003).

Although eroding shorelines do contribute sediment to the Chesapeake Bay, it is important to note that shorelines with erosional conditions are natural to much of the Chesapeake Bay. Sediment from eroding shorelines is critical to maintenance and creation of shallow water and shoreline habitats. Stabilization of eroding shorelines often leads to accelerated downdrift erosion, increased water depth alongshore, and loss of beach. In addition, eroding shoreline sediment typically contains only limited quantities of biologically available nutrients in contrast to eroding topsoil and nutrients delivered from artificial fertilizers, animal waste, and human waste. It should be noted that sediment transport from the Atlantic Ocean is also a major source of sediment to the lower Chesapeake Bay, along with shoreline erosion.

Maryland contributes approximately 20% of sediment pollution reaching the Chesapeake Bay, with 70% of the sediment originating from agricultural land, 21% from urban/suburban areas, and 9% from forests. In the Mid-Bay, the majority of sediment influx comes from shoreline erosion or is produced internally by biological processes. The most abundant bottom sediments in the Mid-Chesapeake Bay, are clay and sand that have eroded from banks and shorelines.

Erosional forces, such as wave action, influence the placement of and movement of James and Barren Islands surface sediments. The surficial substrate surrounding James and Barren islands is predominantly sand, consistent with the character of much of the middle and lower Chesapeake Bay bottom along the Eastern and Western Shore out to about 30 ft. depth (Kerhin et al., 1988)

3.1.5.a James and Barren Island Sediment Sampling

Sediments for chemical and nutrient analysis were collected from five of the James Island benthic sampling stations (JAM-002, JAM-005, JAM-007, JAM-009, and JAM-010) in Fall 2001 (Figure 3-8). Physical characterizations (grain size analysis) were conducted on sediment samples collected from each of the ten James Island benthic sampling stations in Fall 2001 (Stations JAM-001 through JAM-010). The sediments were sampled with a Ponar grab sampler. The chemical, nutrient, and physical analyses of the sediment samples were conducted in a laboratory using standard USEPA methods. Results are presented in Table 3-12. A complete description of sampling station locations, dates, methods and measured constituents is provided in the Fall 2001 and Summer 2002 sampling report (MPA, 2003e). Based upon the grain size analyses, the area surrounding the James Island archipelago consists of sediments that range from sand to silt to clay. The sediments are predominantly comprised of sand at the majority of sampling stations, except for station JAM-010, which is classified as silty clay and is located in the closest proximity to James Island, east of the Northern Remnant (MPA, 2003e).

Sediments were collected from each of the ten benthic sampling stations surrounding the Barren Island archipelago. Sediments for chemical and nutrient analysis were collected at sampling stations BAR-1 through BAR-5 in Summer 2002 and Spring 2003, and physical analyses were performed on samples from stations BAR-1 through BAR-10 (Figure 3-9). The sediments were sampled with a Ponar grab sampler. The chemical and physical analyses of the sediment samples were conducted in a laboratory using USEPA methods. Results are presented in Table 3-13. A complete description of sampling station locations, dates, methods and measured constituents is provided in the Summer 2002 and Spring 2003 quarterly reports (MPA, 2003g; MPA, 2004b). The area surrounding the Barren Island archipelago consists of sediments that range from sand to silt to clay. The sediments are predominately comprised of sand at all of the sampling stations (MPA, 2005a).

Historically, sediments in the mainstem Chesapeake Bay have low levels of chemical contamination. According to the CBP (1999a) the sediments surrounding the Barren Island archipelago fall under this characterization. A recent investigation found few contaminants in the sediments surrounding the Barren Island archipelago (MPA, 2004b). These contaminants were limited to metals that were low in concentration. Analytical results noted detectable levels of nutrients such as ammonia, nitrogen, and phosphorous. In addition, AVS were found in higher concentrations than the sum of the metal contaminants, which eliminates the potential uptake of metals to aquatic organisms (MPA, 2003e).

According to the Chesapeake Bay Program, sediment data surrounding the James Island archipelago are insufficient for complete characterization; however, the Chesapeake Bay Program data suggests a low probability of chemical contamination (CBP, 1999b). In a study conducted by EA (MPA. 2003e), few contaminants were found in the sediments surrounding the James Island archipelago. The majority of these contaminants were in low concentrations. Acenaphthylene, a polynuclear aromatic hydrocarbon (PAH), was found above the Threshold Effects Level (TEL), but below the Probable Effects Level (PEL). Chemical concentrations that are below the TEL rarely cause adverse biological effects. Chemical concentrations that are between the TEL and PEL occasionally cause adverse biological effects. Chemical concentrations that are above the PEL frequently cause adverse biological effects (MPA, 2003e). Several metals, PAHs, polybiphenol congeners, chlorinated pesticides, volatile organic compounds, dioxin congeners, and butyltins were found to be present in the sediments surrounding the James Island archipelago, but were not at levels of concern. Analytical results noted detectable levels of nutrients such as ammonia, Kjeldahl nitrogen, organic carbon, phosphorous, and sulfides. A complete description of the detected contaminants and their concentrations found in the sediments surrounding the James Island archipelago is provided in the Fall 2001 and Summer 2002 report (MPA, 2003e). A concentration of acid volatile sulfides (AVS) greater than the sum of the metals, immobilizes the metals, which eliminates the potential uptake of metals to aquatic organisms (MPA, 2004b).

3.1.6 Aquatic Resources

3.1.6.a Submerged Aquatic Vegetation (SAV)

The term "submerged aquatic vegetation" is used for both marine angiosperms (the so-called true seagrasses) and freshwater macrophytes that have colonized Chesapeake Bay and its tributaries. SAV encompasses 19 taxa from 10 vascular macrophyte families and 3 taxa from one freshwater macrophytic algal family, the Characeae, but excludes all other algae (CBP, 2003). SAV beds in Chesapeake Bay are mapped and measured annually by VIMS using aerial photography. The reports from 1994 onward are available through the VIMS website at www.vims.edu/bio/sav.

SAV plays an important ecological role within the aquatic environment of the Chesapeake Bay by providing food and habitat for waterfowl, fish, shellfish, and invertebrates. As a primary producer, SAV serve as a basis and important link in the Chesapeake Bay food web. The grasses serve as a nursery habitat for many species of fish, such as juvenile striped bass or blue crabs, which seek refuge from predators in the grass beds. Additionally, SAV provides other important ecological functions within the Chesapeake Bay by producing oxygen in the water column as part of the photosynthesis process; filtering and trapping sediment that would otherwise increase turbidity and potentially bury benthic organisms, such as oysters; protecting shorelines from erosion by slowing down wave action; and removing excess nutrients, such as nitrogen and phosphorus, that could fuel unwanted growth of algae in the surrounding waters (Stevenson and Confer, 1978). As a result, SAV plays a key energy cycling role within the Chesapeake Bay.

Historically, more than 200,000 ac of SAV grew along the shorelines of the Chesapeake Bay, but by 1984, a survey of Chesapeake Bay grasses performed by the Chesapeake Bay Program documented only 37,000 ac in the Chesapeake Bay and its tidal tributaries, less than one-fifth of the original population. There was a dramatic Bay-wide decline of all SAV species in the Chesapeake Bay during the late 1960s and 1970s (Orth and Moore, 1983) that correlates with the great increase in nutrient inputs from the surrounding watershed following World War II (Boesch, 2002), and with the loss of oysters from disease and overharvesting (Newell and Ott, 1999). SAV growth may vary from season to season because of many factors such as, fluctuations in precipitation, increases in waterfowl consuming SAV, or changes in the water clarity due to nutrients, phytoplankton, or increases in turbidity. Other aquatic habitat conditions influencing SAV distribution include temperature, light penetration, water depth, water currents, wave action, nutrient availability, and sediment deposition (CBP, 2003). Storm events and herbivory by aquatic species also influence SAV distribution. In 2003, scientists estimated that about 64,709 ac of SAV were living in the Chesapeake Bay, showing a steady rebound since the 1984 low point. Declining water quality, disturbance of SAV, and alteration of shallow water habitat all contribute to the decline of SAV (CBP, 2004d).

The distribution of SAV species in the shallow waters of the Chesapeake Bay depends greatly on their individual habitat requirements (Orth and Moore, 1984). Salinity is a primary factor affecting SAV distribution; therefore, SAV species often are categorized by salinity tolerance. Tidal fresh species of SAV require a salinity concentration range of 0 to 0.5 ppt. Slightly brackish or oligohaline species require a salinity concentration range of 0.5 to 5 ppt, moderately brackish or mesohaline species require a salinity concentration range of 5 to 18 ppt, and high-salinity or polyhaline species require a salinity concentration range of 18 to 30 ppt

(CBP, 2003). The submerged grasses commonly found in areas of higher salinity in the Chesapeake Bay include *Zostera marina* (eelgrass) and *Ruppia maritima* (widgeon grass). Grasses commonly found in areas of lower salinity include *Potamogeton perfoliatus* (redhead grass) and *Potamogeton pectinatus* (sago pondweed) (Orth and Moore, 1984).

Seventeen species of SAV are commonly found in the Chesapeake Bay and its tributaries. *Zostera marina* (eelgrass), the only "true" seagrass species, can tolerate salinities as low as 10 ppt, and is dominant in the lower reaches of the Chesapeake Bay. *Myriophyllum spicatum* (Eurasian watermilfoil), *Potamogeton pectinatus* (sago pondweed), *Potamogeton perfoliatus* (redhead grass), *Potamogeton crispus* (curly pondweed), *Potamogeton pusillus* (Slender pondweed), *Zannichellia palustris* (horned pondweed), *Vallisneria americana* (wild celery), *Elodea canadensis* (common elodea), *Ceratophyllum demersum* (coontail), *Hydrilla verticillata* (hydrilla), *Heteranthera dubia* (water stargrass), *Najas guadalupensis* (southern naiad), *Najas minor*, *Najas gracillima*, and *Najas* sp. are freshwater species, some of which have the capacity to tolerate some level of salinity, and are found in the middle and upper reaches of the Chesapeake Bay (Stevenson and Confer, 1978; Orth et al., 1979; Orth and Moore, 1981, 1983; Moore et al., 2000). *Ruppia maritima* (widgeon grass) is tolerant of a wide range of salinities and is found from the Chesapeake Bay mouth to the Susquehanna Flats. Approximately nine other species are only occasionally found within the Chesapeake Bay. When present, these less common species occur primarily in the middle and upper reaches of the Chesapeake Bay and the tidal rivers. Of all the species of SAV, the most abundant in the Chesapeake Bay are *Z. marina, R. maritime, V. Americana, H. verticillata, P. perfoliatus, P. pectinatus (Stuckenia pectinata),* and *M. spicatum*. *H. verticillata* (hydrilla), an introduced exotic species, has been shown to dominate SAV beds in the tidal freshwater reaches of the Potomac River (Carter and Rybicki, 1986) and other tributaries to the Chesapeake Bay. Hydrilla has also been reported to occur in the Susquehanna Flats and in the tidal freshwater portions of the Patuxent River, although its growth has not been as widespread as in the Potomac River.

3.1.6.a.1 James and Barren Island SAV Resources

SAV surveys were conducted at James Island during Summer 2002, Spring 2003, and Summer 2003. During the Summer 2002 (June) field survey, a qualitative SAV survey was performed which indicated that widgeon grass (*Ruppia maritime*) was the dominant species along the eastern shorelines of James Island. The four SAV beds identified (Figure 3-10) ranged from 91.4 to 137.2 m (100 to 150 yards) from the eastern shoreline of all three-island remnants (MPA, 2003e). During the Spring 2003 (May) field survey, transects were performed in those areas where SAV beds had been reported in previous qualitataive surveys conducted in 2001 and 2002, as well as several areas in the immediate vicinity where SAV beds had not been reported. SAV gathered from each rake throw was recorded and all SAV collected consisted of horned pondweed (*Zannichellia palustris*). Dense beds were noted to the east of the northern remnant and smaller less-dense beds to the east of the southern remnant (MPA, 2004h). Figure 3-10 illustrates the extent of SAV at James Island found during the spring 2003 survey. During the Summer 2003 (August) sampling event, transects with rake throws were performed in the same areas as the spring survey and a diver also entered the water to make visual observations. A single blade of SAV was collected off the eastern shore of the northern remnant, and identified as horned pondweed, by Dr. Peter Bergstrom of NOAA's Chesapeake Bay office. Dr. Bergstrom commented that much of the widgeon grass on the Eastern Shore of Maryland had died back during the 2003 season. Widgeon grass is the species most likely to be present during the summer months, whereas both horned pondweed and sago pondweed (*Potamogeton pectinatus*) are usually only present during the spring to early summer months (MPA, 2004i).

A review was performed on SAV bed location maps from 1994 through 2000 of James Island and its immediate surrounding waters produced by VIMS. The VIMS aerial SAV maps showed no SAV beds located around James Island prior to 1999; the closest SAV beds in these years were adjacent to the northeastern shores of Taylors Island, one mile south of James Island. VIMS surveys showed James Island to have 18.1 ac in 1999, no SAV in 2000, 22.6 ac in 2001, 7.0 ac in 2002, and no SAV in 2003. Recently, two small beds periodically occur along the eastern shore of the James Island remnants, averaging 10 ac between 1999 and 2003. Both beds were reportedly dominated by widgeon grass. Neither bed was present in 2003 surveys.

SAV surveys were conducted around Barren Island during Summer 2002, Spring 2003, and Summer 2003. During the Summer 2002 (September), a qualitative survey described monotypic (containing only one species) beds of widgeon grass. These beds were predominantly located adjacent to the eastern shoreline of the remnants of Barren Island in waters of about 3 feet in depth. Eelgrass (*Zostera marina*) and the macroalgae sea lettuce (*Ulva lactucna)* were also observed washed up on the beach of the northern tip of the northern remnant (MPA, 2003g).

During the Spring 2003 and the Summer 2003 a total of seven transects and three locations within the geotextile tube areas (located along the western shoreline of the Barren Island northern remnant) were surveyed (156 total stations). At each station, a rake throw was performed to collect SAV for identification. During the Spring 2003 survey, there were 113 observations of SAV in all transects, with the exception of the geotextile tube areas (MPA, 2004b) where no SAV was present. SAV crown densities were highest along the northern and eastern shorelines (MPA, 2004b). During the Summer 2003 survey, there were only 12 observations of SAV. During these observations only horned pondweed was found and it was always located in shallow waters, approximately 0.4 to 2.1 m (1.2 to 6.9 ft) in depth. Dense growths of eelgrass were also observed in shallow salt ponds on the northern end of the northern remnant and southwestern end of the southern remnant (MPA, 2004c). During the Spring 2003 surveys, visual diving surveys revealed that horned pondweed was present in varying densities in most of the shallow water areas surrounding the east, northeast, and southeast areas of the island (MPA, 2004b). Figure 3-11 shows SAV bed crown density found during the Spring 2003 survey.

Annual SAV monitoring by VIMS has shown that SAV beds have made a resurgence since 1999 in the waters on the eastern side of Barren Island. An average of 695 ac of SAV beds was present between 1999 to 2003, peaking at 1,325 ac in 2001. Minimal beds of SAV were found prior to 1999, averaging 1.3 ac between 1994 and 1998. No SAV was documented by the VIMS maps off the western shoreline of Barren where the project would be primarily constructed. However, SAV has been intermittently present along the northern shoreline (VIMS, 2004a). The northern SAV bed has ranged in size from 3 ac in 2003 to 4.9 ac in 1997 to approximately 25 ac in 2001 and 2002. This bed was identified as widgeon grass *(Ruppia maritima)* in 1997 and 2001. The most recent SAV maps of the Barren Island vicinity were generated based on aerial photographs taken on July 26, 2003, and on October 25, 2003 by VIMS. 2003 SAV beds were greatly reduced in size and density compared to 2001 and 2002; and were even smaller than 1999 and 2000 SAV beds. 2003 mapping shows that there are three SAV beds in the vicinity of Barren Island: a SAV bed with 0 to 10% cover located along the northern shoreline of Barren Island; a SAV bed with 0 to 10% cover located approximately 2,000 ft to the north of Opossum Island; and, a SAV bed with 10 to 40% cover located along the southern shoreline of Barren Island and extending for approximately 914.4 m (3,000 ft) along the eastern side of the sand bar that extends southward (MPA, 2005a).

The Chesapeake Bay Program has defined Tier I, II, and III SAV recovery zones. The Tier I SAV distribution restoration target is the restoration of SAV to areas currently or previously inhabited by SAV as mapped through regional and baywide aerial surveys from 1971 through 1990 (Batuik *et al.* 1992; Dennison *et al.* 1993). The Tier II and Tier III distribution restoration targets are the restoration of SAV to all shallow water areas identified as existing or potential SAV habitat, down to the 1- and 2-meter (3.3 and 6.6 feet) depth contours, respectively. Tier 1 areas surround all James Island remnants. Tier I areas have been delineated to the northeast, east, and southeast of Barren Island. Tier II and Tier III zones surround both islands. It is estimated that 298.8 ac of bottom less than 2 m in depth exist within the project footprint at James Island. All of the Barren project area, approximately 92 ac, is less than 2 m in depth.

3.1.6.b Phytoplankton & Zooplankton

Plankton are tiny open-water plants, animals, or bacteria that generally have limited or no swimming ability and are transported through the water by currents and tides. Phytoplankton, or algae, are primary producers that serve as the foundation of the aquatic food web. These organisms fix carbon through photosynthesis, produce life-sustaining oxygen for aquatic organisms, and assimilate nutrients such as nitrogen and phosphorus that flow into the Chesapeake Bay. Phytoplankton growth is limited by light and nutrient availability. Typically, upper Chesapeake Bay waters are light limited and lower Chesapeake Bay waters are nutrient limited. Within, the upper Chesapeake Bay, nitrogen is a limiting nutrient in the spring; phosphorus in summer. Phytoplankton can undergo rapid population growth or 'algal blooms' when water temperatures rise in the presence of excess nutrients, which typically occurs each spring in the Chesapeake Bay (CBP, 2004e). Although phytoplankton are a vital food source for many organisms, a large amount of excess phytoplankton production occurs and eventually sinks to the bottom where decomposition depletes bottom waters of oxygen. Phytoplankton are a good indicator of environmental conditions in the Chesapeake Bay due to their sensitivity and responsiveness to water quality conditions.

The major groups of phytoplankton in the Chesapeake Bay include diatoms, golden-brown algae, green algae, blue-green algae, dinoflagellates, cryptomonads, and microflagellates (CBP, 2004e). Chlorophyll-*a* concentrations provide an indirect measurement of phytoplankton biomass. The chlorophyll-*a* concentrations in the vicinity of James and Barren Islands were measured as part of the quarterly water quality studies. For specific data on the chlorophyll-*a* concentrations in the water quality samples refer to Section 3.1.4. Chlorophyll-*a* concentrations were not measured at the locations that the plankton surveys were conducted.

Zooplankton are planktonic animals that range in size from microscopic rotifers to macroscopic jellyfish. Zooplankton provide an important food source for the Chesapeake Bay, and are responsible for linking the phytoplankton to the higher-trophic level organisms such as forage fish and larval stages of all fish (CBP, 2004e). Salinity, temperature, and food availability are the three key factors in determining the distribution of zooplankton in the Chesapeake Bay (CBP, 2004e). Due to their sensitivity to changes in water quality, zooplankton are good indicators of water quality in the Chesapeake Bay (CBP, 2004e).

3.1.6.b.1 James and Barren Island Plankton Surveys

Plankton surveys were conducted in the vicinity of James Island in the Chesapeake Bay in Summer 2002, Fall 2002, Winter 2003, and Spring 2003. Ichthyoplankton and zooplankton collected during all seasons were quantitatively assessed; the results of the plankton surveys from all four sampling seasons are summarized in Tables 3-14 and 3-15 for James Island. Larval ichthyoplankton collected in the Summer 2002 sampling consisted of bay anchovy (*Anchoa mitchilli*), naked goby (*Gobiosoma bosci*), blenny (Hyppsoblennius sp.), skilletfish (*Gobiesox strumosus*), Atlantic silverside (*Menidia menidia*), northern pipefish (*Sygnathus fuscus*), and seahorse (*Hippocampus erectus*). Four species of fish eggs were collected: bay anchovy (dominant), hog choker (*Trinectes maculatus*), weakfish (*Cynoscion regalis*), and naked goby. Crab zoea was the dominant zooplankton collected, and shrimp larvae and amphipods were also abundant (MPA, 2003e).

Larval ichthyoplankton collected during the Fall 2002 sampling consisted of three species of larvae (bay anchovy, blenny, northern pipefish). Atlantic menhaden (*Brevoortia tyrannus*), which are known to spawn in fall, were the only eggs identified during the fall survey. Copepods dominated the zooplankton collection; shrimp larvae, mysid shrimp, and chaetognaths (arrow worms) were also present in samples from all stations. Amphipods, isopods, polychaetes, cnidarians, gastropods, pelecyopods, cumaceans (lollipop shrimp), and hydroids were also detected in low abundances (MPA, 2003f).

The ichthyoplankton collected during the Winter 2003 survey consisted of three winter flounder (*Pleuronectes americanus*) larvae. Copepods made up 99.9% of the zooplankton collected; crab larvae, isopods, hydrozoans, scyphozoans, and bivalves were also identified (MPA, 2004g).

Bay anchovy eggs and larvae dominated the ichthyoplankton collected during the Spring 2003 survey. Weakfish eggs were recovered from most stations, and Atlantic silverside larvae were also present in trawls from every location. Copepods dominated the zooplankton collected from every station, and polychaetes were also present in most samples (MPA, 2004h).

The winter flounder (3 larvae) identified in the Winter 2003 ichthyoplankton survey is the only fish species found solely in the plankton study. That is, winter flounder was not identified in any other fish surveys at James Island except the plankton surveys. Although great numbers were not found, winter flounder presence is not unlikely as the Choptank River is winter spawning ground for this species (MPA, 2004i).

Plankton surveys were conducted in the vicinity of Barren Island in Summer 2002, Winter 2003, and Spring 2003. Ichthyoplankton was collected in all three seasons and zooplankton was collected in the Winter and Spring of 2003. Plankton collected during all seasons was quantitatively assessed; the results of the plankton surveys from the sampling seasons are summarized in Tables 3-16 and 3-17 for Barren Island.

Ichthyoplankton collected during the Summer 2002 surveys yielded six species of fish larvae, and no fish eggs. Larval species collected include bay anchovy, blenny, Atlantic silverside, northern pipefish, lined seahorse, and goby. Blenny larvae numerically dominated plankton densities. Additionally, shrimp larvae, mysid shrimp, and copepods were collected from all stations. Plankton trawls also collected amphipods, isopods, cnidarians, polychaetes, nudibranchs, pelecyopods, cumaceans, and tubellarians (MPA, 2003g).

The Winter 2003 plankton survey collected three individual ichthyoplankton specimens: an unidentified fish egg, and two Atlantic menhaden larvae. Zooplankton was more plentiful compared to the ichthyoplankton in this survey, with 37 taxa collected. The copepods, *Acartia tonsa* and *Centropages hamatus*, accounted for an average 71% and 19% combined density over all of the sample stations. *Ameroculodes sp*., mysid shrimp, and *Neomysis americana* were also some of the other species collected (MPA, 2003a). Spring 2003 plankton surveys collected eight species of ichthyoplankton, with bay anchovy eggs numerically dominant at every station.

The Spring 2003 plankton survey recovered 16 different zooplankton species. The arthropod *A. tonsa* was the numerically dominant species at nearly every station accounting for 79.2% of the total abundance, and *N. americana* was the second most dominant species, accounting for 10.8% of the total abundance (MPA, 2004b). There were two fish species identified solely in the Barren Island plankton surveys, but in no other Barren Island fisheries surveys: rough silverside (*Membras martinica)* and northern pipefish. Both species were limited to the Spring 2003 ichthyoplankton survey at low densities. Rough silverside eggs were identified in the surface [1/100 cubic meters (m^3)] and combined samples (0.5/100 m^3). Rough silverside post yolk sac larvae were present in bottom (0.3/100 m^3), surface (3.8/100 m^3), and combined samples (2.1/100m^3). Northern pipefish post yolk sac larvae were identified in bottom (0.5/100 m^3), surface (0.2/100 m^3), and combined samples (0.3/100m^3). Northern pipefish juveniles were identified in bottom (6.2/100 m^3), surface (1.3/100 m^3), and combined samples (3.8/100 m^3). The numbers of these ichthyoplankton are low (MPA, 2004c).

3.1.6.c Benthic Macroinvertebrates

Benthic invertebrates are a vital element of the Chesapeake Bay ecosystem. Benthic invertebrates supply an important linkage between primary producers and higher trophic levels, such as humans and fish. The health of a benthic community is the result of a combination of factors that include sediment quality; water quality, particularly salinity and DO; time of year; ecological interactions with predator, prey, and competitor populations; and physical conditions including substrate type, and erosive or accumulative forces. Benthic communities affect water quality and sediment quality in the Chesapeake Bay by filtering particles out of the water column to provide greater water clarity and remove chemicals from the sediment (USEPA, 1989). Soft bottom (i.e., muddy or sandy) habitats comprise 99% of the Chesapeake Bay. Oyster beds and other hard bottoms comprise the remaining 1% of Chesapeake Bay bottom substrate (Chesapeake Bay Benthic Monitoring Program (CBBMP), 2004).

Benthic macroinvertebrates (or macrobenthos; invertebrates >0.5 mm) are large, generally soft-bodied organisms without a backbone living in or on bottom sediment that make up a diverse assemblage of species. To date, over 340 species of benthic macroinvertebrates have been collected from soft bottom habitats by the CBBMP since the program was initiated in 1984 (CBBMP, 2004). The majority of Chesapeake Bay benthic macroinvertebrate species collected belong to one of six groups: gastropods, bivalves, polychaete worms, oligochaete worms, amphipods, and chironomids.

Compared to historical conditions, the benthic community of the Chesapeake Bay has undergone significant changes. Oyster beds, hard bottom habitats, and the communities associated with these structures have been drastically reduced. Anoxia, increased sediment input, and increased phytoplankton production have been the major stressors. Mid-Bay macrobenthic biomass is much less than in similarly productive estuaries (Hagy, 2002). Subsequently, it is hypothesized that historically, the macrobenthos performed a great deal of carbon processing. In today's Chesapeake Bay, a large portion of this service is provided by bacteria. The consequence is that much less carbon energy is passed up the food chain to support higher trophic levels.

Crustacean and benthic invertebrate species collected during Barren Island sampling during Fall 2002, Winter 2003, and Spring 2003 (bottom trawling, beach seine, gillnetting, and pop net surveys) included grass shrimp (*Palaemontes* sp.), scuds (Family Gammaridae), clam worms (Family Nerieidae), blue crab (*Callinectes sapidus*), eelgrass isopod (Family Idotedae), horseshoe crab (*Limulus polyphemus*), and lined seahorse. James Island surveys over the same period identified blue crab, scuds, grass shrimp, black-fingered mud crab (*Eurypanopeus depressus*), and horseshoe crab. The following sections discuss the major commercially important macroinvertebrates of the Chesapeake Bay system.

3.1.6.c.1 Clams

The razor clam (*Tagelus plebius*) is a deep-burying clam that lives in burrows that can extend as deep as two or three feet into the substrate. Razor clams live within the middle Chesapeake Bay, both intertidally and subtidally in water up to 30 feet deep (Lippson and Lippson, 1997).

The soft-shell clam (*Mya arenaria)* represents a significant fishery in the middle portion of the Chesapeake Bay. The species occurs in various soft substrates, but most prominently in sandy areas with relatively shallow water (MES *et al*., 2002). Optimal areas for soft-shell clams are found on the Eastern Shore from the Pocomoke Sound to Eastern Bay, and on the western side from the Rappahannock River to the Severn River (USACE-Baltimore, 1999).

Soft-shell clams feed on small detrital particles, phytoplankton, small zooplankton, and bacteria (CBP, 2004j). Most of the predation on soft clams occurs during the larval and juvenile stages. In addition to being a commercially important species, soft-shell clams have an ecologically important role in the food chain. Clam larvae are an important food source for larger planktonic organisms, including larval fish, jellyfish, and comb jellies. Crabs, eels, finfish, waterfowl, muskrats, and raccoons prey on juveniles and mature clams.

Soft-shell clam abundance has decreased from historical levels. In addition to fishing mortality and predation, populations are affected by several pathological conditions, including disseminated neoplasia and *Perkinsus* sp. protozoan infections. Clam population and disease status assessments conducted in 2001 found that infection levels of *Perkinsus* sp. in soft-shell clams greatly varied among regions with severe levels found on some sites in Eastern Bay, the Chester River, and in the Patuxent River (Homer, 2003).

3.1.6.c.2 Eastern Oyster

The Eastern oyster, (*Crassostrea virginica)*, also called the American or Atlantic oyster, has long been considered one of the Chesapeake Bay's keystone species. Over-harvesting, dwindling habitat, pollution, and diseases are all responsible for the dramatic decline in oyster populations. Historic overharvesting removed huge volumes of large oyster shells, and destroyed reef habitats and suitable sites for oyster spat settlement. In fact, current oyster harvests show that much of what was classified as productive oyster bottom at the turn of the century is no longer capable of producing an economically viable harvest (MDNR, 1997). Pollution, particularly suspended solids and eutrophication, have further limited the quality and quantity of available habitat; however, the biggest challenge to oyster populations in the Chesapeake Bay is the impact of disease. There are at least 14 different diseases and parasites documented for the eastern oyster; however, two oyster protozoan parasites, *Perkinsus marinus* (Dermo) and *Haplosporidium nelsoni* (MSX), are currently the major sources of oyster mortality in the Chesapeake Bay. MSX thrives in higher salinity brought on by dry years. Dermo tolerates lower salinity, and is more damaging to the oyster population.

Oysters perform valuable ecosystem benefits by consuming algae and other water-borne nutrients by filtering water at a rate of up to 5 liters per hour (1.3 gallons per hour) (CBP, 2004i). Oyster reefs historically provided the only available hard bottom habitat for numerous species, such as worms, snails, sea squirts, sponges, small crabs, and fishes. The oyster usually lives in water depths of between 2.4 and 7.6 m (8 and 25 ft). Seasonal deficiencies in DO in Chesapeake Bay waters prevent their establishment in most waters over 10.7 m (35 ft) deep.

3.1.6.c.3 Blue Crab

The blue crab is both commercially and ecologically important. Blue crabs are classified as general scavengers: bottom carnivores, detritivores, and omnivores. At different stages of development, they serve as both prey and as consumers of plankton, benthic macroinvertebrates, fish, plants, mollusks, crustaceans, and organic debris. As larvae, they are vulnerable to fish, jellyfish, shrimp, and other planktivores. Juvenile crabs are consumed by various fish and birds, as well as other blue crabs. Predators of adult crabs include American eels, predatory fish, sea turtles, herons and egrets, various diving ducks, raccoons, and humans.

Blue crabs are found from the mouth of the Chesapeake Bay to tidal freshwater areas. Blue crabs utilize nearly every habitat type during some stage of their life cycles. Juvenile and soft-shell adult crabs often hide in SAV beds for protection. The areas around James and Barren Islands tend to be shallow with some areas of SAV cover, which makes those areas good blue crab habitat (MPA, 2003d; MPA, 2002d). The areas surrounding James and Barren Islands have a medium to high crab abundance (MPA, 2003i). Blue crab mating occurs from June to October generally in shallow water of the middle and Upper Bay areas. During winter, female crabs will remain in the higher salinity waters of the Lower Chesapeake Bay, whereas males will remain in the upper portions, migrating to deeper waters to spend the colder months.

The blue crab was the dominant species collected during the Spring 2003 bottom trawling survey conducted at James Island and was collected from all but one station during Barren Island surveys in Summer 2002. Blue crabs were also prevalent in beach seine sampling at Barren Island in Summer 2002 and Spring 2003 surveys. Pop net (Spring and Summer 2002) and gillnetting surveys (Spring 2003) caught blue crabs at both James and Barren Island. Blue crabs were absent from Winter 2003 gillnetting surveys, likely due to their migration to deep waters during winter months.

3.1.6.c.4 Horseshoe Crab

Horseshoe crabs (*Limulus polyphemus*) are benthic or bottom-dwelling organisms found in both estuarine and continental shelf habitats. Horseshoe crabs are arthropods, part of the largest group of all living animals that includes insects, spiders, scorpions and crabs, but are not true crabs. The horseshoe crab population ranges from the Yucatan peninsula to northern Maine, but they are most commonly found in the mid-Atlantic region between Virginia and New Jersey.

Dependent upon sandy beaches for spawning, the horseshoe crab is Maryland state-listed as a species of special concern due to continued loss of spawning habitat and increased commercial harvesting. The species is therefore not under legal protection but efforts have been made to regulate commercial harvesting along the Mid-Atlantic Coast.

Horseshoe crab populations occupy an important ecological role in estuarine and coastal habitats and efforts have been made to manage the species through Maryland and Interstate Fisheries Management Plans (FMPs) (MDNR, 2004d). Adults are an important component in the diet of juvenile loggerhead turtles, a threatened species that uses the Chesapeake Bay as a summer nursery area. Horseshoe crab eggs are food for several fin fish species. Further, several shorebird species depend on horseshoe crab eggs to replenish their fat supply on their migrations to Canadian breeding grounds.

Horseshoe crabs were collected at James Island in the Spring 2003 bottom trawling survey and gillnet sampling events.

3.1.6.c.5 James and Barren Benthic Sampling

Benthic sampling was conducted in Fall 2001, Summer 2002, and Spring 2003 at 10 locations in the vicinity of James Island (MPA, 2003e; MPA, 2004h) (Figure 3-8). Benthic sampling was also conducted in Summer 2002, Fall 2002, and Spring 2003 at 10 locations in the vicinity of Barren Island (MPA, 2003g; MPA, 2003h; MPA, 2004b) (Figure 3-9). A complete description of sampling station locations, dates, methods, abundance and distribution is provided in the quarterly sampling reports for James and Barren Islands (MPA, 2003e; MPA, 2003e; MPA, 2003h; MPA 2004b). Sediments were sampled and then characterized at five of the benthic sampling stations surrounding James Island in Fall 2001 and Summer 2002 and at all ten benthic sampling stations surrounding James Island in Spring 2003 (Figure 3-8). All sampling seasons were generally similar in their analyses (MPA, 2003e; MPA, 2004h). The substrate surrounding James Island was predominately sand at all but two stations. Silt was the major component of stations JAM-004 and JAM-010 with a lesser quantity of sand and clay (MPA, 2003e; MPA, 2004h). Similarly, the substrates surrounding Barren Island were predominately sand at all but two stations. Stations BAR-001 and BAR-009 contained a significant enough fines fraction to be classified as predominately mud. *In situ* water quality measurements (Section 3.1.4.b) were taken at each of the benthic sampling stations (MPA, 2003e; MPA, 2004h). Results of the benthic community studies at James and Barren Islands were found to be typical of this area of the Chesapeake Bay. The complete benthic community taxa collected from all seasons and all years for James Island is reported in Table 3-18. The Barren Island taxa collected from all seasons and all years is listed in Table 3-19.

In total, 100 benthic invertebrate taxa were identified during the 20 field surveys at James Island. James Island surveys showed the majority of the species collected were not stress-tolerant, but most samples were dominated by the gem clam (*Gemma gemma*). This tended to result in low overall diversities at most locations. Benthic communities that exhibit low diversity, high abundance, and dominance by a single species are indicative of stressed environments.

A total of 84 benthic invertebrate taxa were identified during the 20 field surveys at Barren Island. The total number of distinct taxa ranged from a low of 45 during the Spring 2003 survey to a high of 59 during the Summer 2002 survey. Benthic invertebrate presence in sediments surrounding Barren Island ranged from a low of 1,668 organisms per square meter during the Fall 2002 survey to a high of 2,774 organisms per square meter during the Summer 2003 survey.

The most dominant species identified during the combined 2002–2003 surveys of Barren Island representing 18.4% of the total count of benthic invertebrate taxa was the polychaete, *Mediomastus ambiseta.* Other abundant species observed across each of the seasonal field surveys included the gastropods, barrel bubble snail (*Aceocina canaliculata)*, solitary bubble snail (*Haminoea solitaria)*; the polychaetes, *Paraonis fulgens* and barred-gilled mud worm (*Streblospio benedicti)*; the amphipod, four-eyed amphipod (*Ampelisca abdita)*; the echinoderm, white synapta *(Leptosynapta tenuis)*; and the hemichordate, acorn worm (*Saccoglossus kowalevskii)* (MPA, 2005a).

The remains of some aquatic invertebrates such as American oyster, blue crab, horseshoe crab, Atlantic ribbed mussel (*Geukenisa demissa*), Atlantic razor clam (*Siliqua costata*), softshell clam, northern dwarf tellin (*Tellina agilis*), bay barnacle (*Balanus improvisus*), and eastern melanpus (*Melampus bidentatus*) were observed along the shorelines during the quarterly surveys at Barren Island (MPA, 2003e; MPA, 2003f; MPA, 2004g; MPA, 2004h). Other invertebrate species observed at Barren Island include marsh fiddler crab, marsh periwinkle, saltmarsh snail (*Melampus bidentatus*), mud snail (*Nassarius obsoletus*), ghost crab (*Ocypoda quadrata*), wharf crab (*Sesarma cinereum*), and red jointed fiddler crab.

Night surveys were conducted at James and Barren Island to capture potential horseshoe crab spawning activity. The goal of the survey was to capture nocturnal horseshoe crab spawning, which was expected to occur in late spring, during a full moon around high tide. The surveys documented 417 horseshoe crabs along the beach on the eastern shoreline of James Island, including 137 spawning pairs, 134 individual males, and 9 individual females. Spawning activity was also noted along the sand spit on the northern end of the middle remnant and along the northwestern beach of the middle remnant. Observers noted egg predation by common grackle and semi-palmated plover (MPA, 2004h).

At Barren Island, horseshoe crabs were caught in the gill nets during fisheries sampling, and were also observed spawning during night surveys conducted simultaneously with the Barren Island terrapin nesting surveys discussed in Section 3.1.9.c.1. During the seven-day survey, 491 horseshoe crabs were documented along the Barren Island shorelines. Horseshoe crab activity was expected to be highest at non-eroded beaches with gradual slopes upward from the water's edge. The greatest activity was documented at the southern portion of the geotextile tube beach, where approximately half of the horseshoe crab sightings occurred (MPA, 2005a).

3.1.6.c.6 Data Analysis: Benthic Index of Biotic Integrity

The Chesapeake Bay Benthic Index of Biotic Integrity (B-IBI) was used to evaluate the benthic community. The B-IBI combines individual metrics and assigns a score to each of the metrics to describe the benthic community and to provide an assessment of benthic community conditions. The scores for each of the B-IBI metrics (scaled from 1 to 5) at each location are averaged across attributes to calculate an index value for each location.

The indexes used to evaluate the benthic community and calculate the B-IBI, include Abundance, Shannon-Weiner Diversity, Stress-Sensitive Taxa Abundance, Stress-Indicative Taxa Abundance, and the Carnivore/Omnivore Abundance Index.

Index values are compared to the Chesapeake Bay Restoration Goal to assess the present condition of benthic community structure and composition at a given location. Locations that meet or exceed the Chesapeake Bay Restoration Goal of 3.0 are considered to have good benthic condition and are indicative of good habitat quality. Index values equal to or greater than 2.7 but less than 3 indicate a marginally stressed community. Index values equal to or greater than 2.1 but less than 2.7 indicate a degraded community. Index values less that 2.1 indicate a severely degraded community (USEPA, 1994). In order to calculate the B-IBI, each station must be classified by salinity and substrate type because both are major environmental factors that control the spatial distribution of macrobenthic communities (Sanders, 1958; Rhoads and Young, 1970; Young and Rhoads, 1971; Boesch 1973; Mountford et al., 1977).

Annually, the salinity at James and Barren Islands classifies the stations as mesohaline (5-12 ppt) or high mesohaline (12-18 ppt) (Sections 3.1.1 and 3.1.4.b). According to data compiled from UMCES (2003) James Island general bottom type is mostly sand with a few small areas of cultch and sand with cultch, and Barren Island bottom type is mostly sand with a few small areas of sand with cultch and mud with cultch. Sediments were sampled during seasonal studies at both James and Barren Islands at the benthic community sampling sites. Most of the James Island sampling sites were also primarily sand and clay with the exception of Stations JAM-004 and JAM-10, which were comprised primarily of clay and silt (Table 3-12). Barren sediment sampling locations (Table 3-13) were primarily sand substrate with some silt and clay substrate composition variances between seasonal surveys. Stations BAR-001 and BAR-009 contained a significant enough fines fraction to be classified as predominantly mud for the purposes of the B-IBI calculations. The minor differences recorded may be attributed to the normal variances between each sediment grab at a given location (MPA, 2005a).

Tables 3-20 and Table 3-21 provide values for each of the metrics factored into B-IBI scores for James and Barren Islands, respectively. The B-IBI was derived using data for warmer months and is only indicated for the summer season. However, it was calculated for all seasons sampled for comparative purposes. Total scores for all but the summer season should be used with caution. The calculated B-IBI scores, shown in Table 3-22 were low for all sampling stations at James Island in Summer 2002, Fall 2002, and Spring 2003, ranging from 1.0 to 1.8, with two exceptions. High scores occurred at James Island Stations, JAM-010 in Fall 2001 (total B-IBI score of 3.8) and JAM-001 in Spring 2003 (total B-IBI score of 3.0). No stations sampled in Summer 2002 met the goal. The low B-IBI scores may be related to a combination of factors: below normal precipitation for the October 2001 and June 2002 sampling events, the predominance of one species (gem clam) at all the sampling stations, and the amount of stress tolerant species recovered in the samples (MPA, 2003e). High abundances of a single species (such as the gem clam) can drive B-IBI scores down even though the dominant species can be filling a unique niche and providing an important trophic link (e.g. fish forage). Total B-IBI scores ranged from 2.2 to 5 for all stations at Barren Island as displayed in Table 3-23. The lowest Barren Island scores were found during Spring 2003 at stations BAR-2 and BAR-5; which each had a total B-IBI score of 2.2. The highest Barren Island score was found at BAR-1, located to the west of the Northern Remnant, during the Summer 2002 with a total B-IBI score of 5.0, the highest B-IBI score that can be attained.

The benthic community around James Island was determined to be stressed according to the B-IBI (Benthic-Index of Biotic Integrity) scores (MPA, 2005b). The benthic environments in the vicinity of James and Barren Islands are relatively pristine from a sediment quality perspective. However, the benthic indices for these areas are not indicative of a thriving benthic community in all areas. This can be attributed to factors such as the substrate type, ecological interactions with predators and competitors, erosive and accumulative forces around the eroding islands and, potentially, adverse meteorological conditions in the year that sampling took place. The benthic community surrounding Barren Island was determined to be relatively healthy at most locations by calculating the B-IBI during Summer 2002, Fall 2002, and Spring 2003 (MPA, 2005a). Even though the B-IBI is only considered reliable for samples collected in warmer months, examination of the data across all seasons sampled indicates little variability in the overall scores among seasons at most stations (Tables 3-22 and 3-23).

3.1.6.d Fish

The Chesapeake Bay supports more than 295 species of fish at some point in their lifecycles (CBP, 2004a). The distribution of these fish is dependant on temperature, salinity, available habitat and food, and annual migratory cycles (Lippson & Lippson, 1994). The fish in the Chesapeake Bay can be classified as resident or migratory species. There are 32 resident species in the Chesapeake Bay (CBP, 2004a). The resident species of fish tend to be smaller in size and remain in shallower water than the migratory species (EPA, 1989; CBP, 2004a). The migratory species are categorized into those that spawn in the ocean and live most of their life in the Chesapeake Bay, and those that spawn in the freshwater tributaries of the Chesapeake Bay and spend most of their life in the ocean (EPA, 1989; CBP, 2004a). The lifecycles of the migratory species are defined by the salinity regime in the waters in which they live. Highly abundant species such as the bay anchovy (*Anchoa mitchilli*) form a critical link in the food web, serving as the dietary basis for other species, including a variety of birds and mammals. Many other species, including striped bass, and the Atlantic menhaden (*Brevoortia tyrannus*), support a multimillion-dollar commercial fishing industry.

Table 3-24 presents a list of fish that are known to occur in the mesohaline salinity regime from the Bay Bridge to the Potomac River, typical of James and Barren Islands.

3.1.6.d.1 Seasonal Sampling at James and Barren Islands

In order to identify the fish species utilizing the area around James and Barren Islands, a four-season sampling program was implemented including surveys in Summer 2002, Fall 2002, Winter 2003, and Spring 2003. Based on recommendations of natural resource agencies on the PDT, survey sampling techniques include bottom trawling, beach seining, gillnetting, and pop netting. Bottom trawl and beach seine surveys were conducted at both islands for all four quarters. 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 (MPA, 2004b). At James Island, gillnet surveys were conducted in all seasons except the summer of 2002, and at Barren Island, gillnet surveys were conducted in all four seasons. The gillnet surveys were used to collect data on fish assemblages in the offshore water column (MPA, 2004b). Pop netting was conducted in the Spring and Summer of 2003 at both James and Barren Islands. The pop netting surveys targeted fish that utilize the SAV beds in the vicinity of the islands as habitat.

As expected, sampling data indicated that beach seine surveys detected juvenile fish, while bottom trawl and gillnet surveys detected larger sub-adult to adult fish. This is mainly because juveniles and smaller fish tend to remain 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 the bottom trawl surveys.

i) Bottom Trawling Results

In the vicinity of James Island, bottom trawling yielded few species (Table 3-25). In both the Summer 2002 and Fall 2002 surveys, the dominant finfish in the bottom trawl was the bay anchovy and the dominant shellfish was the blue crab (MPA, 2003e; MPA, 2003f). Finfish species caught during the bottom trawl surveys consist of Atlantic silverside, spot (*Leiostomus xanthurus*), northern pipefish, naked goby, feather blenny (*Hyppsoblennius hentz)*, silver hake (*Merluccius bilinearis*), hogchoker, and striped bass (*Morone saxatilis*) (MPA, 2003e; MPA, 2003f; MPA, 2004g; MPA, 2004h).

In the vicinity of Barren Island, the Summer 2002 bottom trawl survey collected 10 species (Table 3-25). Bay anchovy was the most abundant at all stations except for one. Striped anchovy (*Anchoa hepsetus*) was collected from all stations at low abundances., Bluefish (*Pomatomus saltatrix*), Atlantic spadefish (*Chaetodipterus faber*), weakfish, striped blenny, feather blenny, and summer flounder (*Paralichthys dentatus*) were also collected during the Summer 2002 bottom trawl (MPA, 2003g). The Fall 2002 bottom trawl produced six species of fish. The highest abundance of fish in one tow consisted of one skilletfish, thirteen Atlantic silverside, and five green goby (*Microgobius thalassinus*). Striped bass, bay anchovy, and alewife (*Alosa pseudoharengus)* were also caught during the fall sampling (MPA, 2003h). The Winter 2003 bottom trawl only yielded one individual, a blueback herring (*Alosa aestevalis*) (MPA, 2003a). The Spring 2003 trawl survey yielded four species. Bay anchovy was the most abundant at every station. The other species collected consist of one bluefish, one striped bass, and one striped searobin *(Prionotus evolans)* (Table 3-25) (MPA, 2004b).

Fish catch data are also available from trawl surveys in the Mid-Chesapeake Bay through Chesapeake Bay Multi-species Monitoring and Assessment Program (CHESMAP) and Chesapeake Bay Fishery-Independent Multi-species Survey (CHESFIMS). Both of the data sources however, use a larger otter trawl with a larger mesh size and longer tows. Because of this, different larger species will be caught than in the trawl surveys discussed above. The CHESMAP data examined the presence of striped bass, white perch (*Morone americana*), Atlantic croaker (*Micropogonias undulates*), summer flounder, and weakfish in the Mid-Chesapeake Bay region. White perch were found in low abundances (0 to 500 fish) in all of the sampling seasons. The remainder of the fish species found were present in low to medium abundances (500-3000 fish) with the greater numbers of fish generally caught in the late spring to summer (VIMS, 2004b). The CHESFIMS data from 2000 indicate that in the main stem of the Chesapeake Bay, the greatest abundances of fish were Atlantic croaker, bay anchovy, and spot (UMCES, 2004a). Additionally, the CHESFIMS data from Summer and Fall 2002 and Spring 2003 concur with the studies conducted at James and Barren Islands in that bay anchovy was the species of greatest abundance caught in the otter trawl. Similarly, striped anchovy was the second most abundant species in the trawl surveys. The species caught also had many similarities between the CHESFIMS data and the fisheries sampling performed at James and Barren Islands (CHESFIMS, 2004).

ii) Beach Seine Sampling Results

At James Island during the Summer 2002 beach seine sampling, Atlantic silversides were the dominant species collected (Table 3-26) (MPA, 2003e). This result is consistent with the findings of the MDNR seine survey in the Choptank River in the summer of 2002, at which time Atlantic silversides were the most common species as well (MDNR, 2004f). During the Fall 2002 survey, Atlantic silverside and red drum (*Sciaenops ocellatus*) were consistently collected at all sampling sites (MPA, 2003f). In Winter 2003, there were no organisms collected (MPA, 2004g). For the Spring 2003 sampling effort, the total number of individuals collected was far greater during the day than at night. During the day, bay anchovy and Atlantic silversides were the dominant species collected (MPA, 2004h). Some of the other species collected during the beach seine surveys include summer flounder, menhaden, blueback herring, striped bass, white perch, spotted seatrout (*Cynoscion nebulosus*), northern pipefish, and Atlantic croaker (Table 3-26) (MPA, 2003e; MPA, 2003f; MPA, 2004g; MPA, 2004h).

At Barren Island, the Summer 2002 beach seine sampling produced 26 different species. Bay anchovy was the most abundant, and Atlantic silverside were also present in high abundances. Other fish collected in significant numbers include silver perch (*Bairdiella chrysoura*), red drum, and southern kingfish (*Menticirrhus americanus*). One summer flounder was collected (MPA, 2003g). These findings are consistent with those of the MDNR seine survey in the Nanticoke River when, in the Summer of 2002, the most abundant species were Atlantic silversides (MDNR, 2004f). During the Fall 2002 survey, red drum and Atlantic silverside were abundant. Skilletfish, mummichog (*Fundulus heteroclitis*), striped killifish (*Fundulus majalis*), striped bass, and striped mullet (*Mugil cephalus*) were also collected during the fall survey (MPA, 2003h). Five different species were collected during the Winter 2003 survey (MPA, 2003a).

Atlantic silverside was the most abundant, and mummichog, striped killifish, striped bass, and white perch were also collected during the winter survey. The Spring 2003 survey yielded 12 fish species. Both daytime and nighttime seine samples were collected during the spring survey. Atlantic silverside, bay anchovy, banded killifish (*Fundulus diaphanus*) and striped killifish were the most abundant species during this survey (MPA, 2004b). Atlantic silverside, bay anchovy, banded killifish, blueback herring, mummichog, winter flounder, and striped killifish were also caught during the surveys in relatively high numbers (Table 3-26) (MPA, 2003g; MPA, 2003h; MPA, 2003a; MPA, 2004b). Table 3-26 provides a complete list of species caught during the surveys.

iii) Gillnetting Sampling Results

Gillnetting was conducted in the vicinity of James Island in Fall 2002, Winter 2003, and Spring 2003. For all gillnet sampling events, the most abundant fish species found at all gillnet sampling stations was Atlantic menhaden. Other species caught during the gillnet surveys include, but are not limited to striped bass, bluefish, white perch, weakfish, spot, Atlantic croaker, Atlantic herring (*Clupea harengus*), and alewife (Table 3-27) (MPA, 2003f; MPA, 2004g; MPA, 2004h).

At Barren Island, during the Summer 2002 gillnet surveys, menhaden were the most abundant species overall. Weakfish and spot were also abundant. Some of the other species caught during the survey include bluefish, alewife, Atlantic croaker, red drum, and summer flounder. Fall 2002 collections yielded four species (MPA, 2003g). During the Fall 2002 survey, white perch was the most abundant, and Atlantic menhaden, and striped bass were also collected during the survey (MPA, 2003h). Five different species were caught during the Winter 2003 gillnet survey. Striped bass was the most abundant species. Atlantic herring, Atlantic menhaden, blueback herring, and white perch were also collected during the survey in relatively low numbers compared to striped bass (MPA, 2003a). The Spring 2003 gillnet survey yielded eight different fish species. Atlantic croaker, Atlantic menhaden, and spot were the most abundant species, and were caught at every station. Bluefish, hogchoker, striped bass, weakfish, and white perch were collected at relatively low abundances (Table 3-27) (MPA, 2004b).

iv) Pop Net Sampling Results

Pop Net sampling was conducted in the vicinity of James and Barren Islands in Spring and Summer 2003. The purpose of this sampling was to evaluate the areas of SAV around the islands for habitat use by aquatic species.

At James Island, the Spring 2003 pop net survey yielded only one finfish species, Atlantic needlefish (*Strongylura marina*). During the Summer 2003 survey, the most common species was bay anchovy. Also collected during this sampling season were Atlantic silverside and feather blenny. The number of aquatic individuals decreased from 70 individuals in the Spring 2003 season to 9 in the summer (September) sampling. Species diversity remained the same from the 2003 spring season to the 2003 summer sampling (Table 3-28). The small yield is likely due to the minimal amount of SAV in the vicinity of James Island in the Spring and Summer 2003 (MPA, 2003c; MPA, 2004e).

At Barren Island, the Spring 2003 pop net survey yielded three fish species: Atlantic needlefish, Atlantic silverside, and weakfish. The Summer 2003 survey yielded, bay anchovy, Atlantic silverside, Atlantic needlefish, skilletfish, striped anchovy, naked goby, and fourspine stickleback (*Apeltes quadracus*). The most common finfish species collected was bay anchovy (Table 3-28) (MPA, 2005a; MPA, 2003b; MPA, 2004d).

3.1.6.d.2 Summary of Fish Survey Results

The species caught in the fisheries surveys were typical of mesohaline areas of the Mid-Bay region. Based on the fisheries survey results, the area around James and Barren Islands are attracting fish in the larval, juvenile, and adult life stages. The larval plankton surveys (Section 3.1.6.b) and the Pop Net data indicate that the greatest number of juvenile fish in the study area are bay anchovy. There is a greater abundance of SAV at Barren Island compared to James Island, therefore, Barren Island likely provides greater nursery habitat than James Island.

The most significant finfish fisheries in the Chesapeake Bay waters surrounding James and Barren Islands consist of croaker, menhaden, spot, and striped bass (MPA, 2003d). These species were all collected during the four quarters of environmental sampling around James and Barren Islands. Commercial fisheries will be discussed further in Section 3.1.6.f.

3.1.6.e Essential Fish Habitat (EFH)

In 1976, and later amended in 1986, the Magnuson Fishery Conservation and Management Act (Magnuson Act) established a management system for the marine fishery resources of the United States. The Magnuson Act requires each of the eight Regional Fishery Management Councils (Councils) to evaluate the effects of habitat loss or degradation on their fishery stocks and take actions to mitigate damage. Recognizing the importance of fish habitat to the productivity and sustainability of U.S. marine fisheries, Congress added habitat conservation provisions to the Act in 1996.

The renamed Magnuson-Stevens Fishery Conservation and Management Act of 1996 (MSFCMA) calls for direct action to stop or reverse the continued loss of fish habitats, and mandates the identification of Essential Fish Habitat (EFH) for managed species of marine, estuarine, and anadromous finfish, mollusks, and crustaceans. EFH is broadly defined as "those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity." The MSFCMA requires the Councils to describe and identify the essential habitat for their managed species, minimize to the extent practicable adverse effects on EFH caused by fishing, and identify other actions to encourage the conservation and enhancement of EFH.

The MSFCMA also establishes measures to protect EFH for designated species and identified life stages. Federal agencies, such as the USACE, must consult with NMFS on all actions or proposed actions authorized, funded, or undertaken by the agency that may adversely affect EFH. In turn, NMFS must provide recommendations to Federal and state agencies on such activities to conserve EFH. These recommendations may include measures to avoid, minimize, or mitigate adverse effects on EFH resulting from the proposed action. The Magnuson-Stevens Act requires cooperation among NOAA's NMFS, Regional Fisheries Management Councils, fishing participants, Federal and state agencies, and others to achieve EFH protection, conservation, and enhancement.

EFH has been identified within some parts of the Chesapeake Bay and its tributaries for 16 species (NOAA, 2004). Fish species with EFH in the Chesapeake Bay are as follows:

- Atlantic butterfish (*Peprilus triacanthus*)
- Atlantic sea herring (*Clupea harengus*)
- Atlantic sharpnose shark (*Rhizopriondon terraenovae)*
- Black sea bass (*Centropristus striata*)
- Bluefish (*Pomatomus saltatrix*)
- Cobia (*Rachycentron canadum*)
- Dusky shark (*Charcharinus obscurus*)
- King mackerel (*Scomberomorus cavalla*)
- Red drum (*Sciaenops occelatus*)
- Red hake (*Urophycis chuss*)
- Sandbar shark (*Charcharinus plumbeus*)
- Sand tiger shark (*Rhizopriondon terraenovae*)
- Scup (*Stenotomus chrysops*)
- Spanish mackerel (*Scomberomorus maculatus*)
- Summer flounder (*Paralicthys dentatus*)
- Windowpane flounder (*Scopthalmus aquosus*)

NMFS directed USACE-Baltimore to focus the EFH assessment for the Mid-Chesapeake Bay Islands on the EFH designations for the Choptank River estuary. The detailed EFH Assessment is included in Appendix E. The waters in the vicinity of James and Barren Island are designated EFH for the following species and their life stages:

- windowpane flounder (*Scopthalmus aquosus*), juvenile and adult stages;
- bluefish (*Pomatomus saltatrix*), juvenile and adult stages;
- summer flounder (*Paralicthys dentatus*), juvenile and adult stages;
- king mackerel (*Sxomberomorus cavalla*), eggs, larvae, juvenile, and adult stages;
- Spanish mackerel (*Scomberomorus maculatus*), eggs, larvae, juvenile, and adult stages;
- cobia (*Rachycentron canadum*), eggs, larvae, juvenile, and adult stages; and
- red drum (*Sciaenops occelatus*), eggs, larvae, juvenile, and adult stages.

After further consultation with NMFS, it was concluded that of species with EFH designated in the Choptank River, only juvenile and adult summer flounder, adult and juvenile bluefish, and juvenile red drum were likely to occur in the study area. All three species were collected from the waters around James and Barren Islands during the environmental sampling in the spring, summer and fall. This indicates that the EFH provided by the SAV is being utilized by target species and is therefore considered Habitat of Particular Concern (HAPC). The additional presence of SAV in the vicinity of James and Barren Islands indicates that the area is considered HAPC for certain species managed under the MSFCMA, specifically summer flounder and red drum, if those species are using the SAV for habitat (MPA, 2003d). "HAPC are discrete areas within EFH that either play especially important ecological roles in the life cycles of Federally managed fish species or are especially vulnerable to degradation from fishing or other human activities" (Kurland, 2002).

In summary, the Mid-Bay region is EFH for summer flounder, bluefish, and juvenile red drum; and SAV beds in the area are HAPC for red drum and summer flounder. The complete EFH assessment can be found in Appendix E.

In addition to EFH, some regions within the Chesapeake Bay have also been designated Habitat Areas of Particular Concern (HAPC). HAPC are those areas of special importance within EFH that may require additional protection from adverse effects. HAPC is defined on the basis of its ecological importance, sensitivity, exposure, and rarity of the habitat (Dobrzynski and Johnson, 2001).

The Mid-Atlantic Fisheries Management Council (MAFMC), the regional council that oversees the Chesapeake Bay, has designated HAPC for one of its managed species: summer flounder (MAFMC, 1998a). Specifically, the MAFMC designated SAV and macroalgae beds in nursery habitats as HAPCs for juvenile and larval-stage summer flounder. Although, MAFMC's HAPC definition does not contain maps or geographic coordinates of the designated HAPC, the SAV beds near James and Barren Islands qualify as HAPC (Dobrzynski and Johnson, 2001). NMFS has also designated HAPC in the Chesapeake Bay for nursery and pupping grounds for one highly migratory species, the sandbar shark, but not for any other Atlantic highly migratory species.

The South Atlantic Fisheries Management Council (SAFMC) has designated HAPC for red drum. Specifically, the SAFMC designated passes between barrier islands into estuaries as very important for the productivity of any estuary. Any rapid changes to this environment may cause stresses too great for red drum to withstand. The SAV within the Chesapeake Bay including that in the James and Barren Island vicinity are also critical areas for red drum, particularly for 1- and 2-year-old fish (SAFMC, 2004).

3.1.6.f Commercially Important Species & Commercial Fisheries

The Chesapeake Bay has been ranked as third in the nation in fishery landings. Only the Atlantic and Pacific Oceans exceed the Chesapeake Bay in production. Fish species including striped bass and the Atlantic menhaden support a multimillion-dollar commercial fishing industry. Maryland's commercial fishing industry alone harvested an average (2000 to 2002) of over 13 million pounds of fish annually, at a dockside value of $7.3 million (Maryland State Archives, 2004).

The Mid-Chesapeake Bay supports commercial fishing for soft shell clams, oysters, blue crabs, and finfish. Of those four fisheries, the most productive is the blue crab fishery. There are 19 commercially important finfish species designated by the MDNR. Five key fish (Atlantic menhaden, American eel, white perch, striped bass, and catfish) make up more than 90% of the average (1990-2002) total annual harvest of over 701,257 pounds.

3.1.6.f.1 Clams

Two commercially important clams are found in the vicinity of James and Barren Islands and include soft-shell and razor clams. Soft-shell and razor clam surveys at James and Barren Islands identified razor clams as more prevalent than soft-shell clams. At James Island, clam surveys showed a general lack of a substantial number of clams and a lack of productive clam beds in the vicinity, per MDNR definition. Razor clams were the most prevalent. Barren Island surveys identified 3 legal and 14 sublegal soft-shell clams (less than 2 inches in length) plus 964 sublegal razor clams. There were no locations in the Barren Island survey with a productive natural clam bar ranking as defined by the Maryland Code of Regulations (COMAR) 08.02.08.11 criteria (producing 500 hardshell clams per hour, ½ bushel of soft shell clams per hour, or ½ bushel of razor clams per hour). No recent (post-1999) harvest data is available for razor clams.

Harvest of soft shell clams in the Chesapeake Bay has varied widely between 1990 and 1999, ranging from a low of 148,161 pounds in 1999 to a high of 2,130,961 in 1990 (Table 3-29) (MPA, 2002c). In waters west of James Island, there is a soft-shell clam fishery that produced 6,907 pounds in 2000. During the Fall 2001 sampling in the vicinity of James Island, there were no soft-shell clams collected, but during the Summer 2002 sampling event, two of the ten stations sampled yielded a mean density of 14.28 individuals per square meter (MPA, 2003e). Soft-shell clam surveys were also performed during the Spring 2003 event at which time 78 individuals were found (MPA, 2004h). Soft-shell clam surveys conducted in March 2004 yielded numbers that were too low to be recorded in harvesting rates. Instead, the actual number of individuals was recorded. A total of 27 soft clams were collected during the survey, 22 of which were legal harvest size (MPA, 2004i).

The closest clamming activity to Barren Island occurs south of the Island, north of Ferry Bridge (Bowman, personal communication, 2001) (MPA, 2002d). Specific soft-shell clam harvest information in the vicinity of Barren Island indicated that no soft-shell clams were collected in this area for the last decade (Lewis, personal communication, 2001). Soft-shell clams were sampled during three of the four seasons of environmental sampling in the vicinity of Barren Island: Summer 2002, Fall 2002, and Spring 2003. They were only found during the Spring 2003 survey, at which time soft-shell clams were recovered from six of ten sampling locations. The average number of individuals found per square meter ranged from 11 to 51 with an average of 11 clams per square meter over the sampling area (MPA, 2004b). Soft-shell clams were also sampled in the Winter 2004 field survey at Barren Island, during which 17 individuals were recovered over four transects covering a 1.3-ac area (MPA, 2004c). Because such low numbers of clams were recovered, a harvesting rate could not be calculated, indicating that there are not enough clams in the vicinity of Barren Island to support a commercial fishery (MPA, 2004c).

3.1.6.f.2 Eastern Oyster

For hundreds of years, eastern oysters were among the most abundant bivalves and the most commercially important fishery resources in the Chesapeake Bay. Oysters were once plentiful enough in the Chesapeake Bay that seasonal harvests were in the millions of bushels. During the 1950s, approximately 35 million pounds of oysters were harvested annually. Oyster landings in the Chesapeake Bay have experienced a 95% decline since 1980, and are estimated to be at their lowest recorded level. Oyster harvests are now tallied in terms of thousands of bushels (Kennedy, 1991; Jordan et al., 2002).

Although there still are productive oyster beds, oysters in the Mid-Bay are greatly impacted by disease and many beds require seeding. The Mid-Bay Region supports a substantial oyster fishery worth an average (1990 to 2002) of over $420,000 annually, although yearly catch size is quite variable and is trending downward. Approximately 130,000 pounds of oysters were collected in the 2002 season (following a catch of only 14,500 pounds in 2001) for the Mid-Bay Region.

There are three natural oyster bars (NOBs) located in the vicinity of James Island (Figure 3-12). NOBs are geographic areas that are in the Code of Maryland Regulations that were in many cases based on the extent of known historic oyster bars. NOBs are designated by the MDNR as a resource of special significance, and oyster recovery is a goal of the Chesapeake Bay 2000 Agreement. The present locations and classifications of the legally defined NOBs were formally adopted in 1983 following extensive changes to the original charted bar boundaries, and assignment of coded numbers to individual oyster bars. Many NOBs are no longer either commercially or ecologically productive oyster beds and haven't been for many years (MDNR, 2005).

The Hills Point North and Hills Point South bars (NOB 14-5) are located to the north. The Hoopers Cove/Slaughter Creek bar (NOB 15-2) is located to the east, in the Little Choptank River. The Granger/Cators Cove bar (NOB 14-6/15-1) is located at the mouth of Oyster Cove approximately 1,000 ft southeast of the island (Figure 3-12). Harvest data for the NOBs in the vicinity of the island are included in the Little Choptank River dockside data. Revenue from the commercial oyster harvest in the Little Choptank River topped one-half million dollars in 1997 through 2000, and it is likely that NOB 14-5, NOB 15-2 and NOB 14-6/15-1 make significant contributions to this industry (MPA, 2003d).

There are two NOBs (NOB 23-2 and NOB 23-4) located in the vicinity of Barren Island. NOB 23-2 is located to the north and NOB 23-4 to the east of the Island (Figure 3-13). The specific productivity of individual oyster beds is not available; however, oyster harvest data (in bushels) from this region (MDNR Zone 129) are available and listed in Table 3-30. MDNR Zone 129 is a sub-area of Zone 029 and covers the eastern half of the Chesapeake Bay (South of Cove Point and East of the Shipping Channel). Between the years 1990 to 2000, the greatest number of bushels harvested from the region was 7,618 in 1998 and the number has since decreased (MPA, 2002c; MPA, 2002d). The University of Maryland 1:50,000-scale maps "James Island: Oyster Bar Delineations" and "Barren Island: Oyster Bar Delineations" (Figures 3-12 and 3-13) indicate that there are several legally designated NOBs and several historical oyster bars around James and Barren Islands. In addition, the University of Maryland maps also indicate that there are two oyster restoration areas located to the west of James Island and to the east and southeast of Barren Island (MPA, 2003i). None of the restoration areas are located within the proposed project areas.

3.1.6.f.3 Blue Crab

Following the decline of the oyster industry, the commercial harvesting of blue crabs became the dominant commercial fishery in the Chesapeake Bay (MPA, 2003d). The Chesapeake Bay is the largest producer of crabs in the country; it is estimated that more than one-third of the nation's catch of blue crabs comes from Chesapeake Bay waters. Annual commercial landings have averaged approximately 39 million pounds since 2000 (CBP, 2004j).

The waters surrounding James Island support both hard and soft crabbing industries. In the 2000 season, the Little Choptank River (MDNR Zone 053 (Figure 3-14) produced over 400,000 pounds of commercial hard crabs. The zone located northwest of James Island in the mainstem of the Chesapeake Bay (MDNR Zone 027 (Figure 3-14) produced over four million pounds of commercial hard crabs in the 2000 season (Table 3-31) (MPA, 2003d). The average blue crab catches from 1998-2003 in the waters surrounding James Island (MDNR Zone 027 (Figure 3-14)) were between 4,211,210 and 6,629,981 pounds per year according to UMCES (2004b). The Chesapeake Bay catches in Zone 027 ranged between approximately 4.5 and 6 million dollars for the years 1998 through 2003 (UMCES, 2004b). During all site visits to James Island, commercial crab pot fields were observed and located at the northern tip of the northern remnant and the southern tip and southwestern portion of the southern remnant (MPA, 2003d). During the Spring 2003 and Summer 2003 sampling events in the vicinity of James Island, crab pot surveys were conducted. In April 2003, no crab pots were present in the vicinity of the Island. In early May 2003, the crab pots in the area were mainly off the western shore of the island remnants. However, by mid-May and throughout mid-June there were crab pots present within the footprint north and west of the northern remnant, south of the southern remnant, and within 200 feet of the western shore of all of the remnants. Workboats were observed emptying the crab pots daily during the survey period (MPA, 2004h). Crab pot surveys were also conducted in the vicinity of James Island during the summer of 2003. The July survey encompassed 4,592 ac and contained approximately 1221 crab pots, which equals 1 pot per 3.76 ac. Approximately 1,071 crab pots were located within the August survey area of 3,873 ac (1 pot per 3.6 ac). Approximately 460 pots were located within the September survey area of 1,724 ac (1 pot per 3.75 ac) (MPA, 2004i).

The Hillsboro Office of the Maryland Natural Resources Police (MNRP) was contacted regarding the level of commercial crabbing in the vicinity of Barren Island. It was indicated that crab pots are regularly deployed on the western side of the island, from approximately 300 feet offshore to the navigation channel, during the spring, summer, and fall (Bowman, personal communication, 2001) (MPA, 2002d). The average blue crab catches from 1998-2003 in the waters surrounding Barren Island (MDNR Zone 029 (Figure 3-14)) were between 3,801,205 and 5,744,427 pounds per year according UMCES (2004b). The Chesapeake Bay catches in Zone 029 ranged between approximately 4.5 and 6 million dollars for the years 1998 through 2003 (UMCES, 2004b). Crab pot surveys in the vicinity of James and Barren Islands were conducted from May through September 2003. In May, approximately 850 crab pots were observed to the north, west, and south of Barren Island covering approximately 550.7 ac. In June, there were approximately 700 crab pots observed in the same general areas around the Island covering approximately 743.7 ac, in July, there were approximately 700 crab pots observed over approximately 493.0 ac, and in August there were approximately 1,500 pots observed over 2,987.5 ac. In September, 70 crab pots were observed along three crab pot lines to the north of

Barren Island. Table 3-32 presents the relative crab pot numbers by area during each sampling event. This low number for September may not reflect the typical count for this time of year, and could rather be due to crab pots being removed from the water due to an impending hurricane (MPA, 2004c).

3.1.6.f.4 Finfish

The most significant finfish fisheries in the Chesapeake Bay in the area around James and Barren Islands consist of croaker, menhaden, spot, and striped bass (MPA, 2003d). The total catch within the water body surrounding James Island ranged from 1,119,532 to 1,962,384 pounds in the years 1998 to 2003 (UMCES, 2004b). There are nine pound nets in the vicinity of James Island, of which only two have been set and actively fished in the past five years (Figure 3-15) (MPA, 2004i). Four pound nets are present in the James Island project concept area, however, these nets are inactive (MPA, 2004i). Catch data were available for one pound net license in the James Island vicinity. Between August 1999 and November 2000, 9,134 pounds of striped bass were captured within the four pound nets numbered 241, located far the the west of the Southern Remnant (Figure 3-15). Fishing was mostly conducted from July through November. Catch data are currently unavailable for five other net locations in the James Island vicinity (MPA, 2004i).

Near Barren Island, the total water body catch ranged from 1,143,228 to 2,658,111 (UMCES, 2004b). There are 14 pound net license holders in the vicinity of Barren Island, and the license owners have 23 net locations in the vicinity of the island (Figure 3-16). The majority of the active pound nets in the vicinity of Barren are encompassed in the revised alignments (MPA, 2004c). Catch data were only available for four pound net license holders in the Barren Island vicinity. During the survey, two of the license owners indicated that all of their catch data come from the Barren Island vicinity. The MDNR catch data indicated that the largest poundage reported was from menhaden (236,784 lbs.), striped bass (63,663 lbs.), and croaker (30,048 lbs.) During the survey, the remaining two license owners indicated that 50 to 75% of their catch comes from the Barren Island vicinity. The MDNR catch data indicated that the greatest poundage reported was approximately 775,000-1,200,000 lbs. of menhaden, 99,000-148,000 lbs. of striped bass and 62,000-93,000 lbs. of gizzard shad. Fishing was mostly conducted from May through November. Catch data are currently unavailable for 10 other net locations in the Barren Island vicinity, of which, only five have been used in the last five years (MPA, 2004c).

3.1.6.g Marine Mammals

Atlantic bottlenose dolphins (*Tursiops truncates*) primarily occur in the lower Chesapeake Bay, but are known to frequent areas further north. Atlantic bottlenose dolphins are transient species thought to enter the Chesapeake Bay after migrating north from Cape Hatteras during the spring. The species migrate to areas south of Cape Hatteras during the fall (Baker, 2000). The abundant food resources draw dolphins to the Chesapeake Bay, particularly to the vicinity of the Miles River, Eastern Bay, Choptank River, and Little Choptank River on the Eastern Shore of the Chesapeake Bay.

Pods of Atlantic bottlenose dolphins were sighted during the spring survey in areas south of James Island and off the western shore of Taylors Island (MPA, 2004h). Though dolphins were not observed during surveys of Barren Island, it is highly probable that dolphins would be present in these waters as well. Dolphins migrating northward through the Chesapeake Bay would presumably be present in waters surrounding Barren Island.

3.1.7 Wetlands

Wetlands are areas that are inundated or saturated by surface or ground water at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions (USACE, 1987).

Of the five systems of wetlands classified by Cowardin (Cowardin et al., 1979), four systems of wetlands have been identified in the Chesapeake Bay area: estuarine, palustrine, lacustrine, and riverine. However, only two of these wetland types (estuarine and palustrine) have been identified on James and Barren Islands. Estuarine wetlands are found primarily along the shores of the Chesapeake Bay and its tidal rivers. The estuarine system is defined as deep-water tidal habitats and adjacent tidal wetlands that are usually semi-enclosed by land but have open, partly obstructed, or sporadic access to the open ocean, and in which ocean water is at least occasionally diluted by freshwater runoff from the land. The estuarine system extends upstream and landward to where ocean-derived salts measure less than 0.5 ppt. The palustrine system includes all nontidal wetlands dominated by trees, shrubs, persistent emergents, emergent mosses or lichens, and all such wetlands that occur in tidal areas where salinity due to ocean-derived salts is below 0.5 ppt.

Currently, approximately 12% of wetlands in the Chesapeake Bay watershed are classified as estuarine or coastal wetlands (Tiner, 1994), with the remaining portion composed of various types of inland wetlands. Sixty percent of the Chesapeake Bay's wetlands are inland wetlands classified as palustrine forested wetlands. Palustrine shrub/scrub wetlands and palustrine emergent wetlands make up 10 and 11% of the total wetlands respectively. The remaining 7% are various inland wetlands.

Wetlands are highly valuable because they are vital to the health and productivity of the Chesapeake Bay and its tributaries. Wetlands function to restore and maintain water quality by removing and retaining nutrients contained in stormwater runoff that would otherwise flow directly into the water column. Critical habitat for a diversity of plants and animals, including fish, shellfish, waterfowl, shorebirds, wadingbirds, songbirds, and several mammals is provided by wetlands. Wetlands provide flood control and reduce the effects of storm damage by retaining water, which slowly dissipates to protect and minimize the erosion in coastal areas. Wetlands buffer coastal ponds and shores from highly erosive nearshore wave action. Lastly, wetlands provide many recreational activities (CBP, 2004h; MDNR, 2004a).

Nearly 1.5 million acres of wetlands occur in the watershed of the Chesapeake Bay; 1.3 million acres are nontidal palustrine wetlands and 200,000 acres are tidal estuarine wetlands (CBP, 2004h). The coastal wetlands of Dorchester County and adjacent areas are internationally and nationally recognized to be of ecological significance. The Dorchester County wetlands are contained within a larger region of coastal wetlands on the lower Eastern Shore of Maryland and Virginia identified as "wetlands of international importance" during the Ramsar Convention on Wetlands, primarily because of their importance as a staging and wintering ground for waterbirds and waterfowl. Through international cooperation, the Ramsar Convention has identified wetlands recognized to be of great ecological significance throughout the world, and obliged signatories to undertake conservation measures to ensure that these sites would continue to perform the vital ecological functions for which they were recognized. Dorchester County's coastal wetlands are listed as a "priority wetland" by USEPA, were identified by USFWS as a "unique ecosystem," and are a "focus area" of the *North American Waterfowl Management Plan Atlantic Coast Joint Venture Report*. Their ecological significance extends beyond birds to include estuarine foodweb support, water quality maintenance, and other functions.

There has been a net loss of tidal wetlands as a consequence of loss to development, agriculture, erosion, and rising sea level. The Chesapeake Bay lost about 9% of its tidal wetlands to dredging, filling, and impoundments between the 1950s and late 1970s (Tiner, 1987). Dorchester County marshes, particularly in the Blackwater NWR area, have been lost at an accelerated rate as a consequence of human activities exacerbating natural processes. Natural causes of marsh loss include sea level rise, subsidence, and erosion. Human causes of loss include marsh and wildlife management practices that favored chronic overgrazing by wildlife, marsh burning at a rate far in excess of natural burn frequencies, introduction of exotic grazers (nutria), road construction that alters marsh hydrology and salinity, and perhaps groundwater withdrawals.

The maintenance of existing wetlands and restoration of wetland acreage and function are critical to sustaining habitats for breeding, spawning, nesting, and wintering living resources, including those living resources vital to the regional economy.

3.1.7.a James and Barren Island Wetland Resources

Historically, James Island was an upland island. However, wetlands have developed at James Island as sea level has risen and inundated the shoreline. There are approximately 17.4 ac of wetlands on James Island. The wetlands of the northern and middle remnants are classified by the National Wetlands Inventory as primarily estuarine intertidal and subtidal unconsolidated bottom and emergent wetlands (Field et al., 1991). There are also palustrine scrub-shrub and emergent wetlands on the northern and southern remnants. See Figures 3-17 and 3-18 for a map of wetlands on James Island and Table 3-33 for observed wetland species at James Island.

Barren Island, conversely, was historically largely wetlands. Wetlands are scattered throughout the present Barren Island complex. A total of 84.2 ac of wetlands exist on Barren Island. Barren Island wetlands are largely classified by the National Wetlands Inventory as estuarine intertidal (Field et al., 1991). Of these wetlands there are large portions of unconsolidated shore on the northeastern portion of Barren Island and mainly emergent wetland in the middle and southern areas. Estuarine intertidal scrub-shrub, emergent, and forested as well as palustrine forested and estuarine subtidal wetlands were identified by the National Wetlands Inventory to cover the southcentral area. The middle portions of Barren Island have been impacted heavily by erosion since the National Wetlands Inventory map was completed. See Figure 3-19 for a current delineation of wetlands on Barren Island.

3.1.8 Intertidal Flats Habitats

Intertidal flats, also referred to as tidal mudflats, are the areas of a shoreline or tidal wetland between mean high and mean low tides that are usually not vegetated, but may be dissected by shallow drainage channels sometimes vegetated by saltmarsh species (White, 1989). Intertidal flats are generally low gradient, low energy unvegetated environments that may consist of either mud or sand substrates with carbon and organic components present, such as oyster shell (USFWS, 1997) and are alternately exposed to the air and then flooded by tides. In areas of higher wave energy, these areas are generally the lower part of a beach because wave conditions destabilize the substrate and preclude marsh occurrence. In areas where wave energy is low, intertidal substrate above mean water elevation is generally vegetated by tidal marsh plants. However, in low wave energy areas where sediments have been recently deposited to form substrate at elevations between mean water and mean high water, tidal flats will occur until the time that the area is colonized by marsh vegetation. These conditions also occur on recently placed dredged materials at intertidal elevations. Generally, the area of tidal flats increases as the tidal range increases. It has been estimated that more than half of the coasts of most estuaries are surrounded by tidal flats, and that the extent is determined by both the shape of the estuary and the tidal range. Approximately 99,000 ac of tidal flats have been mapped in Chesapeake Bay by NOAA using USFWS National Wetland Inventory data (Field et al., 1991). Although the Chesapeake Bay tidal range is not high compared to other areas of the country, there are substantial acres of tidal flats as a consequence of the complicated shoreline that results from the Chesapeake Bay's geologic history as a drowned river valley.

Both biological and physical factors influence the distribution, abundance, and species composition of intertidal habitats, including such physical factors as the exposure and impact of waves, substrate composition, texture and slope of the substrate, desiccation, water temperature, and light (USFWS, 1997). Biological influences include competition and predation. Muddy intertidal flats support rich and productive ecosystems comprised of organisms living on the surface, called benthos, and organisms living within the sediments, called infauna (USFWS, 1997). The benthos and infauna species attract larger and more conspicuous organisms such as wading birds and, when tides cover the flats, macroinvertebrates and finfish, which feed on smaller organisms (USFWS, 1997). Therefore, the intertidal flats habitat is extremely valuable to a diversity of species. Extensive use of mudflats created (although temporary) through the PIERP has demonstrated the significance expansive mudflats have within the Chesapeake Bay system.

3.1.8.a James and Barren Island Intertidal Flats Resources

At James Island, 8.4 ac of intertidal habitat has been delineated. At the time of mapping the intertidal habitat consisted of beach and subtidal wetlands of unconsolidated bottom. Intertidal habitat is the first to be impacted by sea level rise and erosion. Therefore, some of this acreage has been recently lost such as the sandy spit connecting the north and middle remnants (Figure 3-17). During the Winter 2003 survey, it was noted that the sandy spit had severely eroded since the Fall 2002 survey, and was only visible above the water at low tide (MPA, 2004g; MPA, 2004h). Barren Island has 17.3 ac of intertidal habitat including tidal flats, beach, and unvegetated salt panne within the marsh on the northerneastern remnant (Figure 3-19).

3.1.9 Terrestrial Resources

The Chesapeake Bay supports a wide variety of mammals, birds, and herpetiles (reptiles and amphibians). The remarkable species diversity and abundance of the Chesapeake Bay is supported by a unique environmental gradient, from higher elevation freshwater environments near its many tributaries to the saline marshlands and shallow open waters at its mouth.

Quarterly terrestrial environmental surveys were conducted at James Island and Barren Island in Summer 2002, Fall 2002, Winter 2003, and Spring 2003. The terrestrial quarterly environmental surveys consisted of inspecting the interior of the islands to develop vegetation characterizations and avian and wildlife observations.

3.1.9.a Vegetative Community Characterization

The species documented in the vegetated communities on James Island during the quarterly surveys of 2002 and 2003, which include low and high marsh, and forested areas, are listed in Table 3-33. The low marshes on James Island are dominated by saltmarsh cordgrass (*Spartina alterniflora*) and also contain square-stemmed spike rush (*Eleocharis quadrangulata*), slough cordgrass (*Spartina pectinata*), and common glasswort (*Salicornia europaea*). The high marshes are dominated by saltmeadow cordgrass (*Spartina patens*) mixed with groundsel tree (*Baccharis halimifolia*), high-tide bush (*Iva frutescens*), big cordgrass (*Spartina cynosuroides*), black rush (*Juncus roemerianus*), beaked spikerush (*Eleocharis rostellata*), reed canary grass (*Phalaris arundinacea*), stout bulrush (*Scirpus robustus*), nut sedge (*Scirpus etuberculatus*), and spike grass (*Distichlis spicata*). Seaside spurge (*Euphorbia polygonifolia*) and perennial salt marsh aster (*Aster tenuifolius*) were also present in the high marsh. Common reed (*Phragmites australis*), an invasive species, was observed in the low and high marshes of James Island (MPA, 2004h). MES *et al.* (2002) indicates that the freshwater wetland is dominated by tall beak-rush (*Rhynchospora macrostachya*).

Upland forested areas were dominated by loblolly pine (*Pinus taeda*), which is often present in monotypic stands. Deciduous plant species including sycamore (*Platanus occidentalis*), wax myrtle (*Myrica cerifera*), common persimmon (*Diospyros virginiana*), American holly (*Ilex opaca*) and willow oak (*Quercus phellos*) also inhabit the upland areas. Areas of scorched trees were present on the northern and southern remnants, and regrowth in these burned areas include young persimmon and pine. The majority of the wooded portions of the island remnants appear to be relatively mature (MPA, 2004h).

Quarterly surveys conducted in 2002 and 2003 documented the species contained within the vegetated communities on Barren Island, which include low and high marsh, scattered freshwater wetlands, and forested areas. The low marshes on Barren Island are dominated by the short and tall forms of saltmarsh cordgrass and big cordgrass; some black needlerush and saltmarsh bulrush (*Fimbristylis castanea*) have also been observed in the low marshes. Vegetation growing in depressions of the marsh floor include slender glasswort (*Salicornia europea*), sea lavender (*Limonium carolinianum*), and saltmarsh aster (MPA, 2003g). The high marshes are dominated by saltmeadow cordgrass and saltgrass (*Distichlis Raf.*), and are subdominated by black needlerush (*Juncus roemerianus).* Marsh elder (*Iva l.*) is the dominant plant, and it is noted as growing with grounsel-tree. Stands of common reed were noted growing in the high marsh on the northern remnant (MPA, 2003g).

Areas of freshwater wetlands are located on the interior of Barren Island. Species within these areas include woolgrass (*Scirpus cyperinus*), arrowhead (*Sagittaria latifolia*), switchgrass

(*Panicum virgatum*), pickerel weed (*Ponterderia cordata*), common reed, and narrow leaved cattail (*Typha augustifolia*). Common reed is considered invasive, and was documented in several locations on Barren Island. A complete listing of the plant species found in the habitats of Barren Island can be found in Table 3-34) (MPA, 2005a).

Upland forested areas on the northern and southern remnants of Barren Island are dominated by loblolly pine, which is often present in monotypic (only loblolly pine) stands, with scattered American holly in the understory. Deciduous tree species are trees that shed their foliage seasonally. Deciduous trees were present in areas of the forest that consisted of a mixture of species, including common persimmon, sweetgum (*Liquidambar styraciflua*), sycamore, black cherry *(Prunus serotina)*, and willow oak. Grasses such as bottlebrush grass (*Hystrix patula*), common reed, saltmarsh cockspur (*Cenchrus tribuloides*) and soft rush (*Juncus effusus*) inhabited open canopy areas in the deciduous portions of the forest. Vines and scrubby vegetation that inhabit the open canopy areas include poison ivy (*Toxicodendron radicans*), greenbriar (*Smilax rotundifolia*), and common raspberry (*Rubus allegheniensis*). The airstrip running through the northern remnant has become overgrown with upland plant species such as loblolly pine, eastern red cedar (*Juniperus virginiana*), switchgrass (*Panicum virgatum*), wax myrtle, broomsedge (*Andropogon virginicus*), groundsel-tree, and marsh elder (MPA, 2003g).

3.1.9.b Terrestrial Invertebrates

Invertebrate species encountered while conducting the quarterly environmental surveys on James Island and Barren Island were recorded, and are presented in Tables 3-35 and 3-36. It should be noted that the environmental surveys were not designed to fully characterize the terrestrial invertebrate communities on James Island and Barren Island because the footprint of the project was not intendedto encroach upon the existing islands. Therefore, the species listed in this report likely do not represent the diverse invertebrate fauna utilizing the island habitats.

Invertebrate species observed on James Island during the quarterly environmental surveys are listed in Table 3-35. Invertebrate species found include four species of butterflies, which are mourning cloak *(Nymphalis antiopa)*, black swallowtail *(Papilio polyxenes)*, monarch (*Danaus plexippus*), and red admiral *(Vanessa atalanta)*. Other invertebrate species observed include big sand tiger beetle (*Cicindela formosa*), seaside dragonlet (*Erythrodiplax berenice*), praying mantis (eggs) (*Mantis religiosa*), marsh periwinkle (*Littorina irrorata*), and marsh fiddler crab (*Uca pugnax*).

Invertebrate species observed on Barren Island during the quarterly environmental surveys are listed in Table 3-36. Seventeen invertebrate species, including five species of butterflies, were documented on Barren Island. Butterfly species noted are common wood nymph (*Cercyonis pegala*), eastern-tailed blue (*Everes comyntas*), monarch, orange-clouded sulphur (*Colias eurytheme*), and red spotted purple (*Limenitis arthemis*).

3.1.9.c Amphibians and Reptiles

The herpetile (reptile and amphibian) population of the Chesapeake Bay includes frogs, toads, turtles, salamanders, newts, and snakes. Most amphibian species utilize freshwater wetlands and upland wet pools of the Chesapeake Bay area for protection, feeding, and reproduction. The diamondback terrapin (*Malaclemys terrapin*) is the only North American turtle that lives exclusively in brackish water. Terrapins feed mostly on mollusks that inhabit salt marshes, tidal flats, and shallow water habitats (CBP, 2004L). Herpetiles are frequently observed members of all Chesapeake Bay habitats.

Note that exclusively aquatic herpetiles (i.e., sea turtles) also utilize the Chesapeake Bay as habitat. Terrestrial requirements for sea turtles are limited to nesting habitat, although there is no evidence that sea turtles use the Chesapeake Bay area to nest (NOAA, 2003).

3.1.9.c.1 James and Barren Herpetile Surveys

Non-avian wildlife species observed on James Island and Barren Island are included in Tables 3-35 and 3-36. The list of amphibians and reptiles utilizing James Island or Barren Island was compiled from qualitative observations during the seasonal terrestrial surveys of the islands. Species included on the list were either observed directly, or signs of their presence were observed.

Zero amphibian and six reptile species were observed on James Island during the environmental surveys. The reptile species consisted of diamondback terrapin, box turtle (*Terrapene carolina*), eastern mud turtle (*Kinosternon subrubrum*), rough green snake (*Opeheodrys aestivus*), garter snake *(Thamnophis sirtalis*) (remains), and northern brown water snake (*Nerodia sipedon*) (remains). Box turtle remains were the only reptile species observed during the Winter 2003 survey (MPA, 2003e; MPA, 2003f; MPA, 2004g; MPA, 2004h). Diamondback terrapins were observed nesting on the beaches during the environmental surveys and additional surveys for signs of nesting diamondback terrapins on the beaches of the remnants were conducted May 28 through June 3, 2003, and June 11 through June 16, 2003. The beach was visited daily, to locate and count nests and tracks on the beach above the high tide line. The cool weather and frequent rain in early June seemed to prevent the terrapins from nesting until approximately June 10 (MPA, 2004h).

The surveys found terrapin use of the eastern beach of the middle remnant of James Island for nesting. There were no signs of predation of the nests and no tracks of predators were seen on the remnant. There were 15 nests located above the high tide line along the beach and several terrapins were observed in the water awaiting an undisturbed beach before approaching.

Indications of two amphibian and seven reptile species were noted on Barren Island during the quarterly surveys. Fowler's toad (*Bufo fowleri*) and narrow mouthed toad (*Gastrophryne carolynensis*) were the observed amphibian species. The narrow mouthed toad is considered highly rare on Maryland's rare, threatened and endangered species list; this list and the status of the narrow mouthed toad is discussed in more detail in Section 3.1.10. The reptile species consisted of diamondback terrapin, box turtle, eastern mud turtle, eastern painted turtle, northern red-bellied turtle (*Psuedemys rubriventris*), northern water snake, and spotted turtle (*Clemmys guttata*). The remains of the northern water snake were found on Barren Island during the Fall 2002 field study, no live observations of this species were recorded during the environmental surveys. Diamondback terrapins were observed nesting on the beaches of Barren Island (MPA, 2005a).

Surveys were conducted from June 12-18, 2003 at Barren Island to determine the extent of diamondback terrapin nesting. During the diamondback terrapin survey, 141 terrapins and 173 terrapin nests were observed along the beaches of the island. Along the northeastern shoreline of the northeastern remnant, 23% of all terrapin sightings occurred. The northern beach of the northern remnant accounted for 29% of the nests observed. In general, it was observed that beaches with a gradual slope from the waters edge to the beach had the greatest usage as nesting habitat. Predated nests were noted during the environmental surveys, and signs of red fox tracks were noted within and adjacent to the majority of the predated nests. Boat tail grackles were also observed feeding on some of the remaining terrapin eggs and shells at several nesting locations. About nine terrapins were observed in the waters adjacent to the southwestern beach on the southern remnant but they were unable to reach the sandy shoreline due to the lack of high tide along this eroded area. There were no terrapin nests observed at the oyster shell beach on the eastern shoreline of the southern remnant (MPA, 2005a).

3.1.9.d Avifauna

The Chesapeake Bay provides valuable and diverse habitat for avian species. Seasonal surveys conducted in the Chesapeake Bay have identified five major groups of inhabiting birds—colonial waterbirds, shorebirds and marsh birds, waterfowl, predatory and scavenging birds (raptors), and other land birds.

Six species of colonial nesting waterbirds inhabit the Chesapeake Bay region: great blue heron (*Ardea herodias*), the great egret (*Ardea alba*), the snowy egret (*Egretta thula*), the little blue heron (*Egretta caerulea*), the green-backed heron (*Butorides striatus*), and the night heron (*Nycticorax nycticorax).* Colonial waterbirds hunt in shallow water habitat, feeding mainly on small fish, amphibians, and arthropods. They nest in tall trees in mainland areas, but can nest on shrubs and even dense grassy vegetation on islands isolated from terrestrial predators. Colonial waterbirds concentrate their reproductive energies in colonies at just a few locations.

Shorebirds, marsh birds, and waterfowl are common residents throughout the Chesapeake Bay. Other common avians are gulls, terns, brown pelicans (*Pelecanus occidentalis*), and the cormorants (*Phalacrocorax* sp.). Wading birds include the sandpipers, sanderlings, willet (*Cataoptrophorus semipalmatus*), black-bellied plover (*Pluvialis squatarola*), dowitchers (*Limnodromus* sp.), and glossy ibis (*Plegadis falcinellus*). Dozens of species of waterfowl (i.e., ducks and geese) inhabit or migrate to the Chesapeake Bay region, including the commonly sighted mallard (*Anas platyrhynchos*), wood duck (*Aix sponsa*), and red-breasted merganser (*Mergus serrator*) (CBP, 2004j).

The American bald eagle and osprey are the Chesapeake Bay's most familiar raptors. The osprey is tolerant of human activity, and it builds its nests along the shoreline and on navigation markers, utility poles, dead trees, and manmade structures near the water. The American bald eagle nests, roosts, and perches at the top of tall trees in upland areas, often in loblolly pine stands. The trees must be in areas where human activity is limited because bald eagles have little tolerance for human activity.

Land birds include birds typically present in upland habitats in the mid-Atlantic region, such as American robin (*Turdus migratorius*), northern cardinal (*Cardinalis cardinalis*), blue jay (*Cyanocitta cristata*), and various species of finches and sparrows.

The diversity of avian fauna in the Chesapeake Bay is largely affected by the number of migratory species. The Chesapeake Bay is located along the Atlantic Flyway, a major migration route for neotropical migrants and migrating waterfowl. Waterfowl and other birds migrating along the Flyway find food and shelter in the Chesapeake Bay's many coves and marshes. The Chesapeake Bay also serves as one of the most heavily used wintering areas for waterfowl. On average, nearly a million waterfowl winter each year on the Chesapeake Bay; more than 35% of all the waterfowl using the Atlantic Flyway (NPS 2003). Waterfowl staging and concentration areas have been identified in Maryland by MDNR throughout Chesapeake Bay. These areas are typically afforded additional protection from activities that could disrupt waterfowl concentrations. Surveys suggest that unvegetated island habitats are preferentially selected by many migratory bird species because of their relative lack of human disturbance and predators (USACE-Baltimore, 2004c).

Loss of habitat along waterways poses the biggest threat to many bird species in the Chesapeake Bay watershed. Deforestation, shoreline development, and shoreline erosion disrupt nesting activities, and chemical contaminants in the water damage the food source of many Chesapeake Bay birds. The Chesapeake Bay's vast tidal marshlands are important nesting, nursery, and wintering areas for colonial waterbirds, wading birds, and several Federally listed and state-listed endangered species. Rare, threatened, and endangered species found in the Chesapeake Bay are discussed in Section 3.1.10.

One goal of the Chesapeake Bay Program is to restore avian populations in the Chesapeake Bay to levels measured in the 1970s. In order to assess the status of Chesapeake Bay avian fauna, state biologists and USFWS count at least 20 species or species groups of waterfowl each winter in the watershed. Although waterfowl populations are variable because of their migratory nature and the effects of factors outside the basin, these annual counts provide an estimate of trends in Chesapeake Bay waterfowl.

As of September 2004, ten of the 20 monitored waterfowl species have met their goals and are showing improving trends in populations: mallard, gadwall (*Mareca strepera*), American widgeon (*Mareca Americana*), northern shoveler (*Anas clypeata*), northern pintail (*Anas acuta*), green-winged teal (*Anas crecca*), scaup (*Aythya affinis*), ring-necked duck (*Aythya collaris*), bufflehead (*Bucephala albeola*), and ruddy duck (*Oxyura jamaicensis*). Ten of the 20 monitored waterfowl have not met their goals. Four of these 10 species have shown improving trends (but have not met goals): black duck, redhead, scoters, and Canada goose (migratory). The remaining six species have shown declining trends: canvasback (*Aythya valisineria*), common goldeneye (*Bucephala clangula*), long-tailed duck (*Clangula hyemalis*), mergansers sp., brant (*Branta bernicla*), and tundra swan (*Cygnus columbianus*) (CBP, 2004k).

3.1.9.d.1 James and Barren Avian Surveys

Qualitative and quantitative avian surveys were performed during the four quarters of study at James Island and Barren Island. The qualitative surveys consisted of identifying bird species encountered while conducting the terrestrial portion of each quarterly survey, and noting the habitats in which they occurred. Quantitative bird surveys were conducted as part of the quarterly survey sampling at five locations at James Island and five locations at Barren Island. The quantitative survey methods consisted of observing all avifauna within a 180° arc of a set location for 15 minutes, and noting the species, habitat, and number of individuals observed. Observations were repeated twice at each station. The quantitative surveys provide bird species information primarily from the intersection of the aquatic and terrestrial habitats, which captures shorebirds, wading birds, and waterfowl (MPA, 2005a).

The quantitative surveys at James Island detected 41 different species during all four seasons of surveys; the sampling locations are depicted in Figure 3-20. Table 3-37 presents the bird species and number of individuals counted during the James Island timed surveys for each location and season, and also includes a combined total number of individuals. Surf scoter (*Melanitta perspicillata*) (179), bufflehead (*Bucephala albeola*) (177), common grackle (*Quiscalus quiscula*) (58), osprey (*Pandion haliaetus*) (32), and herring gull (*Larus argentatus*) (29) had the highest total number of individuals from all the stations and seasons during the timed surveys (MPA, 2003e; MPA, 2003f; MPA, 2004g; MPA, 2004h). Osprey (10) was the most abundant species detected in the Summer 2002 survey. Brown pelican (*Pelecanus occidentalis*), mute swan (*Cygnus olor*), great blue heron (*Ardea herodias*), great egret (*Ardea albus*), American bald eagle (*Haliaeetus leucocephalus*), Forster's tern (*Sterna forsteri*), pine warbler (*Dendroica pinus*), and red-winged blackbird (*Agelaius phoeniceus*) were observed four or fewer times during the Summer 2002 timed surveys (MPA, 2003e). Bufflehead (76), herring gull (29), and black scoter (*Melinitta nigra*) (17) were most abundant in the Fall 2002 survey (MPA, 2003f). Surf scoter (176), bufflehead (101), common grackle (48), osprey (12), ring-billed gull (*Larus delawarensis*) (12), and sanderling (*Calidris alba*) (12) were the most abundant during Winter 2003 (MPA, 2004g). No bird species was observed more than nine times during the Spring 2003 timed surveys; osprey (9) and common grackle (7) had the highest number of observations during this survey (MPA, 2004h).

The qualitative bird surveys at James Island detected a total of 71 different species during all quarterly surveys. Table 3-38 lists the species observed and the season in which they were observed at James Island. Double crested cormorant (*Phalacrocorax auritus*), mute swan, Canada goose (*Branta canadensis)*, osprey, American bald eagle, American crow (*Corvus brachyrhynchos*), and Carolina chickadee (*Poecile carolinensis*) were observed in all four seasons at James Island. MPA (2004h) notes that osprey, northern cardinal, Eastern kingbird (*Tyrannus tyrannus*), northern flicker (*Colaptes auratus*), and red-winged blackbird were nesting on James Island during Spring 2003.

James Island is located within a MDNR Sensitive Species Project Review Area noted to feature waterfowl, wading bird, and shorebird use (MDNR, 2004e). Waterfowl such as scoters, mallards, geese, and swan were documented utilizing James Island during the environmental surveys; and shorebirds such as terns, sandpipers, and yellowlegs were documented on James Island during one or more quarters of study (MPA, 2003e; MPA, 2003f; MPA, 2004g; MPA, 2004h). The island is less than one mile north of an area known as a colonial waterbird nesting site (MPA, 2003i), and the quarterly survey results document green heron (*Butorides virescen*s), great egret, great blue heron, brown pelican and cormorant on James Island. Section 3.1.10

details the State and Federally listed rare, threatened, and endangered species observed at James Island.

The quantitative avian surveys at Barren Island detected a total of 45 different bird species during four seasons of surveys; the observation stations are depicted in Figure 3-21. Table 3-39 presents the bird species and number of individuals counted during the Barren Island timed surveys for each location and season, and also includes a combined total number of individuals. Mute swan (531), brown pelican (309), double crested cormorant (170), turkey vulture (*Cathartes aura*) (136), and great black-backed gull (*Larus marinus*) (127) had the highest count of individuals as a combined total over all the stations and seasons during the timed surveys. Mute swan (110), double crested cormorant (30) and herring gull (36) were the most abundant species detected in the Summer 2002 survey. Mute swan (356), brown pelican (293), double crested cormorant (79), turkey vulture (136), and great black-backed gull (114) were most abundant in the Fall 2002 survey. Mute swan (60) followed by semi-palmated sandpipers (15), great blue heron (12), and herring gull (10) were the most abundant during Winter 2003. The combined seasonal and sampling location totals of great blue heron and great egret individuals were 70 and 74 respectively; these species were detected in the greatest numbers (55 and 70, respectively) during the Spring 2003 survey (MPA, 2005a).

The qualitative bird surveys at Barren Island detected a total of 107 different species during all four seasons of sampling. Table 3-40 lists the species observed at Barren Island, the season and habitat they were observed in, and their probable residency status. Mute swan, herring gull, great blue heron, American bald eagle, northern cardinal, American crow, Carolina chickadee, Carolina wren (*Thryothorus ludovicianus*), and double-crested cormorant were observed during all four seasons of Barren Island surveys, and are believed to be resident species. Migrant species observed include tundra swan (*Cygnus columbianus*), bufflehead, scoter species, ruby throated hummingbird (*Archilocus colubris*), sanderlings, sandpipers, plovers, gulls, terns, yellowlegs, sharp-shinned hawk, northern harrier, loons, thrushes, warblers, kinglets, and wrens (MPA, 2005a). Bird species diversity and abundance were highest at quantitative sampling stations that consisted of shallow, sheltered, aquatic ecosystems. The presence of the Barren Island remnants appear to be partially responsible for maintenance of the sheltered shallow water habitat, and it is expected that the avian utilization of these habitats would be affected as Barren Island continues to erode (MPA, 2005a).

Barren Island is located within a MDNR Sensitive Species Project Review Area noted to feature colonial water bird nesting. Two colonial water bird nesting sites are noted on the southern remnant (MDNR, 2004e; MPA, 2005a). Brown pelican, double crested cormorant, and herring gull were observed nesting on a small remnant islet just south of the main southern remnant. During the Winter 2003 survey, great blue heron nesting activity was noted in the forested areas of the southern remnant (MPA, 2005a). State and Federally listed rare, threatened, and endangered species observed at Barren Island are discussed in Section 3.1.10a.

A letter received from MDNR (Byrne, 2004; Appendix G) mentions historic waterfowl concentration and staging areas known to occur along the open water that is part of or adjacent to the shorelines of both James and Barren Islands. Additionally, Barren Island supports a breeding colony of waterbirds.

3.1.9.e Mammals

The habitats of the Chesapeake Bay watershed support a variety of mammal species. Upland grasses, shrubs, and forests provide an abundant source of food and shelter for various species of deer, mice, and squirrels. Habitat diversity is essential for other species, including the river otter (*Lutra canadensis*), muskrat (*Ondatra zibethicus)*, and beaver (*Castor canadensisis*) that utilize both land and aquatic habitats of the region. The Chesapeake Bay also contains suitable habitat for a number of Federally threatened or endangered species, including the Delmarva Fox Squirrel (*Sciurus niger cinereus*). Rare, threatened and endangered species inhabiting the Chesapeake Bay are further discussed in Section 3.1.10.

3.1.9.e.1 James and Barren Mammalian Surveys

Non-avian wildlife species observed on James Island and Barren Island are included in Tables 3-35 and 3-36. The list of mammals utilizing James Island and Barren Island was compiled from qualitative observations during the seasonal terrestrial surveys of the islands. Mammals included on the list were either observed directly, or signs of their presence such as scat, bones, or tracks were observed (MPA, 2005a).

Environmental surveys conducted at James Island documented evidence of utilization by river otter (*Lutra Canadensis*), raccoon (*Procyon lotor*), sika deer (*Cervus nippon*) or white-tailed deer (*Odocileus virginianus*), and muskrat. Otter, raccoon, sika deer, and muskrat prints, trails, and scat were common on James Island during the four seasons of environmental surveys. Raccoons and otter were observed during the Fall 2002 and Winter 2003 surveys, respectively. The skulls of two raccoons were discovered on the northern remnant during the Winter 2003 survey; the cause of death was not evident (MPA, 2003e; MPA, 2003f; MPA, 2004g; MPA, 2004h).

Indications of four mammal species were identified on Barren Island during the quarterly environmental surveys: muskrat, raccoon, red fox (*Vulpus fulva*), and sika deer. The presence of cropped vegetation and a distinct browse line in the forested area indicate that the deer on Barren Island may be abundant. Red fox and raccoon were noted utilizing habitat near diamondback terrapin nesting areas (MPA, 2005a). Terrapin nesting is discussed further in Section 3.1.9.c.

3.1.10 Rare, Threatened and Endangered Species (RTE)

The Endangered Species Act (ESA) of 1973 and the Maryland Nongame and Endangered Species Conservation Act (NESCA) of 1975 are Federal and State Acts that protect certain species of plants and animals. Section 7 of the ESA provides a consistency clause that requires consultation with USFWS and NMFS if a proposed project may affect RTE species. A similar requirement for consultation is required in the NESCA, if a proposed project may affect state RTE species.

Consultation was conducted, in accordance with Federal and state requirements, with USFWS Ecological Services office in Annapolis, Maryland; the Habitat Conservation Division of the NMFS in Oxford, Maryland; and MDNR's Fish, Heritage, and Wildlife Administration in Annapolis, Maryland. Requested information included critical habitat and Federal- and state-listed RTE species.

The response letter from NMFS (Colligan, 2004; Appendix E) provided a list of endangered and threatened aquatic species within this agency's jurisdiction. The list included the shortnose sturgeon (SNS) *(Acipenser brevirostrum)* and several species of sea turtles, including leatherback (*Dermochelys coriacea*), loggerhead (*Caretta caretta*), Kemp's ridley (*Lepidochelys kempi*), and green sea turtles (*Chelonia mydas*). The letter (Colligan, 2004) pointed out that these species are likely to be present in the vicinity of the study area, and may be affected by the project. Consequently, the Mid-Chesapeake Bay Islands Ecosystem Restoration project must undergo Section 7 consultation and USACE is responsible for initiating this consultation when the project details are developed.

The response letter from USFWS (Moser, 2004; Appendix E) provided information regarding Federally listed endangered or threatened species within the project areas at James and Barren Islands. This information includes reference to the Federally listed threatened American bald eagle nesting on the northern remnant of James Island and the southern end of Barren Island near Whitewood Cove. The USFWS letter (Moser, 2004) stated that any construction or forest clearing activities within one-quarter mile of an active nest may impact American bald eagles, and if such impacts may occur, further Section 7 consultation with USFWS may be required. Since the USFWS letter was received, the American bald eagle was removed from the endangered species list in 2007. It remains in a five year monitoring phase to ensure the population is indeed not slipping backwards. The summary statement provided by the USFWS indicates that, except for occasional transient individuals, James and Barren Islands are not known to support any other Federally proposed or listed threatened or endangered species.

Additional communication with Glenn Therres of MDNR Heritage Program in March 2005 provided further information on the status of the American bald eagle nests on James Island and Barren Island. Mr. Therres stated that one active nest remained on James Island, located on the middle remnant. Mr. Therres also noted that the American bald eagle nest formerly located on the southern end of Barren Island was blown down in 2004, and it is not known whether the nest will be rebuilt in 2005.

The response letter from MDNR (Byrne, 2004; Appendix E) referenced the American bald eagle nests on James and Barren Islands. There is also a record of the state-listed endangered eastern narrow-mouthed toad occurring on Barren Island.

3.1.10.a Federally Protected Species Identified

Table 3-41 provides a listing of the RTE species observed in the vicinity of James Island, their Federal and state status, and the time period they were observed. There are currently no plant or animal species observed during field investigations at James Island listed on the Federal RTE list. Although recently delisted in 2007, the American bald eagle was listed as Federally threatened throughout nearly all of this study period. American bald eagles were observed on James Island during the Summer and Fall of 2002 and the Winter and Spring of 2003 (MPA, 2003e; MPA, 2003f; MPA, 2004g; MPA, 2004h). Adult and immature American bald eagles and one nest were observed in the summer, fall and spring during field investigations (MPA, 2003e; MPA, 2003f; MPA, 2004h). No immature American bald eagles were observed in the winter during field investigations (MPA, 2004g).

Table 3-42 provides a listing of the RTE species observed in the vicinity of Barren Island, their Federal and state status, and the time period they were observed. There are currently no plant or animal species observed during field investigations at Barren Island listed on the Federal RTE list. Although recently delisted in 2007, the American bald eagle was listed as Federally threatened throughout nearly all of this study period. American bald eagles were observed on Barren Island during the Summer and Fall of 2002 and the Winter and Spring of 2003 (MPA, 2003g; MPA, 2003h; MPA, 2005a). Adult and immature American bald eagles and one nest were observed in the summer and fall during field investigations. Mature American bald eagles were observed in the winter and spring during field investigations (MPA, 2003g; MPA, 2003h; MPA, 2003a; MPA, 2004b).

USFWS and NMFS have identified the SNS as a particular concern in the Chesapeake Bay. Due to the critical status of shortnose sturgeon in the region, NMFS has requested that the USACE carry out a Section 7 consultation as the project develops. No SNS were captured in the waters immediately surrounding James or Barren Island in the Reward Program as of January 13, 2005. The nearest SNS catch to the project area was approximately 8 nautical miles to the northwest of Barren Island and to the south of James Island, where three SNS were captured by way of pound nets. Seasonal fisheries surveys were conducted in 2002 and 2003 at James and Barren Island to characterize existing finfish communities surrounding the islands for the Mid-Chesapeake Bay Feasibility Study. Several fisheries gear types were used during the various fisheries surveys: bottom trawl, popnet, gillnet, and beach seine. There were no SNS identified in any of the surveys at James or Barren Island. Based on these observations, SNS are probably transient to the vicinity of James Island and Barren Island.

The Chesapeake Bay is an important developmental and foraging habitat for sea turtles in the summer months. No nesting is known to occur within the Chesapeake Bay (Evans et al. 1997). Of the three Federally protected sea turtle species found in Chesapeake Bay, loggerheads and Kemp's ridleys are the most common and are most likely to be found in the project area. Leatherbacks typically continue north on their migration past the Chesapeake Bay, while loggerheads and Kemp's ridleys will enter the Chesapeake Bay once water temperatures reach 18 to 20°C (64.4 to 68 ^{o}F) (Lutcavage and Muscik 1985, Byles 1988, CBP 2005). Loggerheads and Kemp's ridleys immigrate into Chesapeake Bay in late May or early June once water temperatures warm and emigrate in September and October (Lutcavage and Musick 1985, Byles 1988, Keinath et al. 1994). Loggerheads account for nearly 90% of the summer sea turtle population in the Chesapeake Bay (CBP, 2005). Most species are more prevalent in Virginia waters than in Maryland, although the loggerhead, leatherback, and Kemp's ridley have all been stranded in Maryland water as far north as the Back River (Kimmel, 2004).

There are two sources of information on the current presence of sea turtles in Maryland waters of the Chesapeake Bay: the Marine Mammal and Sea Turtle Stranding Program (1990 through present) and the Sea Turtle Tagging and Health Assessment Study (operated from 2001 through 2003). The Stranding Program is responsible for the retrieval and examination of all dead stranded marine mammals and sea turtles in Maryland. Of 308 turtles reported in Maryland since 1991, 123 were found in the Chesapeake Bay (Figure 3-22) (Kimmel 2004). The majority of sea turtle strandings occurred from May to November with a small number (2) being recorded in January. The highest concentration of strandings was in June (81), followed by July.

Strandings have occurred throughout the Chesapeake Bay from Tangier Sound to the mouth of Back River (Figure 3-22), but strandings were most heavily concentrated in Calvert and Saint Mary's counties along the western shore. Of the Chesapeake Bay strandings, loggerhead accounted for 91% of all stranding (n=112 turtles). Of the remaining strandings, 6% were leatherback (n=6), 3% were Kemp's ridley (n=3), and less than 1% (n=1) were unknown. No green sea turtles have been reported in the Chesapeake Bay (Kimmel 2004), although one was found along the Maryland Atlantic Coast in 2000.

The second source of knowledge about sea turtle presence in Chesapeake Bay is available from the Sea Turtle Tagging and Health Assessment Study initiated in September 2000 by MDNR's Cooperative Oxford Laboratory (COL). This study established a cooperative agreement with pound net fishermen in Maryland to obtain information such as weight, size, and blood samples from incidentally captured sea turtles. Figure 3-23 identifies the location of participating pound nets from 2001 through 2003. This study has examined a total of 42 sea turtles since the summer of 2001, of which 3 were recaptures. As reported by Kimmel (2004), 17 of the remaining 39 turtles were Kemp's ridleys and 22 were loggerheads (Table 3-43). Incidental takes occurred between May and September in 2001, 2002, and 2003 with the greatest number of captures occurring in June and July. Captures were concentrated northwest of Hoopers Island and near the mouth of Fishing Bay due to a higher reporting of incidental captures by watermen in those areas.

3.1.10.b State Protected Species Identified

The American bald eagle is required to be listed on the state RTE list since it is on the Federal RTE list and the various comments on American bald eagle occurrence in the vicinity of James Island and Barren Island apply to this section as well as the Federally protected species Section 3.1.10.

One avian species and one plant species observed in the vicinity of James Island is listed as "endangered" in the State of Maryland. A species population listed as "endangered" in the State of Maryland is considered to be in jeopardy of continued existence (MDNR, 2001). The royal tern is listed as an "endangered" avian species in the State of Maryland (MPA, 2003h; MPA, 2004h). Canby's bulrush was observed on James Island and is listed as an "endangered" plant in the State of Maryland (MPA, 2004g; MPA, 2004h).

Two avian species observed in the vicinity of James Island are listed as "threatened" in the State of Maryland. A species population listed as "threatened" in the State of Maryland is considered to be in jeopardy of becoming "endangered." The least tern and American bald eagle are listed as "threatened" avians species in the State of Maryland (MPA, 2004h; MDNR, 2001).

Additional species have been observed in the vicinity of James Island that are not considered threatened or endangered, but are considered rare breeding species in Maryland, and are listed by the State of Maryland on the State's RTE species list. Avian species listed as rare can have a limited breeding range or their breeding habitats have decreased due to other pressures within the State. Species that are considered rare may be monitored due to their limited breeding status; therefore seasonal actions in the vicinity of such species may have to take this into account (MDNR, 2001). Avian species observed in the vicinity of James Island and are listed on the

State RTE species list as rare breeders include the golden-crowned kinglet, double-crested cormorant, brown pelican, laughing gull, sharp-shinned hawk, spotted sandpiper, northern harrier, yellow-bellied sapsucker, and dark-eyed junco (MPA, 2003e; MPA, 2003f; MPA, 2004g; MPA, 2004h). The big sand tiger beetle was observed on James Island and is listed as rare on the State's RTE list. Plant species observed on James Island and listed as rare on the State's RTE species list include yellow thistle, Elliot's goldenrod, beaked spikerush, and pearly everlasting (MPA, 2003e; MPA, 2003f; MPA, 2004g; MPA, 2004h).

No other plant or animal species observed during field investigations at James Island are listed on the state RTE species list.

One avian species observed in the vicinity of Barren Island, the American bald eagle, is listed as "threatened" in the State of Maryland. Several avian species observed in the vicinity of Barren Island are listed as "endangered" in the State of Maryland. A species population listed as "endangered" in the State of Maryland is considered to be in jeopardy of continued existence. The royal tern, Wilson's plover, and sedge wren are listed as "endangered" avian species in the State of Maryland (MPA, 2005a). The Eastern narrow-mouthed toad was observed on Barren Island and is listed as an "endangered" amphibian in the State of Maryland (MPA, 2005a; MDNR, 2001). Consultation with Maryland DNR regarding the status of the Eastern narrow mouthed toad on Barren Island is ongoing.

Two avian species observed in the vicinity of Barren Island are listed as "in need of conservation" in the State of Maryland. A species population listed as "in need of conservation" in the State of Maryland is considered to be declining and in risk of becoming "threatened." The American bittern and peregrine falcon are avian species listed as "in need of conservation" in the State of Maryland (MPA, 2005a; MDNR, 2001).

Additional species have been observed in the vicinity of Barren Island that are not considered threatened or endangered, but are considered rare, and are listed by the State of Maryland on the state's RTE species list. Avian species listed as rare breeders in Maryland, naturally have a limited breeding range or their breeding habitats have decreased due to other pressures. Avian species observed in the vicinity of Barren Island and are listed as rare on the state's RTE species list include the golden-crowned kinglet, double-crested cormorant, brown pelican, laughing gull, sharp-shinned hawk, gadwall, northern harrier, American oystercatcher, dark-eyed junco, saltmarsh sharp-tailed sparrow, hermit thrush, Swainson's thrush, black-throated blue warbler, magnolia warbler, and winter wren (MPA, 2005a). An undetermined tiger beetle species was observed on Barren Island (MPA, 2005a). Some tiger beetle species are listed as rare in the State of Maryland (MDNR, 2001).

No other plant or animal species observed during field investigations at Barren Island are listed on the state RTE species list.

3.1.11 Air Quality

The USEPA has established national ambient (outdoor) air quality standards for six common pollutants: ozone, carbon monoxide, sulfur dioxide, particulate matter, oxides of nitrogen, and lead (MDE, 2004b). Ambient air quality in Maryland is determined by measuring ambient pollutant concentrations and comparing the concentrations to the corresponding national standard (USACE, 1996). The National Ambient Air Quality Standards (NAAQS) are separated into primary and secondary standards (USEPA, 2004a).

All parts of Maryland are designated as being in attainment or nonattainment for each of the criteria pollutants. Attainment means that the area has met the NAAQS for a particular pollutant for which NAAQS have been established. Nonattainment is the opposite; it means that the NAAQS for a particular pollutant were not met. All of Maryland is in attainment for particulate matter, nitrogen dioxide, sulfur dioxide, lead, and carbon monoxide. Large parts of Maryland are nonattainment for ozone including Central Maryland, the Baltimore Metropolitan region, the Washington Metropolitan region, part of Southern Maryland and Kent and Queen Anne's Counties on the Eastern Shore.

The primary air quality standards were designed to establish an adequate margin of safety in order to protect public health. The secondary standards were established to protect public welfare, including protection of personal property and buildings from adverse effects associated with pollutants in the ambient air (USEPA, 2004a).

In protecting public welfare, air pollution effects on the following are considered: soils, water, crops, vegetation, man-made materials, animals, wildlife, weather, visibility, climate, transportation, economy, and personal well-being. The USEPA periodically reviews the scientific criteria upon which the air quality standards are based, and the standards are reestablished or changed based upon the findings (USACE, 1996). The status of the national primary and secondary ambient air quality standards is briefly discussed below for Dorchester County, which includes both James Island and Barren Island Study Areas.

3.1.11.a Ozone Standard Status

The primary and secondary ambient air quality standard for ozone is 0.125 parts per million (ppm) (0.235 milligrams per cubic meter) over a one-hour period, not to be exceeded on more than an average of one day per year for a three-year period. In July 1997, the USEPA announced the new primary and secondary NAAQS for ozone. As of July 1997, the new standards will be replacing the one-hour 0.125 ppm standard with a standard of 0.085 ppm measured over eight hours, with the average fourth highest concentration over a three-year period determining whether an area is out of compliance. The 0.125 ppm one-hour standard will not be revoked in a given area until that area has achieved three consecutive years of air quality data meeting the one-hour standard (MDE, 2004b). Under the Clean Air Act Amendments (CAAA) of 1990, Dorchester County is in attainment for ozone, however, the entire state of Maryland is considered to be part of the Northeast Ozone Transport Region meaning that there is a significant contribution of ozone to the region originating from sources outside of the northeast (MDE, 2004b; USACE, 1996).

3.1.11.b Carbon Monoxide Standard Status

USEPA has established a primary eight-hour ambient air quality standard for carbon monoxide of 9 ppm (10 milligrams per cubic meter), not to be exceeded more than once per year. A very short-term, one-hour standard of 35 ppm (40 milligrams per cubic meter), not to be exceeded more than once per year, has also been established. There is no secondary standard for carbon monoxide in the ambient air (MDE, 2004b; USACE, 1996). The Dorchester County air quality region is in attainment with carbon monoxide standards (MDE, 2004b).

3.1.11.c Sulfur Dioxide Standard Status

USEPA has established a primary 24-hour ambient air quality standard of 0.14 ppm (0.365 milligrams per cubic meter) for sulfur dioxide, not to be exceeded more than once per year. Additionally, a primary annual arithmetic mean concentration of 0.03 parts per million (0.08 milligrams per cubic meter) has also been established by USEPA. The secondary standard for sulfur dioxide is 0.5 ppm (1.3 milligrams per cubic meter) over a three-hour period, not to be exceeded more than once per year. Dorchester County is considered to be in attainment for sulfur dioxide (USACE, 1996; MDE, 2004b).

3.1.11.d Particulate Matter (PM10) Standard Status

The national primary and secondary air quality standard for particulate matter is 0.150 milligrams per cubic meter over a 24-hour period, not to be exceeded on more than an average of one day per year for a three-year period. An annual arithmetic mean concentration of 0.05 milligrams per cubic meter has also been established for both the primary and secondary air quality standards. Dorchester County is considered to be in attainment for particulate matter (USACE, 1996; MDE, 2004b).

3.1.11.e Nitrogen Dioxide Standard Status

The national primary and secondary air quality standard for nitrogen dioxide is 0.053 ppm (0.1 milligram per cubic meter), annual arithmetic mean concentration. The standard is attained when the annual arithmetic mean concentration in a calendar year is less than or equal to 0.053 ppm, rounded to three decimal places. Dorchester County is classified as in attainment for nitrogen dioxide (USACE, 1996; MDE, 2004b).

3.1.11.f Lead Standard Status

The primary and secondary ambient air quality standard for lead is 0.0015 milligrams per cubic meter as a quarterly average. Dorchester County is classified as in attainment for lead (MDE, 2004b).

3.1.12 Noise

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

The degree of disturbance or annoyance of unwanted sound depends on (1) the amount and nature of intruding noise, (2) the relationship between the background noise and the intruding noise, and (3) the type of activity occurring at the location where the noise is heard. Human response to noise varies from individual to individual and is dependent on the ambient environment in which the noise is perceived. Wind, temperature, and general atmospheric conditions can change the sound volume perceived at distances from the noise source.

To ensure a suitable living environment, the Department of Housing and Urban Development (HUD) has developed a noise abatement and control policy, as seen in 24 CFR Part 51. According to this policy, noise not exceeding 65dBA is considered acceptable. Noise above 65 dBA but not exceeding 75 dBA is normally acceptable, but noise above 75 dBA is unacceptable. Regulatory thresholds by state and local governments can also provide criteria to judge the significance of noise impacts.

MDE's 2002 Annual Enforcement Report mentions that the Noise Control Program has been established to provide assistance to the citizens and local jurisdictions across states regarding compliance with community noise issues that are not handled at the local level. Noise has become an increasingly contentious quality of life issue as the state's population increases and urban development progresses. When a noise-level violation is encountered, primary emphasis is placed on compliance assistance and cooperative resolution.

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

Uninhabited islands have few on-site noise sources and have generally low sound levels. However, substantial noise can be generated from boat traffic in adjacent waters and natural sound sources such as wind, waves, and bird colonies may contribute to measured sound levels. Background noise levels for residents in the vicinity of either island might typically be 40 dBA with occasional acute noise sources such as a lawnmower, which will generate 65 to 95 dBA at 50 feet or a leafblower (110 dBA at 50 ft) (Appendix H: UMCES, 2004b. Two common rules of thumb for sound reduction are that sound drops by 6 dBA for every doubling of distance over land and by 5 dBA per doubling of distance over water (UMCES, 2004b).

James Island is generally free of anthropogenic noise sources other than fishing boats, occasional recreational boats, and airplanes. Personal watercraft (PWC) and powerboats may generate noise levels of 70 to 85 dBA at 50 feet (Noise Unlimited, 1995). By comparison, normal freeway traffic noise levels range between 70 to 90 dBA (UMCES, 2004b). Barren Island is also free of general anthropogenic noise sources other than fishing and some recreational boating, but occasionally has more noise attributable to low-flying aircraft due to the close proximity of the Patuxent Naval Air Station.

3.1.13 Light

There are currently no light sources on James or Barren Island. The shoreline area near James and Barren Islands has few major human-made light sources and therefore, has low levels of overall lighting. Sources of light on the mainland include car headlights, occasional streetlights, residential lighting, and lighting from a few commercial establishments. The area around James and Barren Islands is made of mostly single-family homes, agricultural or open fields, wetlands, and forests (UMCES, 2004b).

Lighted navigational aids such as buoys, lighthouses, dock lights, other markings or signage, and lighted vehicles exist in the water surrounding James and Barren Islands. Navigational lighting in the Chesapeake Bay waterways is typically visible for miles but is not usually considered bothersome (UMCES, 2004b).

3.1.14 Hazardous, Toxic, and Radioactive Wastes (HTRW)

Toxic chemicals are a major stressor for the Chesapeake Bay. Chemical contaminants harm plants, animals, fish, and humans, affecting reproduction, development, and the survival of organisms. Major contaminants found in sediments include bulk organics (such as oil and grease), halogenated hydrocarbons (chemicals very resistant to decay such as DDT and PCBs), polycyclic aromatic hydrocarbons (such as petroleum), and metals (such as lead, cadmium, and mercury) (USEPA, 1999). The nature, extent, and severity of toxic effects vary widely throughout the Chesapeake Bay system. Some toxic chemicals such as zinc, copper, and other metals occur naturally in soils and sediments.

Chemical contaminants enter the Chesapeake Bay and its tributaries from point sources (industrial and municipal wastewater treatment plants), and nonpoint sources (urban and suburban stormwater runoff and agricultural runoff). Domestic activities such as home and lawn maintenance, driving, and discarding unused household chemicals add airborne and waterborne contaminants to the Chesapeake Bay. Chemicals typically travel through the watershed and deposit in the Chesapeake Bay and its tributaries. Persistent chemicals may reach harmful levels when they continue to accumulate in the sediment at the bottom of the Chesapeake Bay. As population (currently more than 15 million people) continues to grow in the Chesapeake Bay watershed, the nonpoint sources become difficult to track and control.

According to the Chesapeake Bay Basinwide Toxics Reduction Reevaluation Report (1994), the highest estimated toxic metal loading to the Chesapeake Bay basin comes from urban stormwater runoff, followed by point sources and atmospheric deposition. Metal loading is highest in the Potomac River basin, followed by the Susquehanna River, West Chesapeake Bay, James River, mainstem Chesapeake Bay, Patuxent River, Eastern Shore, York River, and Rappahannock basins. The highest estimated loadings of toxic organic contaminants (PAHs and PCBs) are from atmospheric deposition, followed by urban stormwater runoff and point sources. The West Chesapeake Bay has the highest organic chemical contaminant load, followed by the mainstem Chesapeake Bay, Susquehanna, Potomac, James, Eastern Shore, Patuxent, York, and Rappahannock basins. Atmospheric deposition is of relatively greater importance in the southern Chesapeake Bay. Some of these airborne materials may originate from the sources far away. Chesapeake Bay sediments have become reservoirs of certain persistent toxic compounds which, though banned by current regulations, have accumulated over many prior years of use.

There are no known issues related to hazardous materials manufacturing, storage, or use on James or Barren Islands. No visual evidence of such materials or clandestine dumping was encountered during several site visits conducted between October 2001 and September 2004. Extensive surveys conducted for identification of archaeological and historical sites in the area elicited no evidence of hazardous materials. Phase I Environmental Site Assessments were conducted for both James and Barren Islands. The reports found all databases clear of incidents, midnight dumping is highly unlikely, and influence of Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) sites is virtually impossible. The USFWS reported a gasoline tank on Barren Island that was removed in the 1990's; this was an above ground tank. USACE-Baltimore conducted a search of Federal and state records, and no historical uses were identified that could be related to environmental liability issues. There is no reason to suspect that James Island (USACE, 2003) or Barren Island (USACE, 2004b) contains HTRW that will in any way influence the proposed island restoration project.

3.1.15 Protected Areas

Federal, state, and local laws have been created to protect certain types of areas such as sensitive habitats, flood zones, and agricultural lands from the adverse effects of development. Flood zone regulations concurrently offer protection to life and property by excluding development. James Island and Barren Island are both uninhabited, undeveloped islands that primarily consist of wetland, beach and forested areas. These types of habitats can be subject to protection under Coastal Zone Management regulations, Critical Areas regulations, or flood plain regulations.

3.1.15.a Navigable Channels

Barren Island and James Island are located along the Eastern Shore of Maryland. James Island is located 2.75 nautical miles east of the navigation shipping channel in the main-stem Chesapeake Bay. Statements from the public watermen's meetings held in March 2003, indicate that local watermen regularly utilize a channel off the southern tip of James Island to move from the waters around Taylors' Island to the Chesapeake Bay (MES *et al*., 2002). Barren Island is located 1.62 nautical miles east of the navigation shipping channel in the main-stem Chesapeake Bay. A shallow draft Federal navigation channel is situated approximately 1900 ft. north of the northern tip of Barren Island. Dredged material from this channel has been used in previous habitat restoration projects at Barren Island (USACE, 2002).

3.1.15.b Coastal Zone Management

The Coastal Zone Management Program is a Federal-state partnership established by the Coastal Zone Management Act of 1972. The goal of the Coastal Zone Management Act is to "preserve, protect, develop and, where possible, to restore and enhance the resources of the nation's coastal zone for this and succeeding generations." The partnership established by the Act provides an avenue for consultation between local, state, and Federal governments as they work on complex resource management problems (MDNR, 2002).

The State of Maryland's Coastal Zone Management Program consists of laws and policies that work to achieve a balance between development and coastal zone protection. Approximately two-thirds of Maryland's land is included in the coastal zone area, which consists of the Chesapeake Bay, coastal bays, Atlantic Ocean, and any towns, cities, and counties that contain or help govern the coastline. MDNR is the lead agency for the state Coastal Zone Management Program. The three "themes" of the Maryland Coastal Zone Management Program are sustaining coastal ecosystems, sustaining coastal communities, and promoting government efficiency. Each theme consists of the following supporting goals:

- Sustaining coastal ecosystems;
- Sustain and improve coastal water quality,
- Protect restore and enhance coastal land and water habitats,
- Sustaining coastal communities;
- Reduce threats and losses from coastal hazards,
- Sustain, develop, and revitalize ports, harbors, marinas, and urban waterfronts,
- Provide public access to coast,
- Provide appropriate sites for coastal dependent uses,
- Preserve historic, cultural, and aesthetic coastal features,
- Improving government efficiency;
- Ensure Federal and state consistency with state policies,
- Simplify permit processes,
- Consider the national interest in the coasts, and provide orderly, predictable facility siting,
- Provide for local government and public participation.

Due to their location in the Chesapeake Bay, both James Island and Barren Island are within the defined coastal zone of Maryland (MDNR, 2002). Shoreline erosion of James Island, Barren Island, and the potential for erosion of nearby shorelines sheltered by the islands could be considered a coastal hazard.

3.1.15.c Coastal Barrier Resources Act

The Coastal Barrier Resources Act (CBRA) was passed in 1982, and refined with the Coastal Barrier Improvement Act of 1990 (CBIA). Coastal barriers such as tombolos, spits, islands, dunes, mangroves and beaches help protect the mainland from damage caused by coastal storms, including hurricanes. The goals of the Coastal Barrier Resources Act is to minimize loss of life and property by discouraging development in high risk coastal areas, reduce wasteful expenditure of Federal resources, and protect natural resources associated with coastal barriers.

Historically, Federal expenditures had the potential to encourage growth in coastal areas. The legislation contained in the CBRA and the 1990 CBIA limits Federally subsidized development within coastal barrier units defined by the USFWS. Barren Island is defined as an 'otherwise protected area' under this legislation and James Island is not included in the system (USFWS, 2004).

3.1.15.d Critical Areas

In 1984, the Maryland General Assembly enacted the Critical Area Act to address the increasing pressures placed on Chesapeake Bay resources from an expanding population. The Critical Area Act allowed state and local governments to work together to address land development impacts on aquatic habitats and resources by developing specific local programs that would minimize adverse impacts to water quality caused by pollutants in runoff, conserve fish, wildlife and plan habitat within the critical area, and establish land use policies which would accommodate growth. The Act defines a critical area as "all land within 1,000 feet of the Mean High Water Line of tidal waters or the landward edge of tidal wetlands and all waters of and lands under the Chesapeake Bay and its tributaries" (MDNR, 2004a). Due to their location in the Chesapeake Bay and their natural resources, James Island and Barren Island fall within the definition of a critical area.

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

James Island and Barren Island are designated as Resource Conservation Areas under the Critical Area Law (MDNR, 2004e). Rare, threatened, and endangered species utilizing James and Barren Islands have been documented in Section 3.1.10 and both islands are within waterfowl concentration and staging areas that are protected under critical area law (MDNR, 2004e). Habitat utilized by rare, threatened or endangered species can be protected under critical area regulations (MDNR, 2004a). The habitat on Barren Island designated as colonial waterbird nesting, as discussed in Section 3.1.9.d, may also be afforded protection under critical area regulations.

3.1.15.e Floodplains

Floodplains are low-lying areas, adjoining a watercourse (river, stream, etc.) or water body (ocean or bay) likely to be inundated by floodwater. For insurance purposes, floodplains are delineated by mapping areas that have been inundated in the past or are expected to be inundated by a flood of a specific magnitude (FEMA, 2004). In furtherance to the NEPA, Executive Order 11988 is a Federal law that has regulations regarding protection of floodplains from long or short-term adverse impacts that may be caused by Federal actions (Carter, 1977). All areas of James Island and Island Barren are designated as 100-year floodplains, except for a small portion of the northern tip of James Island (MDNR, 2004e). A 100-year floodplain is an area that has a 1% annual chance of becoming flooded. The elevation of the 100-year flood hazard in Dorchester County is between 5 ft and 6 ft.

3.1.15.f Wild and Scenic Rivers

The Wild and Scenic Rivers Act (16 U.S.C. 1271-1287) was passed on October 2, 1968. It declares that certain "selected rivers of the Nation which, with their immediate environments, possess outstandingly remarkable scenic recreational, geologic, fish and wildlife, historic, cultural, or other similar values, shall be preserved in free-flowing condition, and that they and their immediate environments, shall be protected for the benefit and enjoyment of present and future generations." There are no designated wild and scenic rivers in the Chesapeake Bay watershed.

The Maryland General Assembly passed legislation creating the Scenic and Wild Rivers System in 1968. The Scenic and Wild Rivers System initiated a program mandated to inventory and assess state rivers for inclusion as a scenic and/or wild river, and to prepare river resource management plans for rivers designated as scenic and/or wild by the Maryland General Assembly. A scenic river is defined as a "free-flowing river whose shoreline and related land are predominantly forested, agricultural, grassland, marshland, or swampland with a minimum of development for at least two miles of the river length" (MDNR, 2003A).

The only scenic or wild river located on the Eastern Shore is the Pocomoke River, which is more than thirty-six miles southeast of James Island and Barren Island. The Patuxent River, located on the western shore, is the closest scenic or wild river to James Island and Barren Island. The mouth of the Patuxent River is approximately twelve miles southwest of James Island, and approximately seven miles due west of Barren Island.

The American Heritage Rivers initiative, established by Executive Order 13061, is an innovative response to help river communities that seek Federal assistance and other resources to meet some tough challenges. The American Heritage Rivers initiative objectives are natural resource and environmental protection, economic revitalization, and historic and cultural preservation. There are no American Heritage Rivers in the study area; however, three rivers are designated within the Chesapeake Bay watershed, the Potomac, Upper Susquehanna, and Lackawanna Rivers.

3.2 CULTURAL RESOURCES

Cultural resources, defined as archeological and historic sites or artifacts, at James and Barren Islands have been influenced through the years with their history of human habitation and the continuing erosion of both islands. The cultural resources of James and Barren Islands have been separated into two categories, archeological and historic. Archeological resources are classified as occurring before discovery by Europeans, while historic resources are ones occurring after European discovery.

Cultural resource studies at both James and Barren Islands were undertaken in accordance with Section 106 of the National Historic Preservation Act (NHPA) of 1966, as amended through

1992. These studies included archival research at the Maryland Historical Trust (MHT) in Crownsville, MD, USACE-Baltimore, and Chesapeake Bay Maritime Museum in St. Michaels, MD. Additionally, observations from field studies and site visits of existing cultural resources of the islands were recorded from 2001 to 2004. Archival research and Phase I underwater archeological surveys were also conducted in the spring of 2004 at both James and Barren Islands. The result for the cultural resource surveys conducted at James and Barren Islands are discussed in more detail below.

At James Island, literature research revealed four recorded archeological or historic sites along the eastern shore of the remnants (Figure 3-24 depicts the approximate location of these sites). Only the southern remnant showed signs of possible historic use and possible cultural resources. However, no standing structures on James Island have been recorded or nominated as eligible for listing on the National Register of Historic Places (NRHP) (MPA, 2003d). Numerous shards of pottery, glass, and brick have been observed on the remnants and could potentially be archeological artifacts from previous inhabitants of the island (MPA, 2003d). The Phase I underwater survey revealed several clusters of anomalies (magnetic readings indicating possible ferrous material) within the footprints of the proposed alignments, but none was considered to represent potentially significant cultural resources (MPA, 2004l).

Literature research revealed six recorded archeological or historic sites along the northern and eastern shore of Barren Island (Figure 3-25 depicts the approximate location of these sites. There are no structures on Barren Island listed in NRHP (MPA, 2002d). Evidence of an old demolished hunting lodge is located on the northern remnant. Shards of pottery, glass, brick and a flint arrowhead were observed on the southern remnant and could potentially be archeological artifacts from previous inhabitants of the island (MPA, 2003a). The Phase I underwater survey revealed three clusters of anomalies within the footprints of the proposed alignments. Two of the clusters could potentially represent significant submerged cultural resources and are recommended for avoidance or further investigation (MPA, 2004k).

3.2.1 Archaeological Resources

Both James and Barren Islands appeared to have been home to Native Americans for centuries. Arrowheads, projectiles points, shell middens, and other artifacts have been found on the islands through the years.

At James Island, MHT files indicate one known archeological site on the island. This site, State Site 18DO360, identified as being on the east side of James Island, consists of both Late Archaic, 10,000-9000 Before Present (B.P.), and Middle Woodland (1000-400 B.P.) era short-term camp sites. The prehistoric artifacts found there include two Woodland period points and three stemmed points from the Late Archaic period. In addition, there is a nineteenth to early twentieth century house site at this location. Recorded by Darrin Lowery in 1996, shorelines of both sites are retreating due to erosion (MPA, 2004l).

Four archeological sites are identified by MHT on or within close proximity to Barren Island. These sites are:

1) State Site 18DO351: This site represents a prehistoric shell midden with fire cracked rock and is located northeast of Barren Island Point. The site is eroding from the shoreline and other artifacts may be located at low tide.

2) State Site 18DO160: This site on east Barren Island is a late Woodland shell midden and encompasses 30 by 120 meters. Artifacts collected from the site include Rappahannock Fabric, impressed ceramic, shards of Buckley ware, and Agate ware.

3) State Site 18DO161: This is a Late Woodland shell midden with a scattering of 19th century artifacts located along the west side of Opossum Island. Artifacts recovered at the site include a Madison point, shards of Chinese porcelain, gray stoneware and whiteware.

4) State Site 18DO162: Located at Cove Point, this site represents a prehistoric shell midden eroding away along the eastern shoreline of Barren Island. Artifacts collected included Quartzite flakes and “oyster crackers” (hammer stones used to crack the shells of oysters).

3.2.2 Historical Resources

Europeans and their descendants have inhabited both James and Barren Islands since colonial time to the early twentieth century. English colonists named James Island for Saint James. According to historian Bill Cronin, James Island was settled in the early 1660s and was 1,350 ac in size (Mountford, 2003). According to the original patents, the Patterson (or Pattison) and Killman families were the original settlers of James Island sometime during or prior to the 1800’s. Portions of James Island were later acquired by the Armstrong family; the southern section was known as Armstrong’s Hog Pen, reported to now be underwater, and the northeastern portion was named Armstrong’s Folly. The Patterson family continued to own the central part of James Island into the 1800’s with their seat at “The Grove” located on what is now the southern James Island remnant (MES, 1999). Archeological evidence suggests habitation periods from 1820 to 1860 and from 1900-1930. A village of 20 families and a church was purported to have been on James Island in 1892. Nothing remains of the village today and it is believed to have eroded away into the Chesapeake Bay. In 1903, a map reportedly shows a road running down the west side of the island with lanes leading to four possible farmsteads, but no evidence of this remains today. In addition, some of the island inhabitants were buried on an island ridge (Mountford, 2003). James Island is currently a privately-owned island.

MHT files identified two historic sites on James Island. State Site 18DO410 is a scattering of artifacts dating from the 18th to 20th century located on the east side of the island, this site may represent a War of 1812 site. State Site 18DO360 (location not specified) consists Late Archaic and Middle Woodland era short-term campsites and a 19th to early 20th century house site that is eroding out of the shoreline.

One legend has it that Barren Island first came into English hands when a Nanticoke chief lost a wrestling match to a colonist. The first recorded deed involving Barren Island was in 1664 when Richard Preston received a grant from Lord Charles Calvert for land in Dorchester County including Barren Island, which at the time was nearly a thousand acres (Mountford, 2003). In the 18th and 19th centuries, fourteen farms, small local stores, a one-room schoolhouse and a Methodist Church were on Barren Island. None of these structures or remnants are believed to exist today. A hunting lodge was built on the northwestern side of the island in 1929 with material scavenged from the demolition of the Caswell Hotel in Baltimore and barged over from Solomons Island. Little remains of the lodge today. A runway for small planes was also believed to have been constructed during this period. There are reports of three cemeteries having been located on Barren Island; two have washed away, while the third may still be in the area of Cove Point (Mountford, 2003). MDNR acquired Barren Island in 1988 and eventually negotiated with the USFWS, to add Barren Island to their Chesapeake Marshlands National Wildlife Refuge Complex.

One documented historic site was located on Barren Island according to MHT files. State Site 18DO169 consists of a scattering of historic artifacts along 15 feet of shoreline. Due to the water worn condition of the ceramic, its believed most of the site is underwater. Based on historic maps, a number of houses existed in this area during the last quarter of the 19^{th} century, but none of the structures appear to remain in a 1942 United States Geological Survey (USGS) map.

3.2.3 Existing Historical and Archeological Resources

Existing historic or archeological resources were noted and recorded during quarterly surveys at James and Barren Islands from 2001 to 2003.

At James Island, field surveys showed evidence of the historic use of the island and possible historic and archeological resources on the southern remnant. Shards of glass, brick, and pottery were found along the beaches between the northern and southern remnants; these pieces could potentially be historic artifacts from the households that inhabited the island. No evidence of historic or archeological resources was found on the northern and middle remnants. Along the northeastern shore, a shell midden is evident and pieces of brick and pottery were discovered along the southeastern shore of the southern remnant. Ruins of a brick foundation and possible chimney for a house were observed on the southern island remnant.

On the northern remnant of Barren Island, remnants of the demolished hunting lodge and pier are evident on the northern tip and an old roadbed or runway is evident and transects the central portion of the northern island. Straight channels, that appeared to be manmade with open water, were observed adjacent to the runway on the northern remnant. Also in the southern portion of the southern remnant in the low marsh areas, small dikes appear to have been built to create ponds, most likely for waterfowl. Discarded household items such as water heaters and empty drums are located on the central portion of the island. An old, rusty crane was observed in the northern section of the northern remnant, and an old bulldozer was observed in the central section of the southern remnant. A small, hunting cabin that has been constructed relatively recently is located on the northeastern tip of the southern remnant and is eroding into Tar Bay. Bricks, shards of glass, bits of pottery, and a flint arrowhead were observed on the oyster shell beach in the southeast portion of the southern remnant. No other historic or archeological resources were observed on the remnants during the field surveys or site visits.

3.2.4 Marine Survey of Archaeological and Historic Resources

A submerged cultural resource surveys of the proposed alignments of the possible restoration projects at James and Barren Islands was conducted from March 13 to May 11, 2004 (MPA, 2004k; MPA, 2004l). In conducting the underwater surveys, three primary pieces of remote sensing equipment were used on the survey vessel. A Differential Global Positioning System (DGPS) was used to determine exact position of track lines and objects located underwater. A magnetometer, towed behind the vessel, was used to search for ferrous objects on or below the survey area. A side scan sonar unit, also towed behind the vessel, was used to produce an acoustic image of the sea bottom, which gives a near photographic representation of objects on the sea bottom.

In determining what objects on the sea bottom may represent significant submerged cultural resources, consideration is given to groups of targets. Referred to as clusters, these groups occur when a target produces both a magnetic signature or anomaly and a side scan sonar image. Also, a magnetic source that extends across several survey lines and previous discovered cultural sites are also considered as part of a cluster. While criteria used to determine a cluster maybe somewhat subjective, they represent sites that may warrant further investigation. Several of the anomalies detected during the survey were credited to geologic features. Concentrations of limonite and goethite, described in Section 3.1.2.b, are most likely responsible for generating these anomalies.

3.2.4.a Survey Results at James Island

The underwater survey at James Island was conducted from April 7 to April 30, 2004. Approximately 350 line miles were investigated within the footprint of the proposed alignments off James Island. Following are four clusters that were identified as meeting the criteria listed above for possible submerged cultural resources and recommendations by Panamerican Consultants, Inc. (PCI) for further investigation:

Cluster 1: Cluster consists of 76 anomalies and no side scan sonar targets or entries on the NOAA Automated Wreck and Obstruction Information System (AWOIS) list. Cluster 1 is believed to be a geologic feature and no further investigation was recommended.

Cluster 2: Cluster 2 consists of 76 anomalies, no side scan sonar targets, and is not on the NOAA AWOIS list. Cluster 2 also appears to be a geologic feature and no further investigation was recommended.

Cluster 3: Cluster 3 consists of 31 anomalies, no side scan sonar targets and no entries on the NOAA AWOIS list. Since it too appears to be a geologic feature, no further investigation was recommended.

Cluster 4: Cluster 4 consists of 24 anomalies, with no side scan sonar targets. Cluster 4 appears to also represent a geologic feature and is not recommended for further investigation.

All four clusters of magnetic anomalies found within the proposed dike alignments for the James Island restoration project appear to be geologic features, not potentially significant submerged cultural resources. These deposits were formed by paleo-groundwater table at aerobic/anaerobic boundary and are associated with the rise and fall of river/Bay waters with glacial cycles. Dissolved iron precipitated into sediment matrix upon introduction of oxygen. No further investigation of the clusters was recommended.

3.2.4.b Survey Results at Barren Island

An underwater survey at Barren Island was conducted from April 7 to May 11, 2004 (MPA, 2004k). Approximately 230 line miles were investigated within the footprint of the proposed alignments off Barren Island. The following three clusters were identified as meeting the criteria listed above for possible submerged cultural resources and PCI's recommendations for further investigation:

Cluster 1*:* Cluster 1 consists of 39 anomalies, 26 side scan sonar targets, and one entry on the NOAA AWOIS list. Cluster 1 appears to be a complex site consisting of one large section of possible wreckage represented by side scan sonar targets and a large debris field. Cluster 1 is in the area of an entry in the NOAA AWOIS database indicating the presence of an obstruction. This obstruction was first reported in 1972 and AWOIS indicates it is the remains of a 100-foot wooden-hulled vessel. Based on side scan sonar images collected at the site, this section of possible wreckage is the main section of this vessel, and the debris field to the north possibly represents artifacts and debris from the wreck. It was the opinion of PCI's Principal Investigator that at least part of Cluster 1 represents the possible wreck site of a wooden-hulled vessel, and the potential exists that it represents a historically important site. For this reason, Cluster 1 was recommended for further investigation if avoidance is not possible.

Cluster 2*:* Cluster 2 consists of 11 anomalies, 22 side scan sonar targets, and no entries on the NOAA AWOIS list. Cluster 2 appears to consist of a very long linear object with weak anomalies. Due to the history of erosion of Barren Island, and the fact that Cluster 3 is located in the vicinity of current shore protection, as well as the presence of inundated shore protection also in the vicinity, it was the opinion of the Principal Investigator that this cluster represents the remains of old shoreline protection, and was not recommended for further investigation.

Cluster 3: Cluster 3 consists of 15 anomalies, no side scan sonar targets, and no entries on the NOAA AWOIS list. Cluster 3 appears to be a complex site with a large number of potentially related anomalies. Due to the number of anomalies present in the area, and that many of them extend over multiple survey lines, the potential exists for Cluster 3 to represent a significant submerged cultural resource rather than just debris relating to the history of the fishing and crabbing industry in the area. If avoidance is not possible, it was recommended that Cluster 3 receive further investigation.

Of the three Clusters identified within the proposed alignments at Barren Island, two may have the potential of being significant submerged cultural resources. Cluster 1 may be the remains of a 100 ft. wooden vessel, while Cluster 3 origin is unknown; the potential exists that it may be a significant cultural resource. Both Clusters 1 and 3 were recommended for further investigation if avoidance is not possible.

3.3 SOCIOECONOMIC CONDITIONS

The waters around James and Barren Islands are used extensively for commercial and recreational activities. These activities play an important role in the economics of the region and support the cultural identity of the area. Using Dorchester County as the study area, land and water use, demographics, employment and industry, environmental justice, and public safety are discussed in the following sections.

3.3.1 Land and Water Use

Individuals who crab, fish, or collect shellfish either commercially or recreationally use the waters surrounding the James Island archipelago. Commercial fishers and recreational boaters represent a major group of water users who contribute to the economic well-being of the region. Transportation and commercial shipping occurs in the mainstem Chesapeake Bay channel approximately 3 miles west of James Island (MPA, 2003d).

Land use of the James Island archipelago is limited. James Island is privately owned and used for hunting, fishing and other recreational activities. Other than recreational purposes, the remnants offer little socioeconomic value (MPA, 2003d).

Individuals who crab, fish, or collect shellfish either commercially or recreationally use the waters surrounding the Barren Island archipelago. Recreational boaters represent a major group of water users who contribute to the economic well-being of the region. Transportation and commercial shipping occurs in the mainstem Chesapeake Bay channel west of Barren Island (MPA, 2002d). The waters around Barren Island also contain monitoring stations that provide biotic and chemical data of the Chesapeake Bay.

The Barren Island archipelago is a Federal wildlife refuge regulated by the USFWS. All other access to Barren Island is restricted.

3.3.2 Demographics

The land areas surrounding James and Barren Islands, and Dorchester County as a whole, have a low population density and are relatively rural. In 2000, approximately 30,674 individuals resided in Dorchester County in contrast to 5,296,486 in the State of Maryland (UMCES, 2004b). Dorchester County is anticipated to include approximately 31,600 individuals in 2010 and 32,150 individuals in 2020 (UMCES, 2004b). The Dorchester County's general demographics are relatively consistent with those of the State of Maryland. Male (47.3%) and female (52.7%) populations are consistent with that of the rest of Maryland. White persons account for 69.4% of the population followed by African American (28.4%) and Hispanic (1.3%) persons. The population consists of a slightly elevated proportion of seniors, with 17.7% of persons aged 65 years or older compared to a state average of 11.3%. Residents are less mobile, with 64.6% of people living in the same house as five years ago compared to 55.7% for the state. A smaller proportion of Dorchester county residents hold Bachelor's degrees or higher degrees (12%), compared to Maryland's total population (31.4%), and the percent of high school graduates (74.2%) is also below the state average (83.8%) (UMCES, 2004b).

3.3.2.a James Island

Three County Subdivisions of Dorchester County are in the vicinity of James Island, including Taylors Island, Neck, and Madison. In 2000, approximately 270 individuals resided in Taylors Island, 934 individuals resided in Neck, and 557 individuals resided in Madison (Table 3-44). Cumulatively, the number of individuals residing in the three subdivisions amounts to 5.7% of the total Dorchester County population in 2000 (UMCES, 2004b). There are no permanent residents on James Island (MPA, 2003d).

3.3.2.b Barren Island

The Hoopers Island County Subdivision is in the vicinity of Barren Island. In 2000, approximately 587 individuals resided in the Hoopers Island subdivision, representing 1.9% of the total Dorchester County population (UMCES, 2004b). There are no permanent residents on Barren Island (MPA, 2002d).

3.3.3 Employment and Industry

The majority of employed individuals in Dorchester County (29%) hold jobs in the services sector (Table 3-45). Two other major sectors include manufacturing (19.6%) and wholesale and retail trade (15.5%). Employment statistics reveal that 587 individuals (4.1percent) in Dorchester County are employed in fishing, agriculture, mining, or forestry.

Section 3.1.6.f discusses select commercial fisheries landings in the vicinity of James and Barren Islands. Natural oyster bars are located in the vicinity of both James and Barren Islands. Crab pots, pound nets, soft clam beds and razor clam beds are in these waters as well. The soft-shell clam and razor clam beds in the vicinity of James Island and Barren Island are not commercial beds as defined by MDNR (UMCES, 2004b).

Striped bass, menhaden, and croaker provide the most value to the James and Barren Islands fisheries. In the areas surrounding James and Barren Islands, 114 striped bass permits have been issued to commercial fishermen (UMCES, 2004b). There are 3 pound nets that are actively set in the waters surrounding James Island and 23 in the waters surrounding Barren Island. Only 1 waterman (using 2 of the 3 pound nets around James Island) has reported a catch to the State of Maryland in the last 5 years. Pound net sites surrounding Barren Island appear to be more productive, 14 of the 17 watermen holding pound net licenses having reported catches in the last five years (UMCES, 2004b). The amount of commercial landings surrounding Barren Island is indicative of a productive fishery and is economically important to this region (UMCES, 2004b).

Crabbing is the most economically important fishery in the waters surrounding James and Barren Islands (UMCES, 2004b). Depending on the season, both deep and shallow water areas of water surrounding James and Barren Islands are actively crabbed. The amounts of crabs landed in the waters in this section of the Chesapeake Bay are indicative of a productive fishery (UMCES, 2004b).

3.3.4 Environmental Justice

On February 11, 1994, President Clinton issued Executive Order 12898, "Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations." This EO requires Federal agencies to identify and address any disproportionately high and adverse human health or environmental effects of its programs, policies, and activities on minority and low-income populations.

As defined by the "Environmental Justice: Guidance Under the NEPA" (Council of Environmental Quality, 1997), "minority" includes persons who identify themselves as Asian or Pacific Islander, Native American or Alaskan Native, black (not of Hispanic origin) or Hispanic. A minority population exists where the percentage of minorities in an affected area either exceeds 50% or is meaningfully greater than in the general population. Low-income populations are identified using the U.S. Census Bureau's statistical poverty threshold, which is based on income and family size. The U.S. Census Bureau defines a "poverty area" as a Census tract with 20% or more of its residents below the poverty threshold and an "extreme poverty area" as one with 40% or more below the poverty level (U.S. Census Bureau, 1995).

There are currently no environmental justice issues associated with the Mid-Chesapeake Bay Study.

3.3.5 Public Safety

Public safety provides protection of individuals' health and property. There are currently no existing conditions that result in public safety issues.

3.4 AESTHETIC CONDITIONS AND RECREATIONAL ACTIVITIES

The Mid-Chesapeake Bay region is a widely used recreational and aesthetic resource enjoyed by many different individuals (USACE, 1996). Aesthetic resources encompass the landscape character, or the visual setting of a project, while major recreational resources include activities partaken in for pleasure.

3.4.1 Aesthetics

The Mid-Chesapeake Bay region is considered to have a high aesthetic value. The landscape is characterized by low topographic relief, numerous areas of open water and extensive wetlands with tall grasses, shrubs or trees. This region of the Chesapeake Bay has a limited amount of shoreline development and has an open feel due to the abundance of open fields and long vistas. The few areas that are developed are dominated by one or two story buildings with minimal commercial and industrial areas. In general, islands help to diversify the landscape and add to the aesthetic appeal of the region. Historically, islands played a much larger role in the natural setting of the Chesapeake Bay, but erosional forces have greatly reduced the land area of most islands throughout the Chesapeake Bay region (USACE, 1996). The current footprints of James and Barren Islands represent only a portion of their extents in the mid-1800s (UMCES, 2004b).

3.4.2 Recreation

The Chesapeake Bay's open waters, tidal rivers, shorelines, parks, wildlife refuges, and a rapidly developing system of land and water trails provide excellent opportunities for public use, enjoyment, education, and scientific study with ecotourism becoming very popular in the Chesapeake Bay Region. The traditional uses of the Chesapeake Bay's waters by area residents have attracted visitors from along the east coast of the United States for recreation. Typical recreational activities in the Chesapeake Bay area include fishing, fly-fishing, oystering, crabbing (blue crabs), boating, bike riding, hiking, arboretum and museum tours, sightseeing, wildlife viewing, swimming, hunting, picnicking, and bird watching, as well as enjoying the scenic beauty of the Chesapeake Bay, beaches, and the islands. In recent decades, Chesapeake Bay-related recreation has become a socioeconomic force in the region. Wildlife Refuges such as the Blackwater NWR also draw many visitors to the area (UMCES, 2004b).

3.4.2.a Recreational Boating and Fishing

Based on an aerial survey of recreational boat usage in the Chesapeake Bay, the waters around James and Barren Islands have relatively high usage by both motor and sailboats compared to other Mid-Chesapeake Bay Islands (UMCES 2004b). The aerial survey was conducted in the Maryland portion of the Chesapeake Bay during June through October 2000 and April through July 2001, and led by EA Engineering. A total of 211 boats were observed within a ½ mile of James Island in 25 observations. Of those boats, 103 were stationary motorboats, which were assumed to be fishing boats. Near Barren Island, 246 boats were observed within a ½ mile in 23 observations. Of those boats, 99 were likely fishing boats. When compared to other Mid-Chesapeake Bay islands (from Lower Eastern Neck to Holland Island), Barren Island had the highest number of average motorboats per observation at 10.7 boats per observation (Figure 3-26). This use rate was comparable to that of waters near Sharps Island, which had 10.5 boats per observation. The waters near James Island had the next highest average use rate of 8.4 boats per observation.

To supplement the aerial survey, a model was developed to estimate the potential number of local motorboats likely to use locations throughout the Chesapeake Bay (UMCES, 2004b). The model allocated boat usage to location based on marina locations and number, size and type of registered motorboats by county. The model showed that a significant number of recreational motorboats have easy access to waters within ½ mile of James or Barren Island, although the estimates were lower than those for Mid-Chesapeake Bay islands closer to more populated areas. The total number of registered motorboats was estimated to be about 700 in the James Island vicinity and about 950 for the Barren Island vicinity. In each case, these values are less than 1% of the state total of registered motorboats.

A comparison of the model and aerial survey results suggests that despite the fact that James and Barren Islands are not convenient to large numbers of boaters, they nonetheless enjoy high use rates for this segment of the Chesapeake Bay. When compared to the entire Chesapeake Bay however, these use levels are much lower than those for islands in the densely populated areas of the upper Chesapeake Bay, according to both the aerial survey and model results.

To estimate the number of annual motorboat user days and annual recreational fishing days near each island, model estimates of motorboats with access were combined with other data. Use rates for different types and sizes of boats suggest that the annual number of recreational motorboat user days would be about 20,000 in the vicinity of James Island and about 25,000 in the vicinity of Barren Island. To determine how many of these trips were primarily for fishing, a survey of recreational boat owners was used. That survey demonstrated that 30 to 60% of motorboat outings were primarily for fishing, depending on whether the boat was in-water or trailered (Lipton, 2004). Using these results, annual recreational fishing days were estimated to be about 8,000 days in the vicinity of the James Island and about 11,000 days in the vicinity of Barren Island.

Anecdotal evidence suggests the waters near James Island are popular with recreational fishermen. According to Marty Gary (MDNR), the recreational fishing area around James Island is valued for its firm substrate and rock piles, which serve to attract fish to the area (Gary, personal communication, 2003). The recreational fishermen around James Island are primarily interested in croaker, striped bass and bluefish, and most of the fishing occurs in areas greater than 15 feet in depth. Mr. Gary noted that the overall usage rate is quite high, especially during the peak of croaker season (mid July to the first week of August). Several hundred boats will typically be in the vicinity of the site during that time period. Recreational fishing at Barren Island is thought to be somewhat lower than James Island, but still significant judging by aerial surveys (Wainger, 2003).

3.4.2.b Hunting

Deer (whitetail and sika) and waterfowl are the main species of interest to Maryland hunters. Areas around the islands have the potential to support active waterfowl hunting, although at Barren Island hunting is not allowed (UMCES, 2004b). James Island is privately owned and accessed for hunting (MES et al., 2002). During the 2001 site investigation, two duck blinds in good repair were observed on or near James Island (MES et al., 2002).

3.4.2.c Wildlife Viewing

Wildlife viewing is a popular activity in Maryland and over 1,500,000 people participated in all wildlife viewing activities in 2001 (UMCES, 2004b). Among the most popular wildlife viewing activities was waterfowl bird watching (USFWS, 2001). These survey results indicate that both residents and non-residents of Dorchester County are likely to engage in wildlife viewing around James and Barren Islands, either as the main purpose of their trip or as part of other activities (UMCES, 2004b).

3.4.2.d Educational Uses

Barren Island, which is owned by USFWS, is available for use by researchers, and a current restoration program has attracted a variety of school groups and volunteers to the island who are interested in assisting and learning about wetland restoration. Unlike Barren Island, James Island is privately owned, and is unlikely to serve any prominent educational uses (UMCES, 2004b).

3.5 MOST PROBABLE FUTURE WITHOUT-PROJECT CONDITIONS

The “without-project” condition is defined as the condition most likely to prevail during the future planning period in the absence of the Federal government implementing a plan of improvement. While the future planning period for the Federal and State DMMP encompassed a 20-year time period for the purpose of addressing the dredged material placement needs, this report considers the future without-project conditions in the Mid-Chesapeake Bay area over a 50-year period of analysis. It will provide the baseline condition to evaluate the impacts associated with alternative beneficial use and ecosystem restoration improvements under the study authorities discussed previously.

The most probable “without project” condition related to dredged material placement assumes that the restrictions on raising the dikes at Hart-Miller Island and open water disposal at Pooles Island and Deep Trough will continue. The Poplar Island expansion project has been authorized. It is expected that regular maintenance dredging of the Baltimore Harbor approach channels and approach channels to the C&D Canal would continue as it has in the past, and that maintenance operations in the Honga River would continue sporadically. While the Poplar Island expansion project will extend the life of the existing PIERP, the expansion project will not accommodate the dredged material shortfall projected by the DMMP. Further placement sites will need to be identified and online by 2016 in order to accommodate a 57-million cubic yard shortfall in dredged material placement capacity for C&D Canal approach channels and Chesapeake Bay approach channel maintenance, as discussed in Section 2 (USACE, 2005). Under the circumstance that the proposed project does not proceed, the DMMP will need to be revisited. Other strategies will need to be devised to handle the shortfall in dredged material placement capacity. Under a worse case scenario, if no other alternatives are developed, ocean dumping could be used to dispose of the sediments. However, the cost of this practice is very high and is not Federally cost-shared. Currently, dredged material placement at Barren Island is limited to sporadic maintenance operations in the Honga River. While the use of dredged material from the Honga River would allow for some protection of the northern remnant of the island, it would not provide enough material in time to provide the necessary protection to ensure the southern remnants and SAV beds would still be present and viable within the planning horizon.

The most probable "without project" condition of the mid-Chesapeake Bay Islands is the continued erosion and eventual disappearance many of the 105 Chesapeake Bay islands considered for restoration. Land subsidence, rising sea level, and wave action are causing valuable island habitats to be lost due to erosion throughout the Chesapeake Bay more quickly than they are being created. In the last 150 years, it has been estimated that 10,500 ac have been lost in the mid-eastern portion of the Chesapeake Bay alone (USACE, 2004a). Roughly 12,000 ac of remote island habitat remain, all of which is endangered of being lost. Section 3.1.1 has documented the continuing erosion of James Island and the portions of Barren Island that have not been protected with geotextile tubes. For James Island, annual erosion rates are estimated at 4.9 acres per year, and the island is projected to disappear by the year 2021. For Barren Island, erosion rates are estimated at 4.1 acres per year, leading to a loss of 82 acres of existing island habitat, and loss of the SAV habitat protected by the southern remnant that is currently underwater.

The most probable "without project condition" would lead to the eventual loss or degradation of natural resources that are associated with the 105 islands including wetlands, sand beaches, upland nesting areas, shallow water habitat, and intertidal mudflats. These habitats are critically important to the health and diversity of the Chesapeake Bay. Specifically, at James and Barren Islands, terrestrial surveys document animal utilization of the wetland, forested, beach, and shallow waters surrounding the islands. The bird surveys documented utilization of all habitats on the islands by either resident, wintering, nesting, and migrating birds including passerines, waterfowl, shorebirds, and birds of prey. Several rare, threatened, and endangered species have been documented using James Island (18 species) and Barren Island (23 species). Horseshoe crabs and diamondback terrapins were observed nesting on the uneroded beaches of both islands. SAV beds would likely suffer adverse impacts without the shelter provided by the shorelines of the islands. SAV beds in the vicinity of James Island and Barren Island are considered to be HAPC for summer flounder and red drum, and tend to be located in the shallow waters to the east of James Island and Barren Island, which are sheltered from wind and waves by the islands' shorelines.

Island structures also inhibit the erosion of mainland shorelines by providing shelter from wind and wave forces. Specifically, modeling results at Barren Island show that the existing island provides the populated Hooper's Island shoreline to the east some protection from wind and waves. If Barren Island is not present to provide shoreline protection, Hoopers Island will continue to be exposed to additional erosive forces.

SECTION 3

FIGURES

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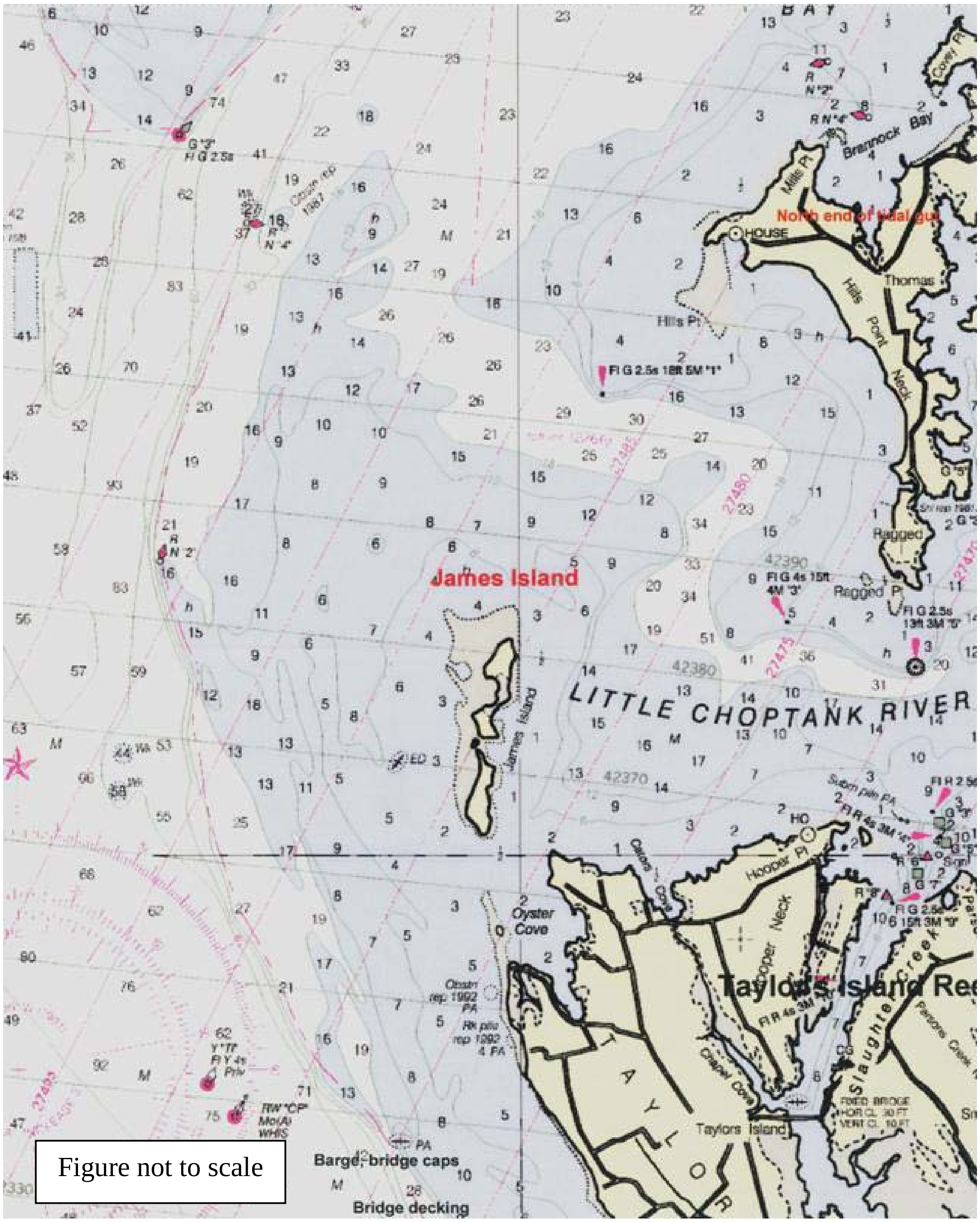

Figure 3-1: James Island Location Map and Bathymetry

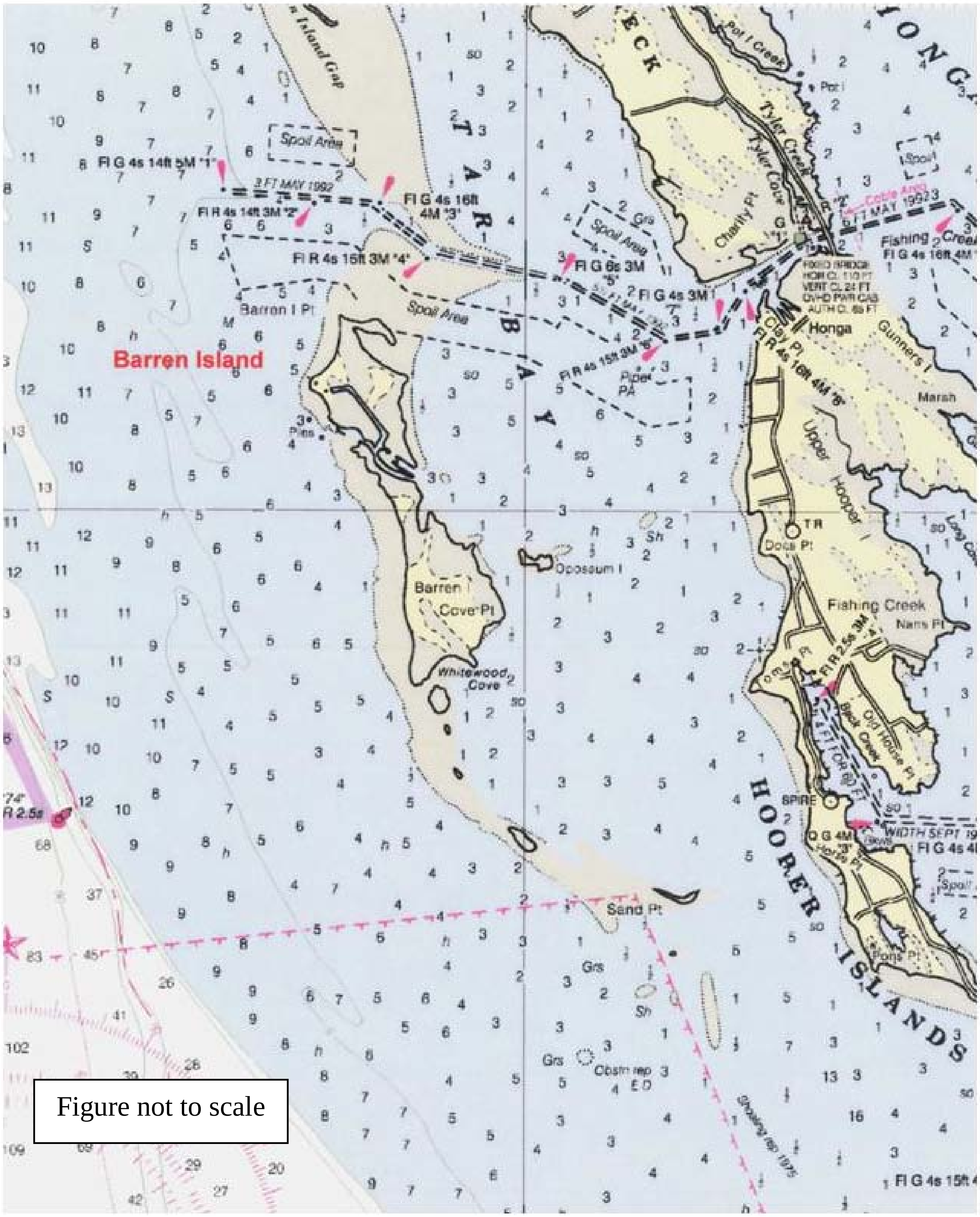

Figure 3-2: Barren Island Location Map and Bathymetry

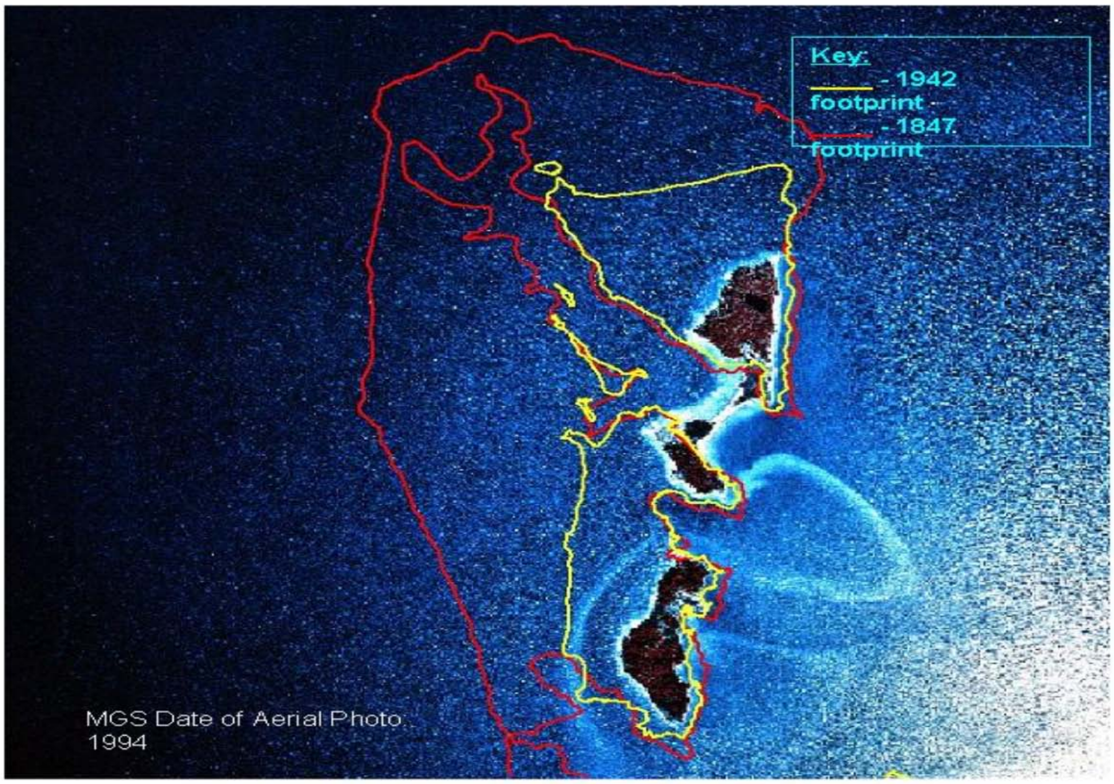

Figure not to scale

Figure 3-3: Historic Footprints of James Island (1847-1994)

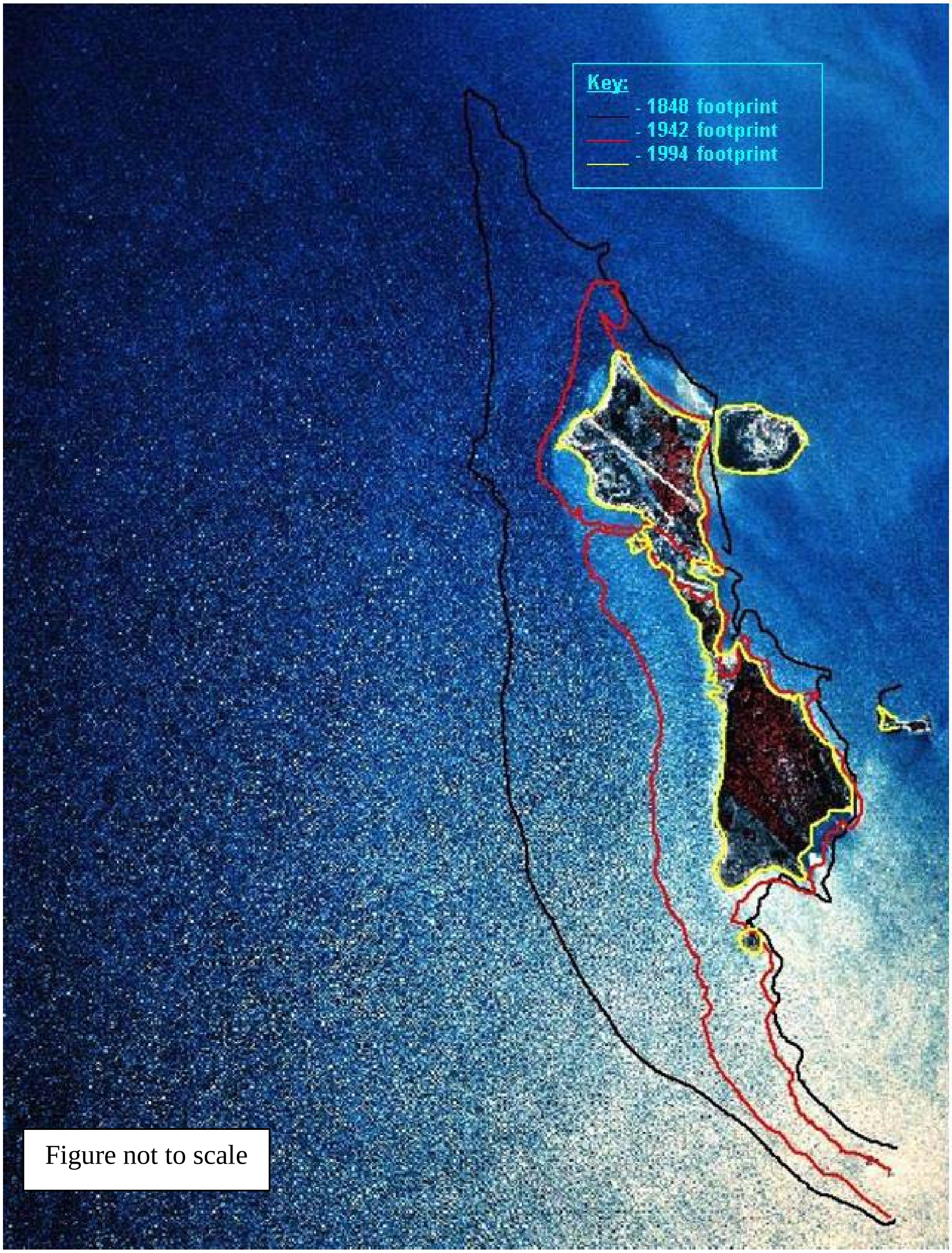

Figure 3-4: Historic Footprints of Barren Island (1848-1994)

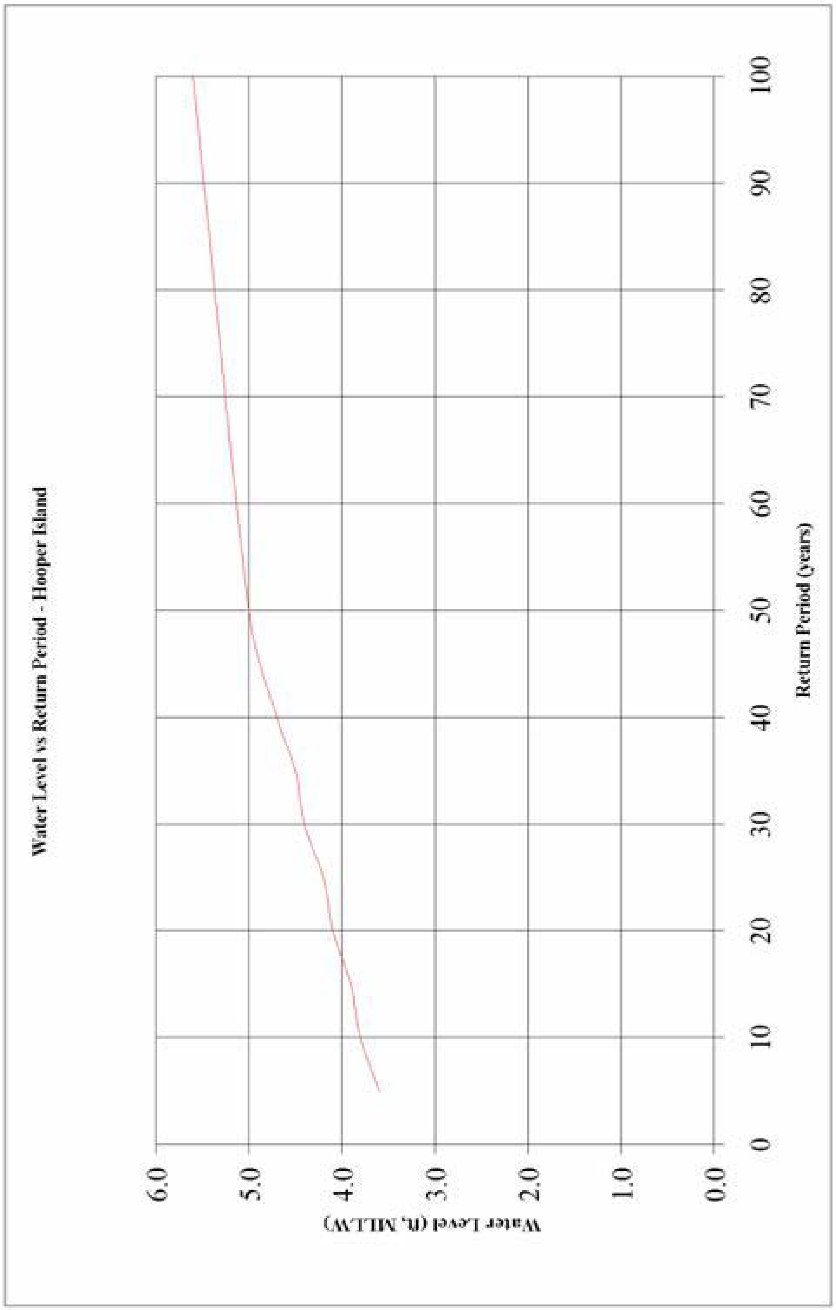

Figure 3-5: Design Water Levels (ft, MLLW) for Hoopers Island, the Station Most Representative for James Island (MNE, 2002a)

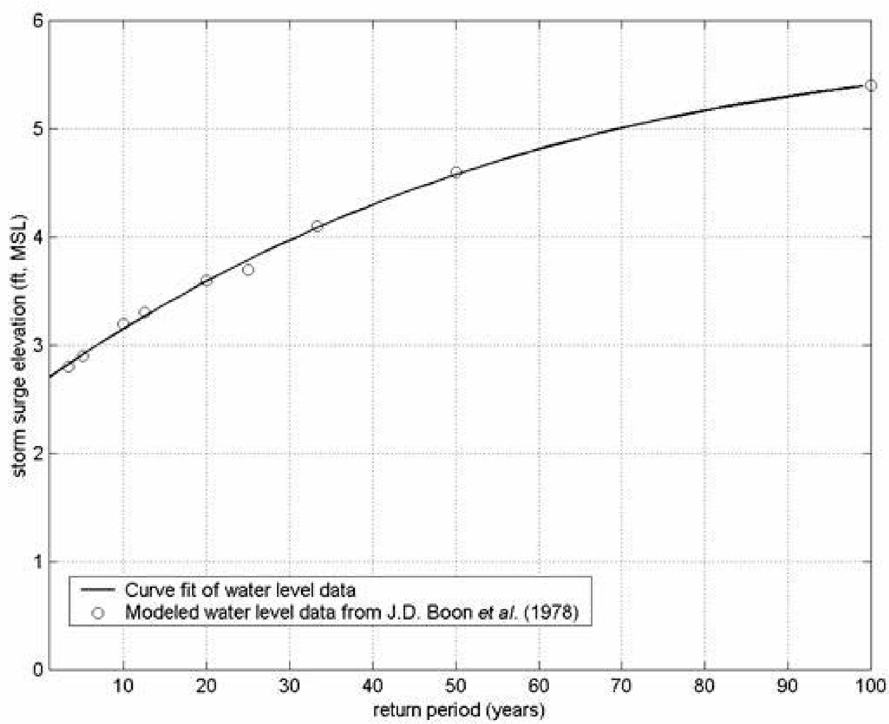

Figure 3-6: Modeled storm surge elevations versus return period at Solomons Island, the Station Most Representative for Barren Island.

*The curve fit provides surge elevations at return frequencies not modeled (ACRE, 2002)

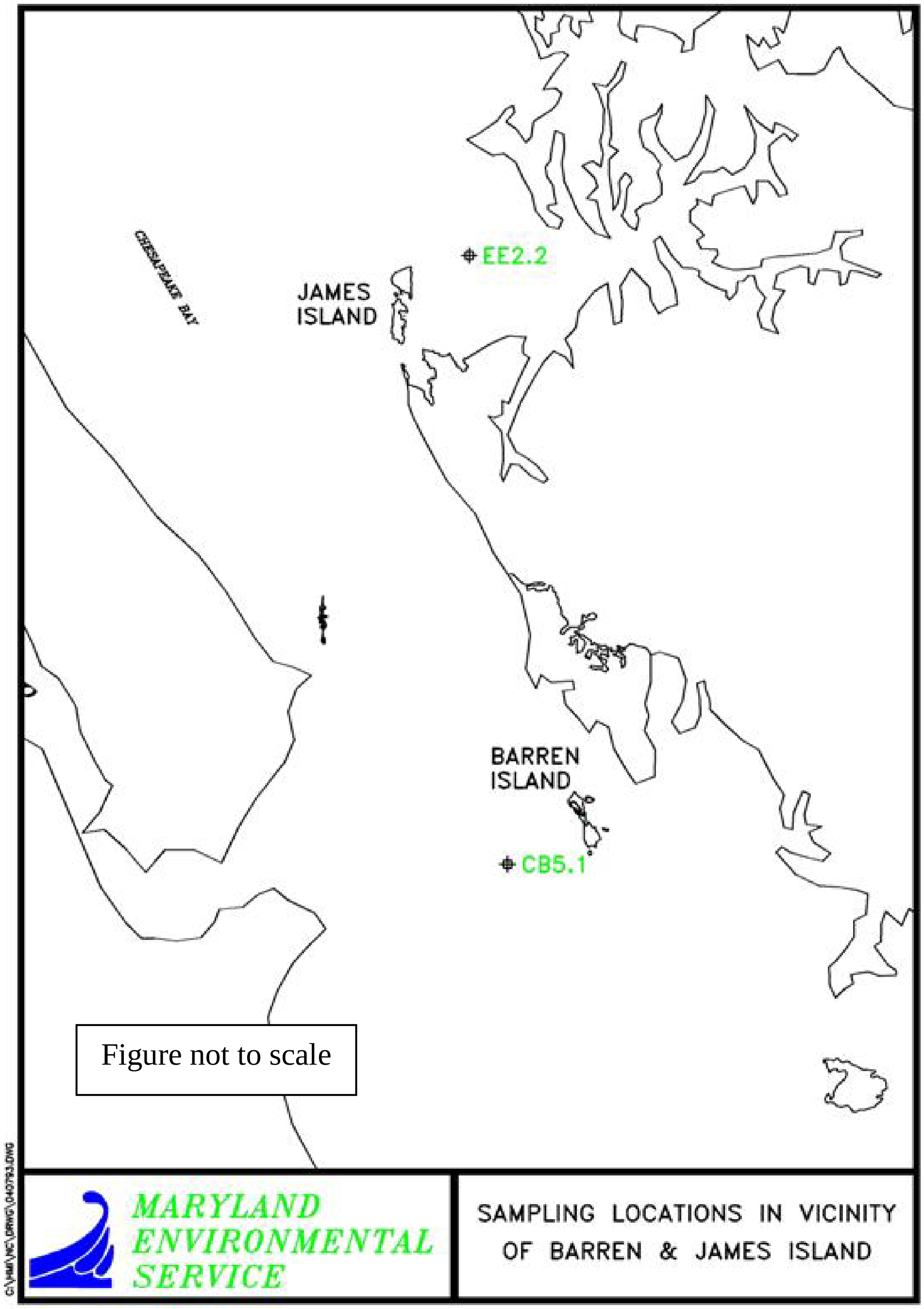

Figure 3-7: Water Quality Monitoring Stations at Barren and James Island

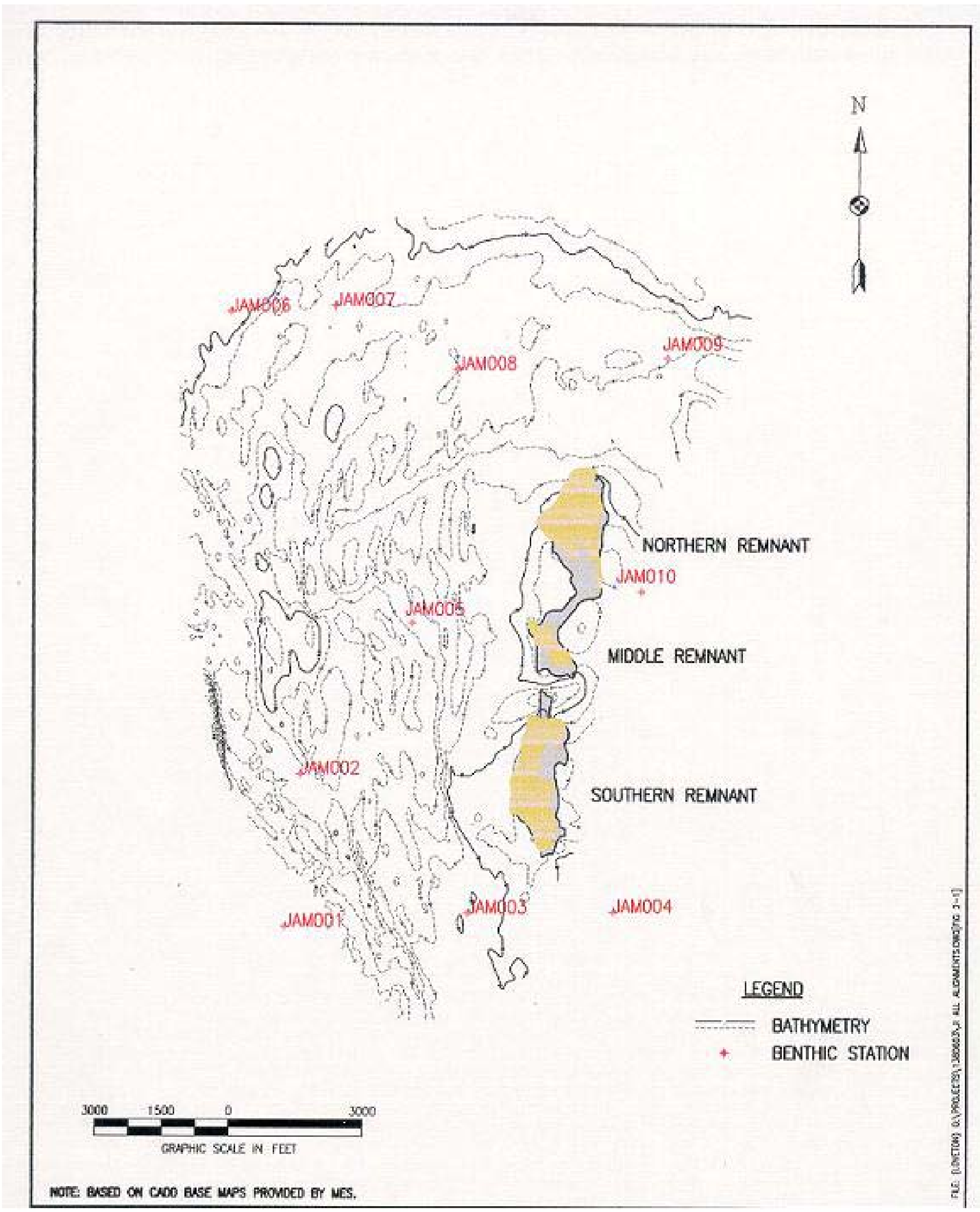

Figure 3-8: Benthic Sampling Stations at James Island

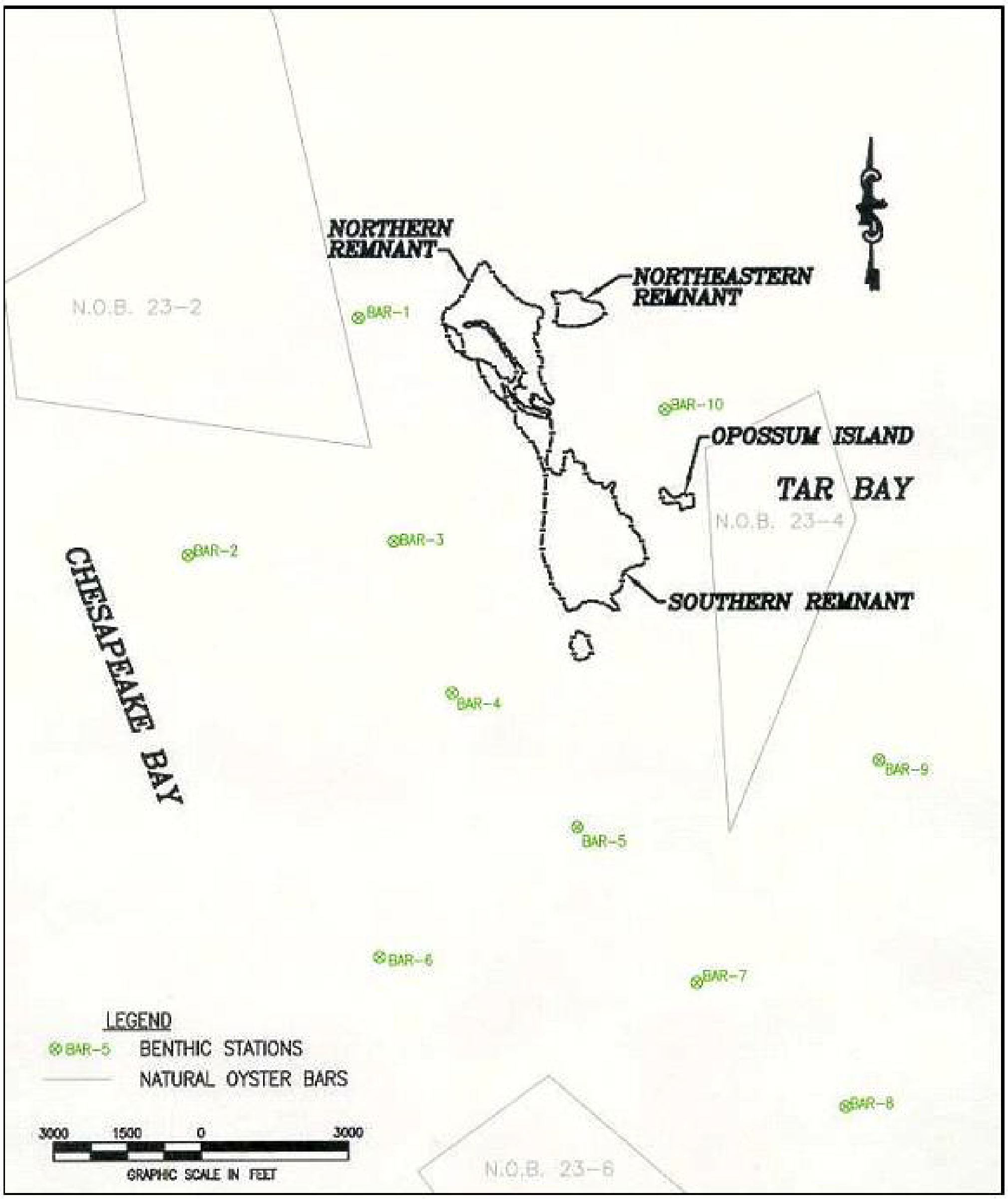

Figure 3-9: Benthic Sampling Stations at Barren Island (MPA, 2003f)

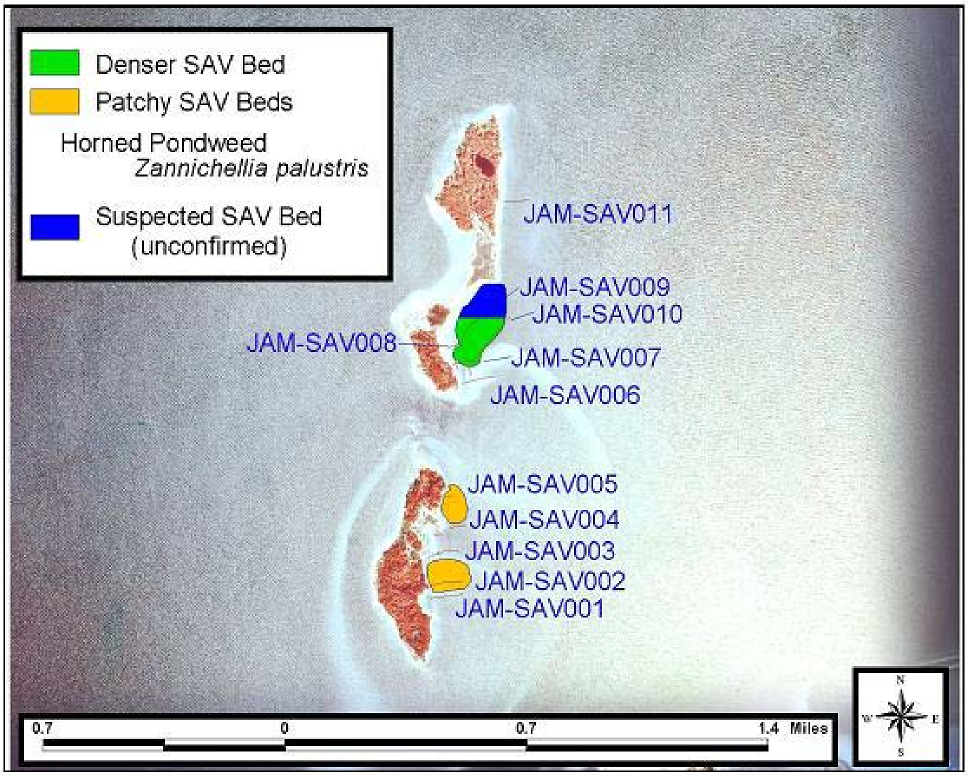

Figure 3-10: Extents of SAV, James Island, Spring (May) 2003 (MPA, 2004h)*

*Please note that JAM-SAV009 is an unconfirmed SAV bed because weather conditions prevented closer inspection of the SAV bed.

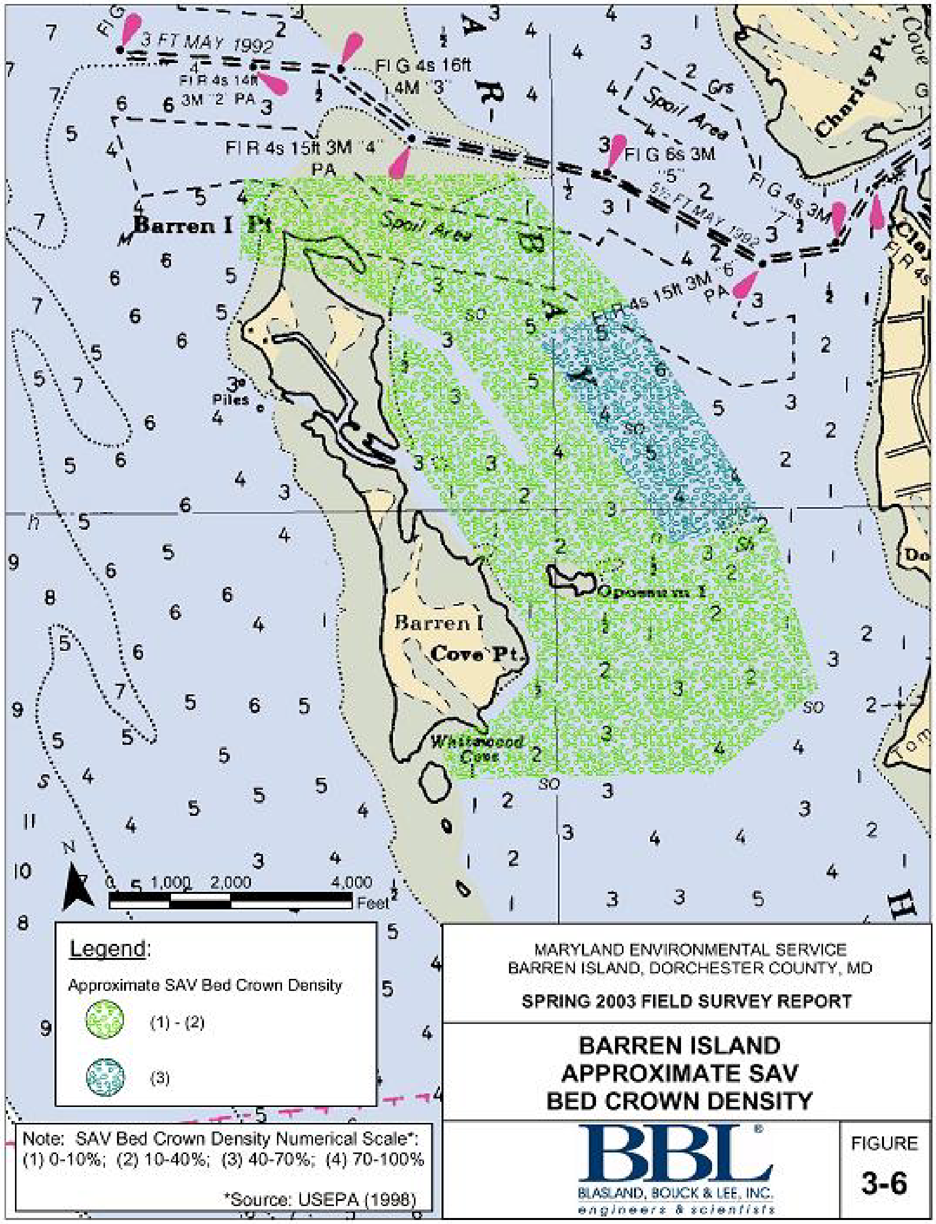

Figure 3-11: Barren Island Approximate SAV Bed Crown Density in Sample Area (MPA, 2004b)

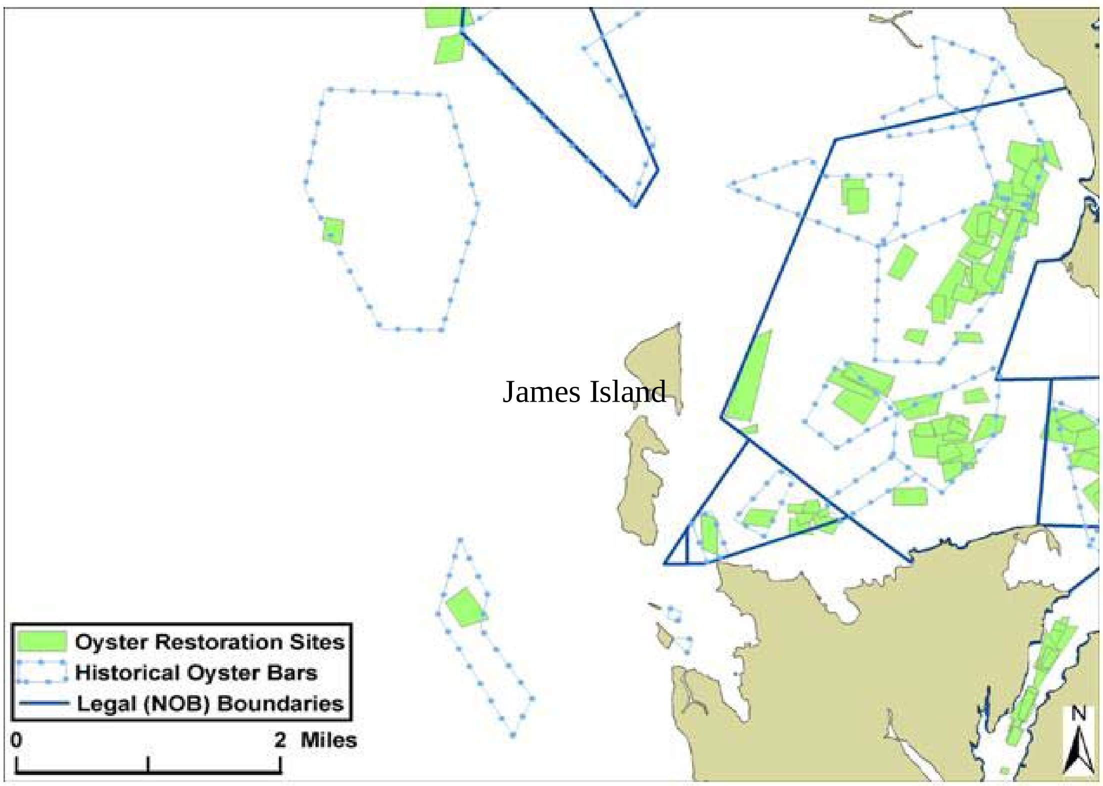

Figure 3-12: James Island (1:50,000): Oyster Bar Delineations
Date source: MDNR (MPA, 2003i)

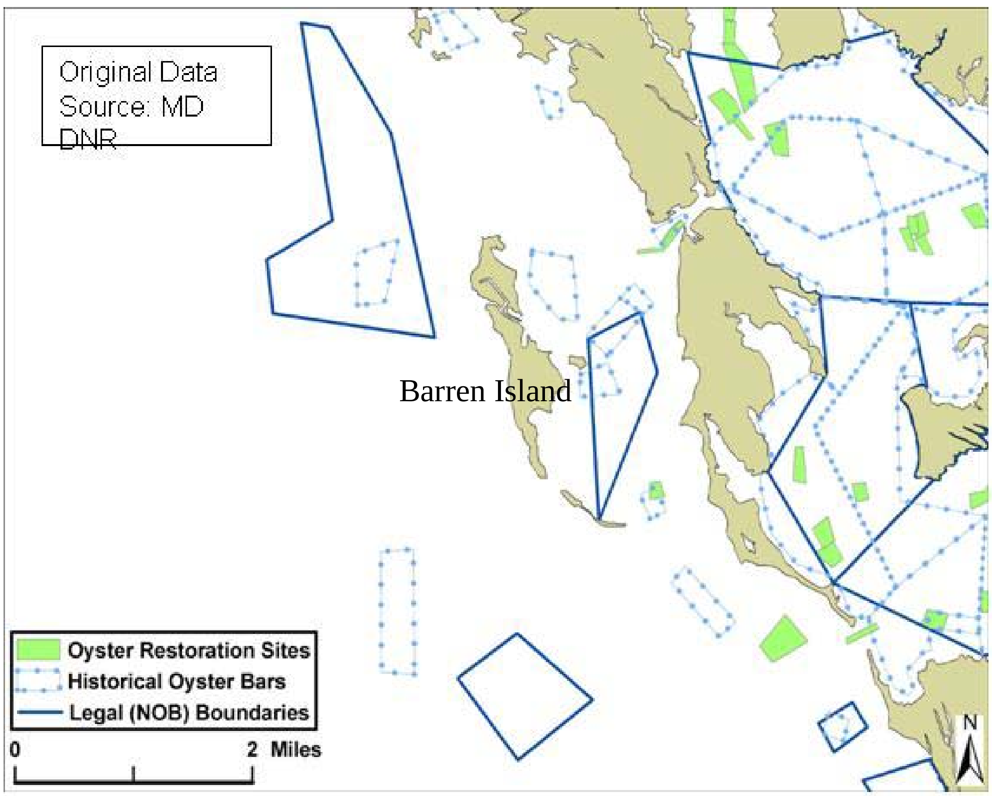

Figure 3-13: Barren Island (1:50,000): Oyster Bar Delineations (MPA, 2003i)

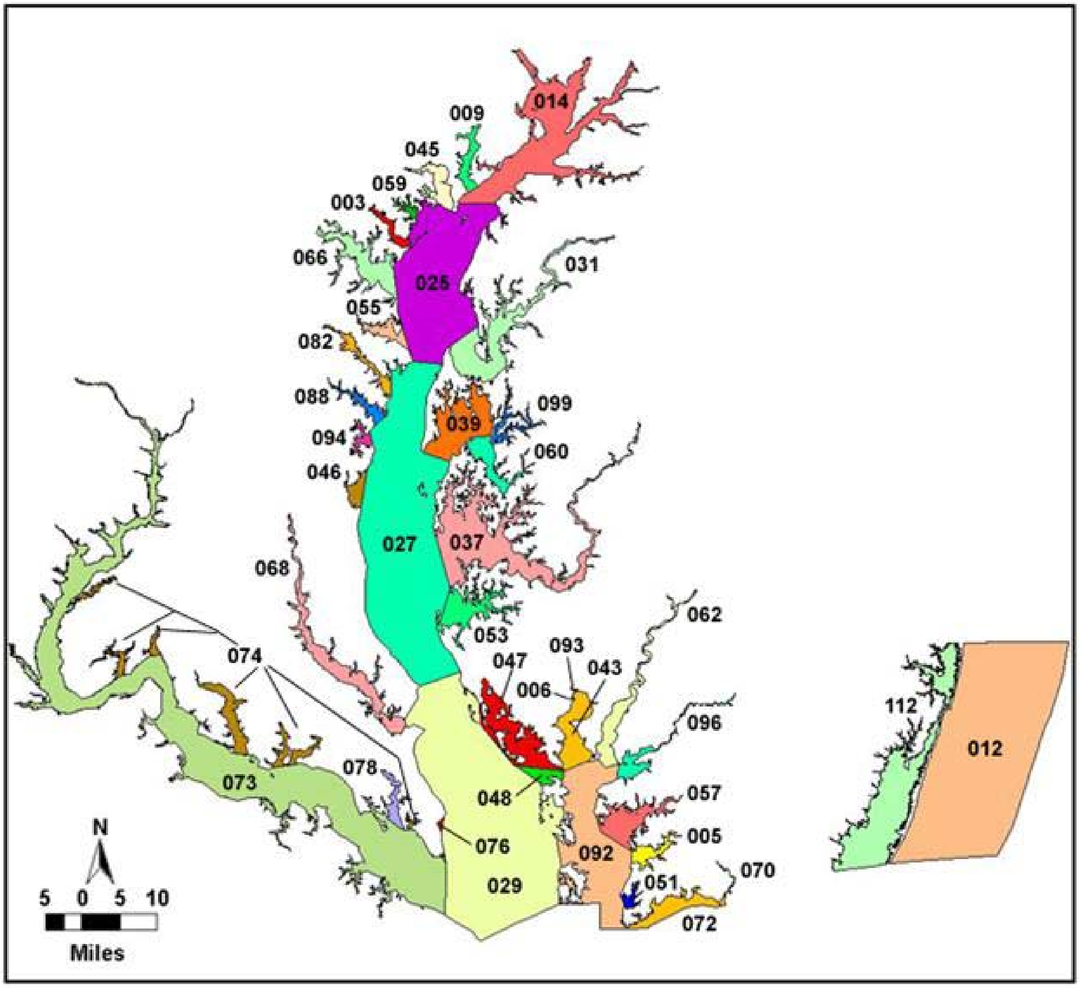

Figure 3-14: Chesapeake Bay Zones (Colors represent different zones) (MDNR, 2004c)

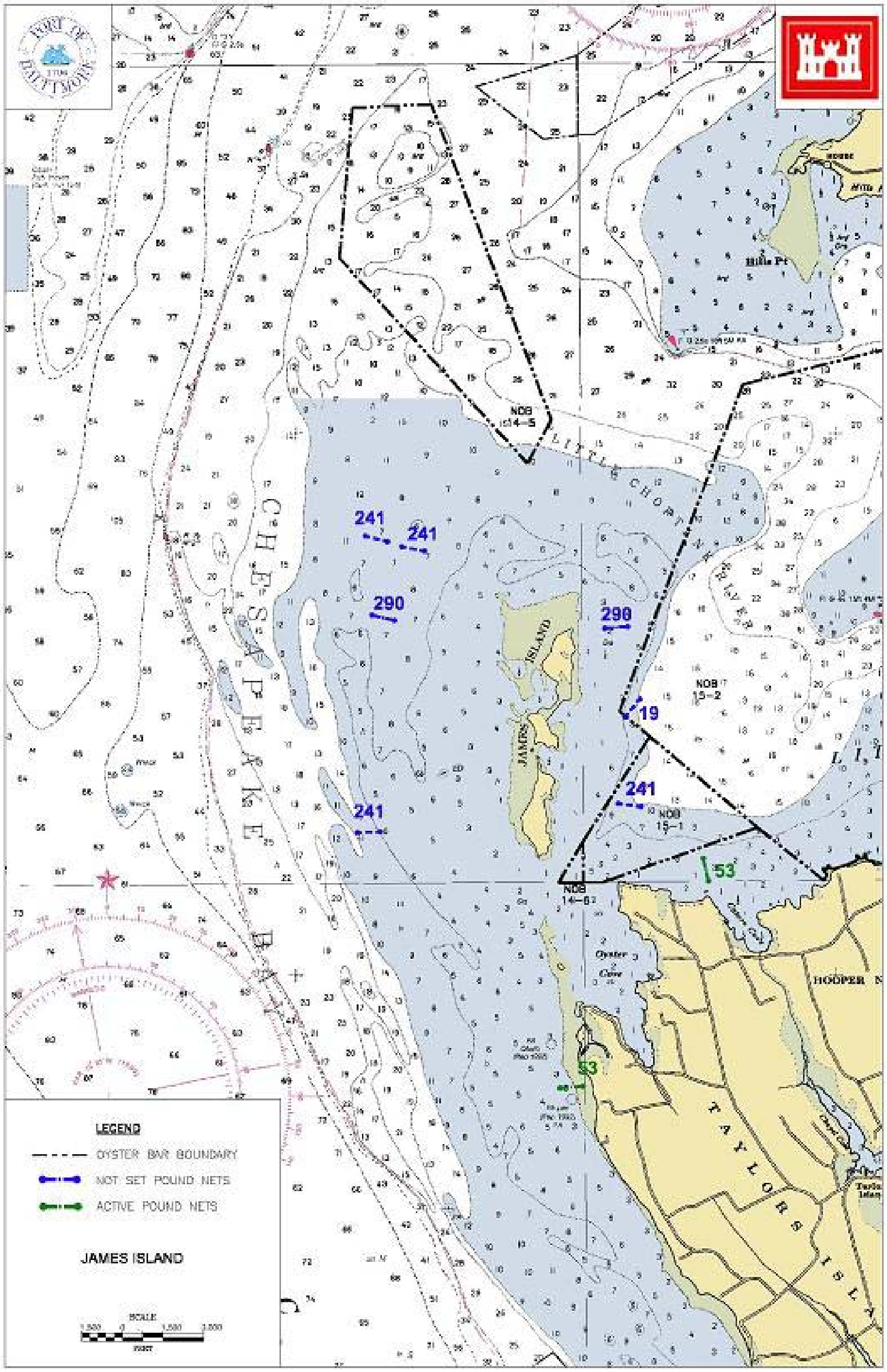

Figure 3-15: Pound Nets within the James Island Project Area in the last 5 years, March, 2004

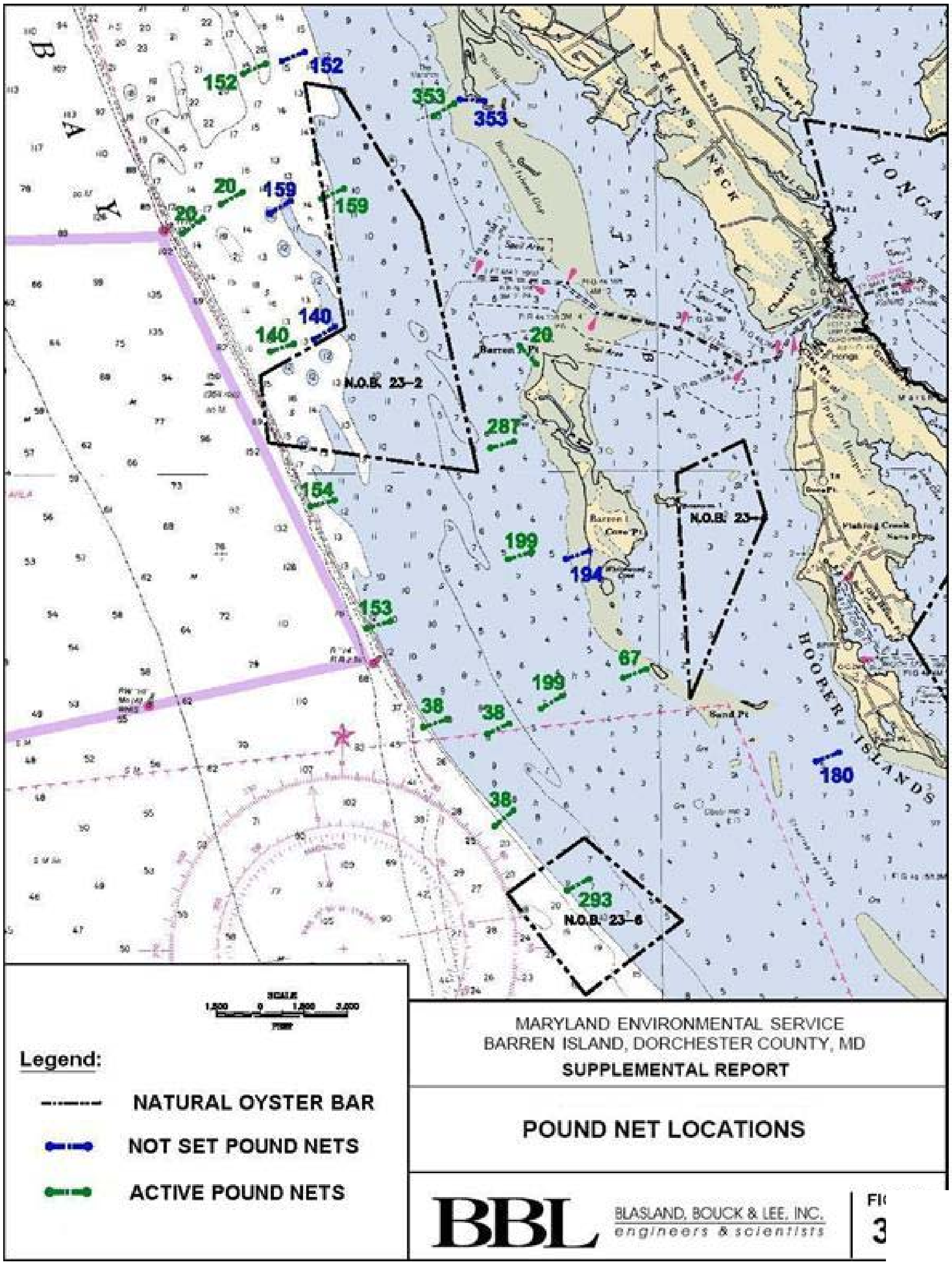

Figure 3-16: Pound Nets within the Barren Island Project Area

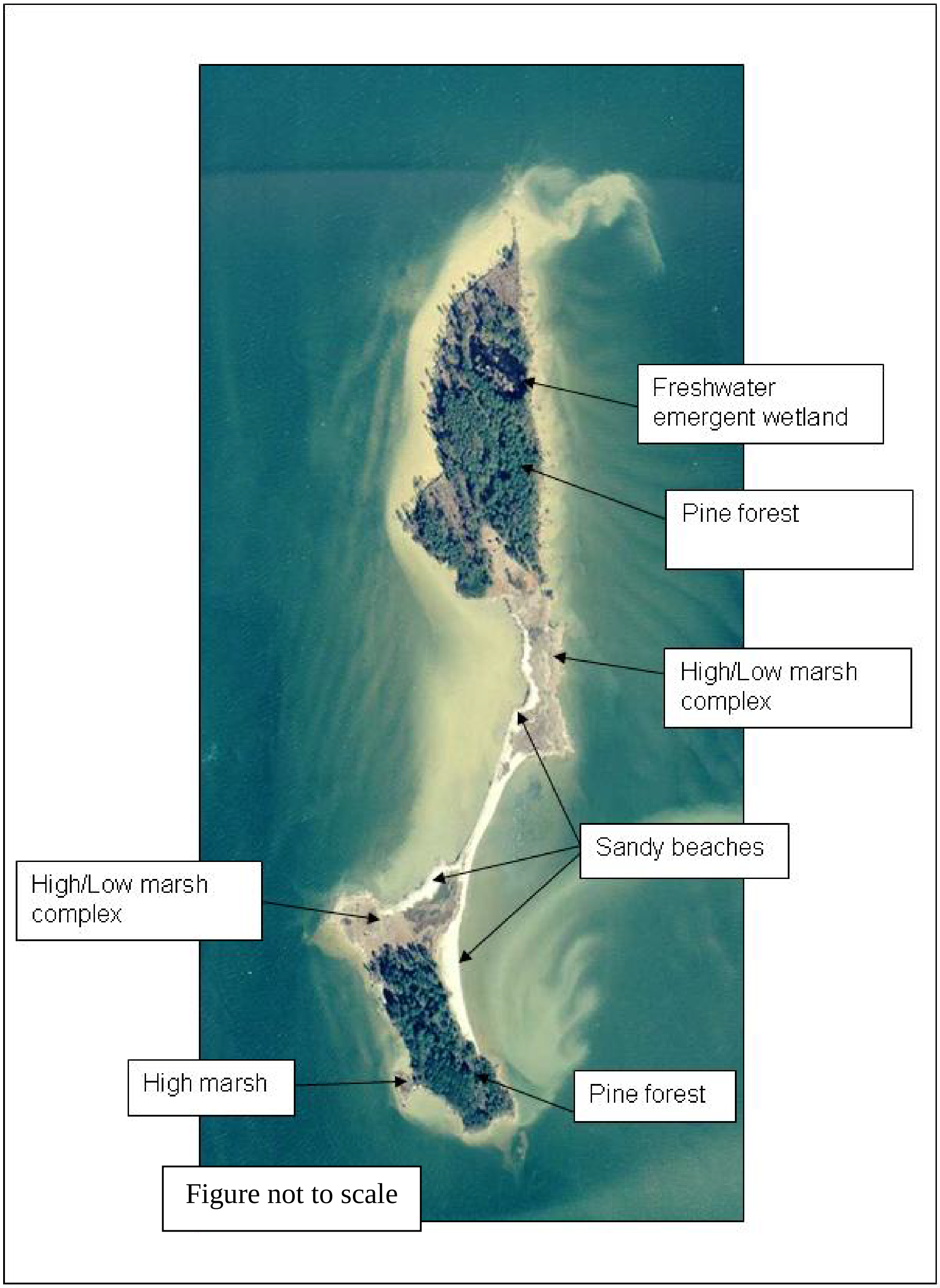

Figure 3-17: James Island Northern and Middle Remnant Habitat Types (MPA, 2004h)

Figure 3-18: James Island Southern Remnant Habitat Types (MPA, 2004h)

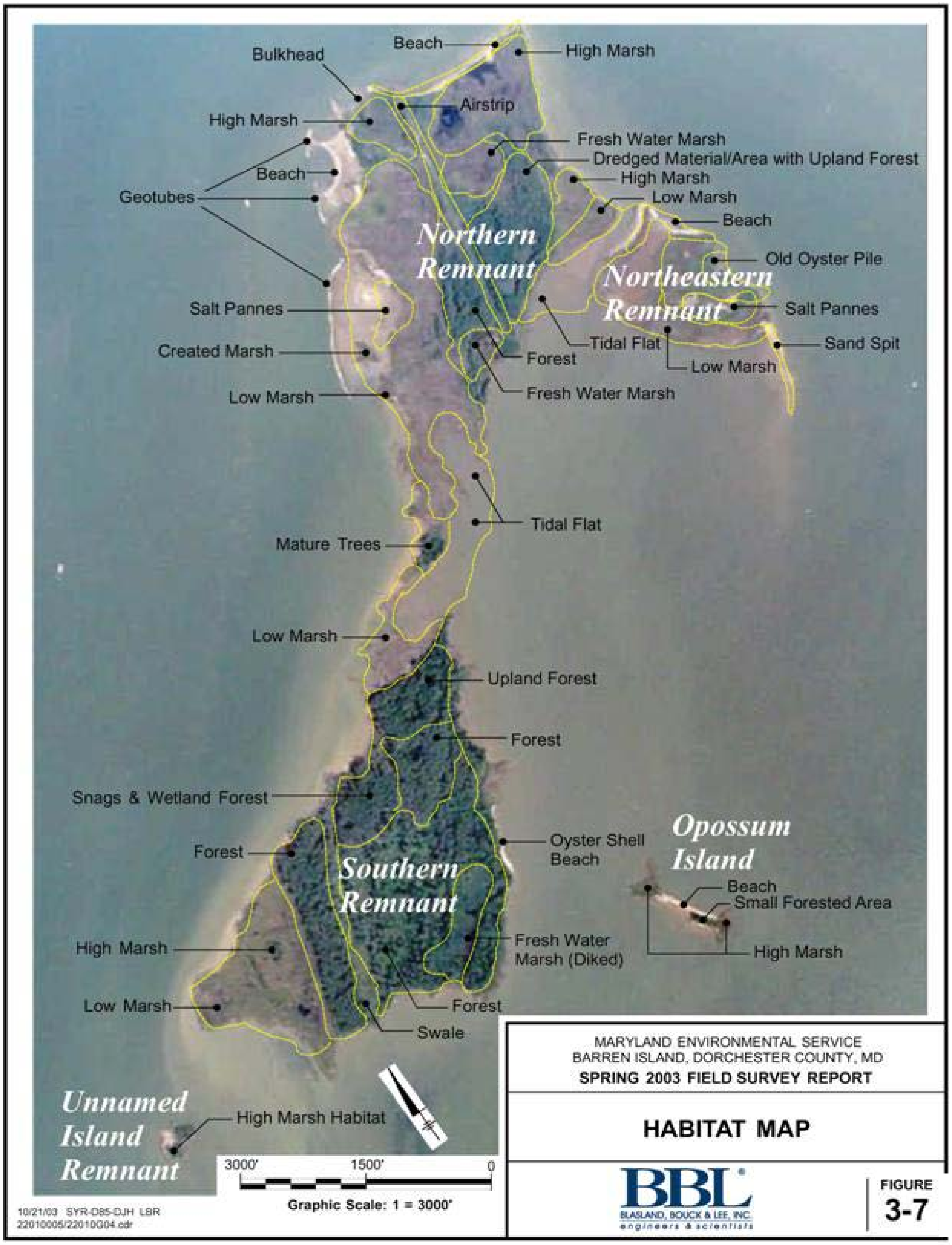

Figure 3-19: Habitat Types of Barren Island, Spring 2003

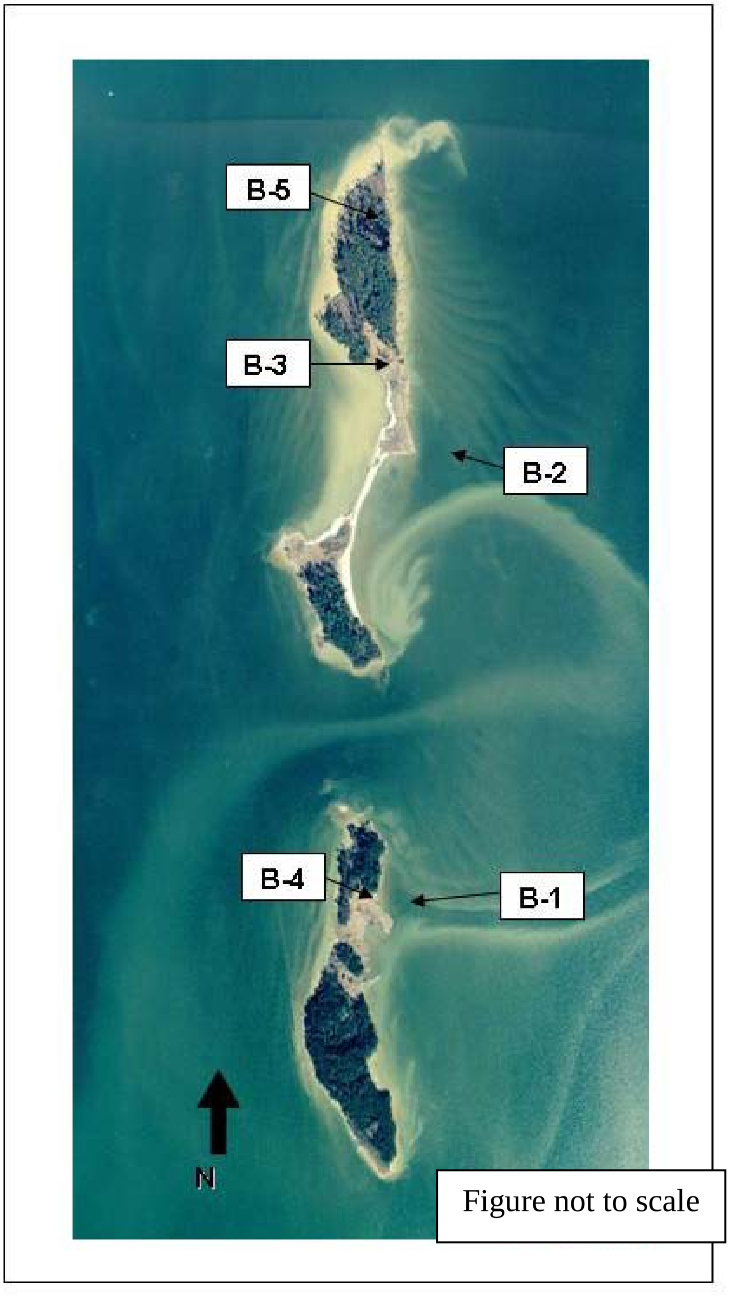

Figure 3-20: Avian Observation Stations on James Island (MPA, 2004g)

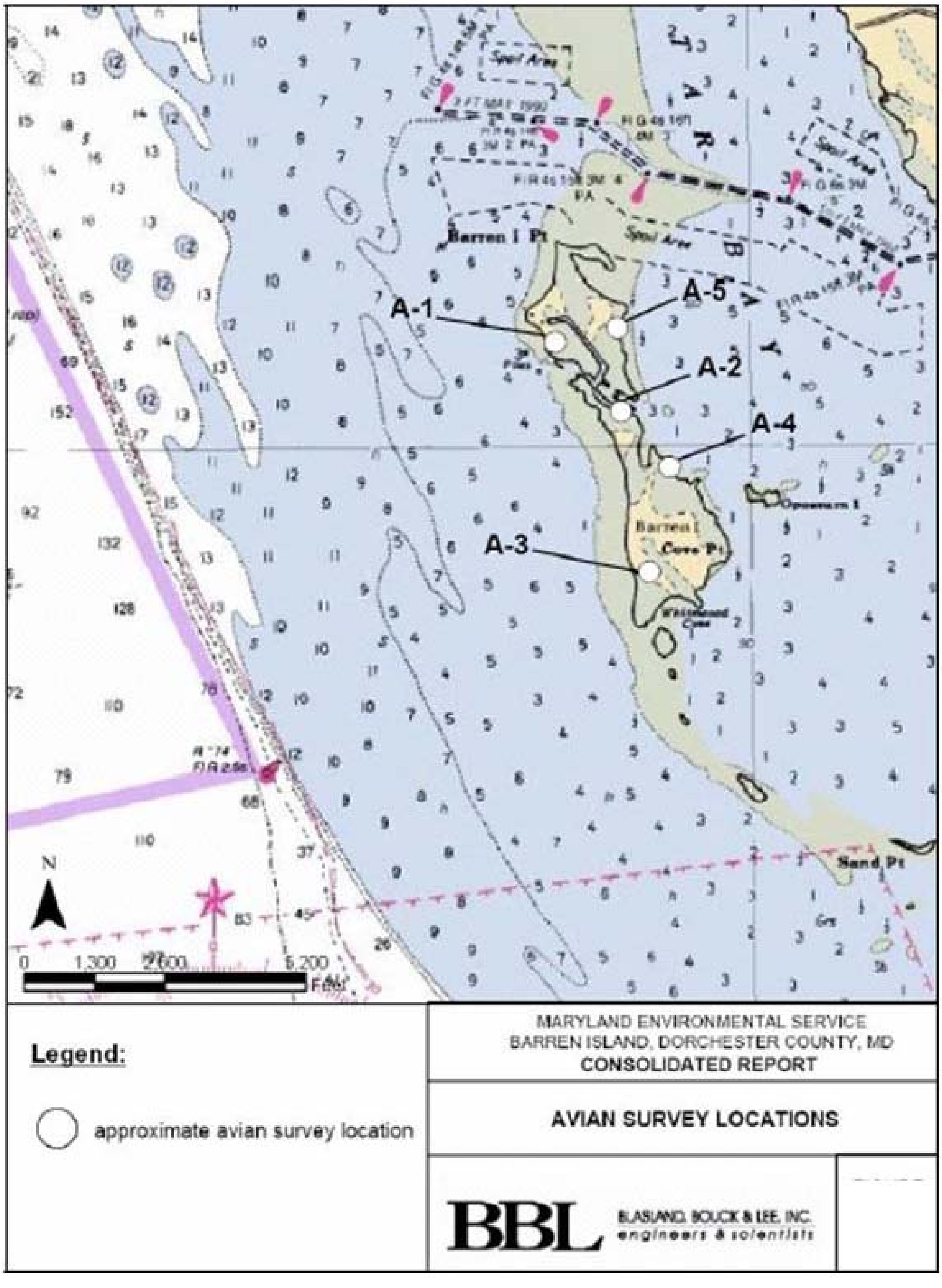

Figure 3-21: Barren Island Avian Sampling Stations (MPA, 2005a)

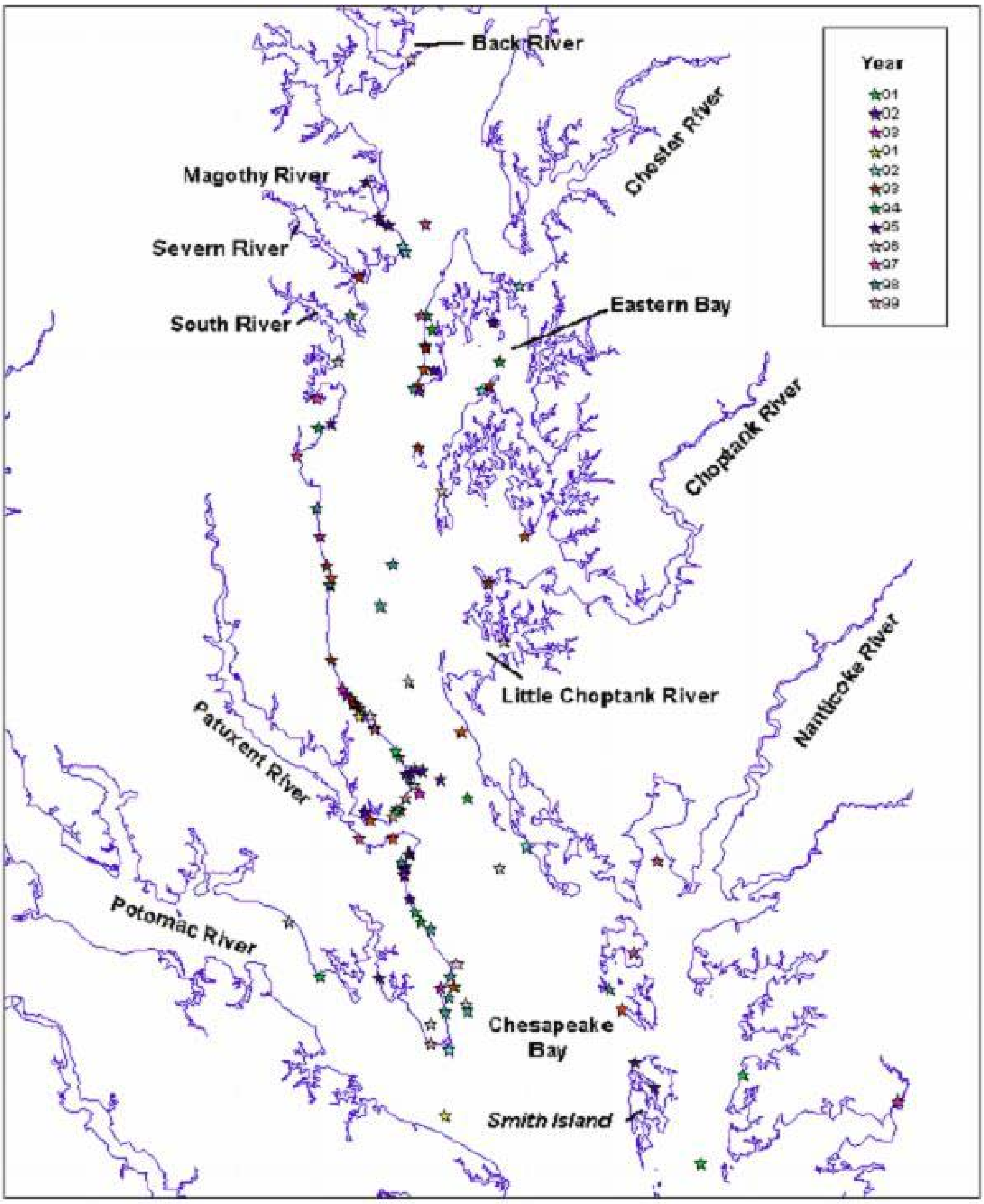

Figure 3-22: Locations of Sea Turtle Strandings in the Maryland Portion of the Chesapeake Bay, 1991 to 2003 (Kimmel, 2004)

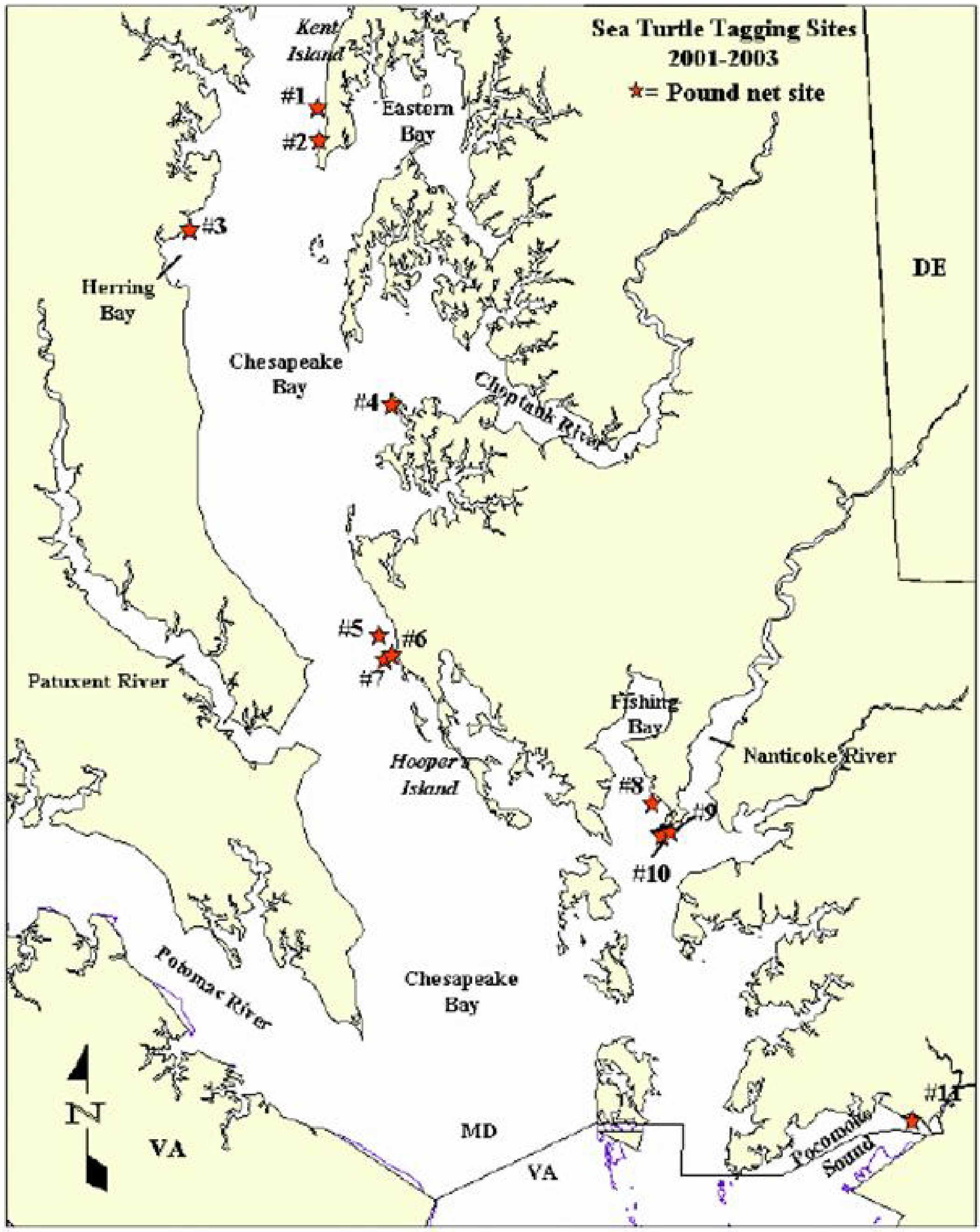

Figure 3-23: Pound Net Sites in the Chesapeake Bay in which Incidentally Captured Sea Turtles were Examined and Tagged, 2001-2003 (Kimmel, 2004)

Figure 3-24: Cultural Resources Map, James Island (MPA, 2003i)

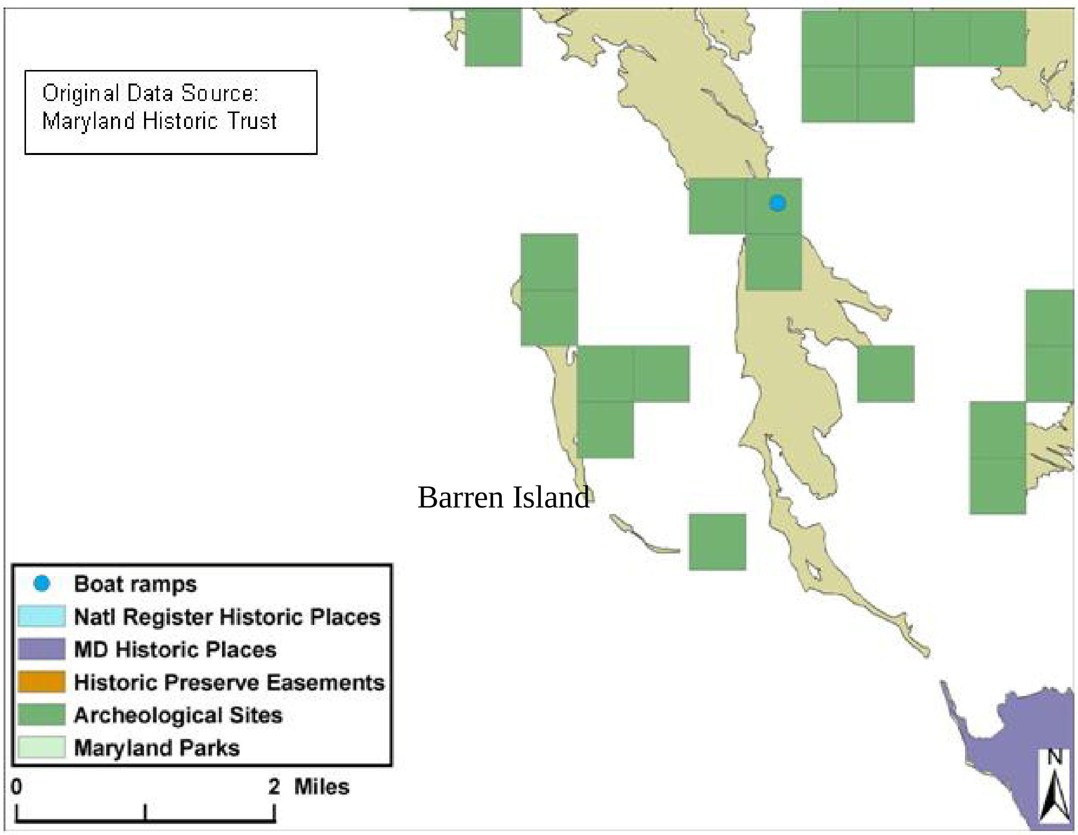

Figure 3-25: Cultural Resources Map, Barren Island (MPA, 2003i)

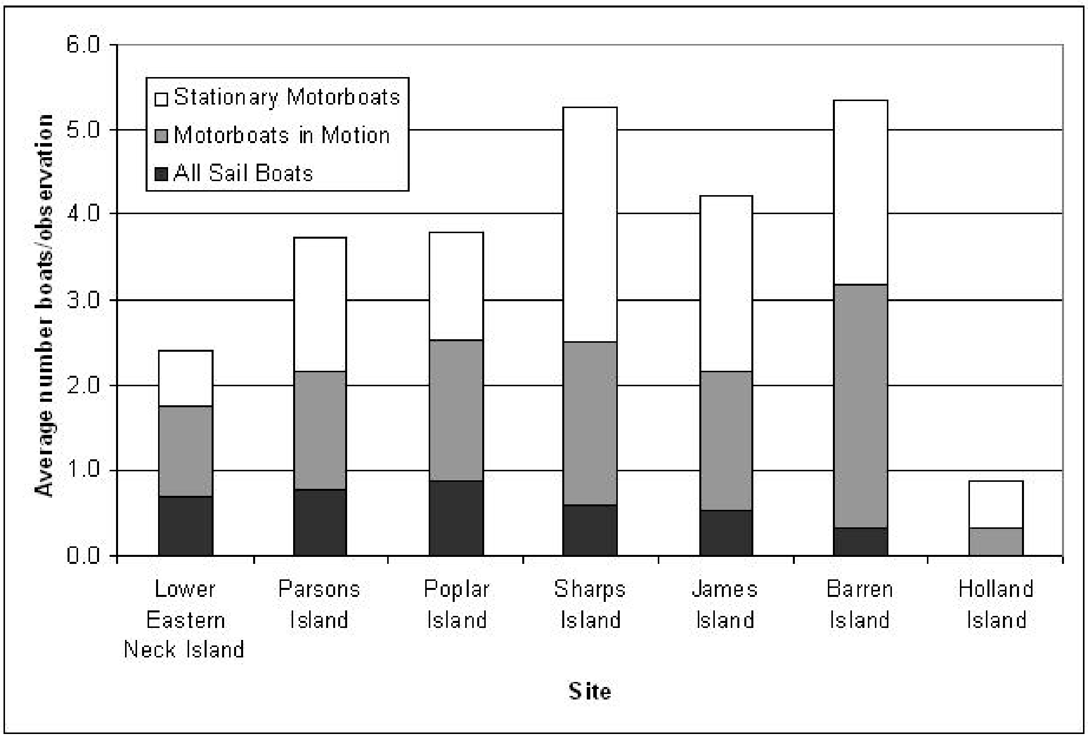

Figure 3-26: Comparison of Aerial Survey Data of Recreational Boat Usage within One-half Mile of Mid-Chesapeake Bay Islands.

SECTION 3

TABLES

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Table 3-1: Astronomical Tidal Datum Characteristics for James Island Vicinity (Hoopers Island) and Barren Island (ft, MLLW) (MNE, 2002a)

Tidal Datum	Cove Point	Sharps Island Light	Barren Island	Taylors Island/Slaughter Creek	Hoopers Island
Mean Higher High Water (MHHW)	1.8	1.8	2.0	1.8	2.3
Mean High Water (MHW)	1.6	1.6	1.8	1.5	1.9
Mean Tide Level (MTL)	0.9	0.9	1.0	0.9	1.1
Mean Low Water (MLW)	0.3	0.3	0.2	0.3	0.4
Mean Lower Low Water (MLLW)	0.0	0.0	0.0	0.0	0.0

*******For locations refer to the following: Cove Point (Figure 3-2), Sharps Island Light (Figure 1-1), Barren Island (Figure 1-1), Taylors Island/Slaughter Creek (Figure 3-15), Hoopers Island (Figure 3-2)

Table 3-2: Design Wind Speeds per Direction and Return Period (mph) for Fastest Mile Wind for James and Barren Islands (MNE, 2002a; ACRE 2002)

Return Period (Years)	Direction							
	N	NE	E	SE	S	SW	W	NW
5	40	37	32	37	36	47	50	54
10	48	44	38	45	43	56	54	59
15	52	48	41	50	47	61	56	62
20	56	52	45	55	51	67	59	65
25	59	55	47	58	54	70	60	67
30	62	57	49	61	56	73	61	68
35	64	60	51	63	58	76	62	70
40	66	62	53	65	60	78	63	71
50	69	66	55	69	63	82	64	73
100	81	76	65	82	74	97	69	81

Table 3-3: Radially-Averaged Fetch Distances and Mean Water Depths Used for Wave Hindcasting – James Island (MNE, 2002a)

Direction	Mean Fetch Distance (Miles)	Mean Water Depth (ft, MLLW)
North	26.9	34.2
Northeast	5.3	9.6
East	5.3	12.2
Southeast	2.4	3.7
South	29.5	43.1
Southwest	6.9	39.8
West	8.3	35.4
Northwest	8.0	28.5

Table 3-4: Radially Averaged Fetch Distance and Mean Water Depth Used for Wave Hindcasting- Barren Island (ACRE 2002)

Direction	**Mean Fetch Distance (Miles)**	**Mean Water Depth (ft, MLLW)**
North	2.8	3
Northeast	1.9	2.6
East	1.6	2.7
Southeast	8.5	5.5
South	55.3	40
Southwest	9.9	37.5
West	8.5	40.5
Northwest	18.6	43.2

Table 3-5: Calculated Averages & Ranges (In Parentheses) of Water Quality Variables for the Upper 14 ft at Maryland's CBWQM Station EE2.2 that Closely Coincide with Dates of the Quarterly Sampling at James Island (CBP, 2004f)

Season	Sample Year	Salinity (ppt)	Temp (°C)	DO (mg/L)	pH (su)	Secchi Depth (m)
Summer (June)	1999	13.7 (13.4 - 14.4)	24.5 (23.3 - 25.7)	6.3 (5.6 - 6.7)	7.9 (7.8 - 8.0)	1.9*
	2000	9.9 (9.9 - 9.9)	24.6 (24.5 - 24.6)	7.9 (7.7 - 8.0)	8.3 (8.3 - 8.3)	0.9*
	2001	12.7 (12.7 - 12.8)	23.9 (23.7 - 24.5)	7.6 (7.4 - 8.0)	8.0 (8.0 - 8.1)	1.0*
	2002	11.9 (11.8 - 11.9)	23.8 (23.5 - 24.2)	8.5 (8.4 - 8.6)	8.3 (8.2 - 8.3)	1.3*
	2003	10.3 (10.3 - 10.4)	21.7 (21.7 - 21.7)	6.6 (6.0 - 7.0)	8.1 (8.0 - 8.1)	0.8*
Fall (Oct/Nov)	1999	15.9 (15.8 - 16.0)	17.5 (15.4 - 19.6)	8.2 (7.5 - 9.4)	8.0 (7.9 - 8.1)	1.8 (1.3 - 2.3)
	2000	15.4 (14.2 - 16.6)	13.6 (12.7 - 14.4)	8.8 (8.6 - 8.9)	8.0 (7.9 - 8.0)	1.6 (1.0 - 2.0)
	2001	17.7** (17.7 - 17.7)	11.5** (11.4 - 11.5)	9.3 (9.3 - 9.3)	7.9 (7.9 - 7.9)	3.7*
	2002	18.3 (17.7 - 18.8)	13.4 (11.8 - 15.0)	9.3 (9.0 - 9.6)	7.7 (7.4 - 8.0)	1.2 (1.0 - 1.4)
	2003	10.8 (9.3 - 12.4)	13.5 (10.4 - 16.7)	10.1 (8.7 - 11.5)	8.3 (8.2 - 8.3)	1.2 (1.0 - 1.3)
Winter (March)	1999	15.1 (15.0 - 15.2)	4.2 (4.2 - 4.3)	10.7 (10.7 - 10.8)	7.8 (7.8 - 7.8)	0.9*
	2000	13.5 (13.5 - 13.5)	8.6 (8.6 - 8.6)	10.4 (10.3 - 10.4)	8.0 (8.0 - 8.0)	1.4*
	2001	16.5 (16.5 - 16.5)	7.1 (7.1 - 7.2)	11.5 (11.5 - 11.5)	8.0 (8.0 - 8.0)	1.8*
	2002	16.7 (16.6 - 16.7)	7.6 (7.5 - 7.7)	10.0 (9.9 - 10.0)	8.0 (8.0 - 8.0)	2.1*
	2003	14.6 (14.5 - 14.7)	3.5 (3.4 - 3.6)	12.5 (12.5 - 12.5)	8.4 (8.3 - 8.4)	1.1*
Spring (May)	1999	12.1 (12.1 - 12.2)	18.5 (18.4 - 18.8)	9.2 (9.0 - 9.4)	8.0 (8.0 - 8.0)	N/A
	2000	10.5 (10.5 - 10.6)	19.1 (19.0 - 19.3)	5.5 (5.3 - 5.6)	7.4 (7.4 - 7.4)	1.8*
	2001	12.2 (12.1 - 12.4)	16.9 (16.3 - 17.1)	9.1 (8.7 - 9.3)	8.4 (8.4 - 8.4)	1.3*
	2002	14.8 (14.8 - 14.9)	16.5 (16.4 - 16.6)	8.3 (8.2 - 8.4)	8.1 (8.0 - 8.2)	2.0*
	2003	10.0 (10.0 - 10.1)	14.9 (14.7 - 15.1)	10.0 (9.3 - 10.5)	8.8 (8.7 - 8.8)	1.2*

*****One reading recorded
N/A- No data available
Note: Turbidity measurements not taken at station EE2.2

Table 3-6: Calculated Averages & Ranges (In Parentheses) of Water Quality Variables for the Upper 14 ft at Maryland's CBWQM Station CB5.1 that Closely Coincide with Dates of the Quarterly Sampling at Barren Island (CBP, 2004f)

Season	Sample Year	Salinity (ppt)	Temp (°C)	DO (mg/L)	pH (su)	Secchi Depth (m)
Summer (Sept)	1999	17.3 (17.2 - 17.7)	22.7 (22.2 - 22.8)	9.2 (8.7 - 9.4)	8.3 (8.2 - 8.4)	1.3*
	2000	13.8 (13.7 - 13.9)	25.0 (24.8 - 25.1)	9.0 (8.9 - 9.1)	8.3 (8.3 - 8.3)	1.4*
	2001	15.9 (15.9 – 16.0)	26.3 (26.2 - 26.3)	7.2 (7.1 - 7.2)	8.1 (8.1 - 8.1)	1.3*
	2002	17.9 (17.9 - 17.9)	24.2 (24.2 - 24.2)	7.2 (7.2 - 7.3)	8.1 (8.0 - 8.1)	1.8*
	2003	11.6 (10.4 - 12.6)	23.7 (23.2 - 24.2)	8.2 (7.5 - 9.2)	8.3 (8.2 - 8.4)	1.1 (1.0 – 1.1)
Fall (Nov/Dec)	1999	16.6 (16.2 - 16.8)	12.8 (9.9 - 16.5)	10.2 (9.9 - 10.7)	8.2 (8.1 - 8.3)	2.0 (1.8 – 2.1)
	2000	18.3 (17.5 - 19.3)	10.5 (6.1 - 14.0)	9.6 (8.0 - 10.6)	8.0 (7.8 - 8.1)	2.5 (2.4 – 2.6)
	2001	19.0 (18.6 - 19.5)	13.0 (12.3 - 13.7)	8.9 (8.6 - 9.0)	7.9 (7.9 - 7.9)	2.3 (2.0 – 2.6)
	2002	18.3 (17.7 - 19.1)	8.8 (5.6 - 12.9)	10.2 (9.5 - 10.9)	8.3 (8.2 - 8.4)	1.6 (1.5 – 1.6)
	2003	10.1 (8.6 - 11.5)	9.5 (5.8 - 13.0)	11.5 (10.4 - 12.5)	8.2 (8.1 - 8.3)	1.3 (1.3 – 1.3)
Winter (March)	1990	16.6 (16.4 - 16.7)	4.7 (4.4 - 5.0)	11.8 (11.8 - 11.9)	8.4 (8.3 - 8.4)	1.6*
	2000	14.0 (13.8 - 14.3)	8.5 (8.1 - 8.8)	10.9 (10.9 - 10.9)	8.4 (8.4 - 8.4)	1.8*
	2001	17.7 (17.7 - 17.7)	6.0 (6.0 - 6.0)	11.2 (11.2 - 11.2)	8.2 (8.2 - 8.2)	1.6*
	2002	19.0 (18.9 – 19.0)	6.9 (6.7 - 7.0)	10.2 (10.2 - 10.2)	7.9 (7.9 - 7.9)	2.2*
	2003	14.6 (14.6 - 14.7)	2.7 (2.7 - 2.8)	13.0 (12.9 - 13.0)	8.2 (8.2 - 8.2)	1.1*
Spring (June)	1999	14.2 (14.2 - 14.2)	23.2 (22.5 - 23.6)	8.7 (8.7 - 8.8)	8.4 (8.4 - 8.4)	1.4*
	2000	10.7 (10.2 - 11.3)	23.6 (22.2 - 24.5)	9.7 (8.0 - 10.4)	8.5 (8.2 - 8.6)	1.3*
	2001	12.5 (12.3 - 13.1)	22.7 (22.0 - 23.0)	11.2 (9.7 - 11.7)	8.7 (8.4 - 8.8)	1.0*
	2002	12.2 (11.9 - 13.1)	23.5 (22.8 - 24.6)	8.0 (5.8 - 9.2)	8.2 (7.9 - 8.4)	1.1*
	2003	11.3 (11.1 - 11.5)	22.9 (22.5 - 23.1)	6.8 (5.9 - 7.5)	8.4 (8.3 - 8.4)	1.0*

* One reading recorded

Note: turbidity measurements not taken at station CB5.1

Table 3-7: Range of Water Quality Conditions at CBWQM Station EE2.2 (1999-2003) (CBP, 2004f)

Sample Season	**Nitrite** (mg/L)	**Ammonium** (mg/L)	**Ortho-phosphate** (mg/L)	**Nitrate** (mg/L)	**Phaeophytin** (□g/L)	**Total Dissolved Phosphorus** (mg/L)
Fall (Oct/Nov)	0.007-0.0331	0.003-0.02	0.0017-0.0044	0.0008-0.2179	0.548-2.96	0.0091-0.0172
Winter (March)	0.0002-0.0174	0.014-0.022	0.002-0.0061	0.0088-0.2918	0.00-3.289	0.0067-0.0134
Spring (May)	0.0049-0.0368	0.009-0.261	0.0012-0.0062	0.0578-0.4418	0.00-0.598	0.0085-0.0139
Sample Season	**Particulate Phosphorous** (mg/L)	**Total Dissolved Nitrogen** (mg/L)	**Particulate Nitrogen** (mg/L)	**Particulate Carbon** (mg/L)	**Dissolved Organic Carbon** (mg/L)	**Chlorophyll *a*** □ /Lġ
Fall (Nov/Dec)	0.0049-0.0182	0.32-0.65	0.0826-0.24	0.452-1.46	3.63-4.79	2.49-17.34
Winter (March)	0.0073-0.0155	0.39-0.60	0.13-0.313	1.01-2.74	3.69-4.48	4.984-14.31
Spring (May)	0.0042-0.218	0.50 0.72	0.105 0.313	0.617-2.820	0.363 0.441	2.243-28.71

Table 3-8: Range of Water Quality Conditions at CBWQM Station CB5.1 (1999-2003) (CBP, 2004f)

Sample Season	**Nitrite** (mg/L)	**Ammonium** (mg/L)	**Ortho-phosphate** (mg/L)	**Nitrate** (mg/L)	**Phaeophytin** (□g/L)	**Total Dissolved Phosphorus** (mg/L)
Summer (September)	0.0006 - 0.0083	0.005 - 0.056	0.0032 - 0.0120	0.0009 - 0.0315	0.019 - 3.084	0.0124 - 0.0342
Fall (Nov/Dec)	0.0007 - 0.0579	0.003 - 0.019	0.0018 - 0.0069	0.0000 - 0.1901	1.271 - 5.801	0.0108 - 0.0202
Winter (March)	0.0012 - 0.0086	0.003 - 0.025	0.0011 - 0.0026	0.0004 - 0.3858	0.000 - 1.525	0.0057 - 0.0102
Spring (June)	0.0004 - 0.0094	0.004 - 0.033	0.0016 - 0.0098	0.0007 - 0.0800	0.000 - 1.925	0.0113 - 0.0251

Sample Season	**Particulate Phosphorous** (mg/L)	**Total Dissolved Nitrogen** (mg/L)	**Particulate Nitrogen** (mg/L)	**Particulate Carbon** (mg/L)	**Dissolved Organic Carbon** (mg/L)	**Chlorophyll *a*** □g/L)
Summer (September)	0.0150 - 0.0415	0.28 - 0.42	0.171 - 0.547	0.943 - 2.540	N/A	5.126 - 36.819
Fall (Nov/Dec)	0.0098 - 0.0289	0.29 - 0.81	0.133 - 0.339	0.724 - 2.200	N/A	5.233 - 14.354
Winter (March)	0.0073 - 0.0096	0.29 - 0.63	0.113 - 0.165	0.720 - 1.250	N/A	3.289 - 11.543
Spring (June)	0.0129 - 0.0238	0.30 - 0.57	0.215 - 0.372	1.260 - 2.580	N/A	6.915 - 16.260

N/A- No data available

Table 3-9: Mean and Range of *In Situ* Water Quality Variables Measured at Stations in the Vicinity of James and Barren Islands, Summer 2002 to Spring 2003

Sample Season	Water Temp (°C)	pH	DO (mg/l)	Salinity (ppt)	Turbidity[1] (NTU)	Secchi (m)
James – Summer (June)	24.6 (24.1-26.9)	8.2 (8 – 8.5)	N/A	12.4 (10.8 – 13.1)	11.0 (1.4 – 68.2)	N/A
James- Fall (Oct/Nov)	11.8 (10.0 – 13.9)	8.1 (7.9 – 8.2)	10.4 (8.9 – 12.3)	19.5 (18.7 – 20.6)	N/A	N/A
James- Winter (March)	9.2 (7.6 – 10.7)	8.3 (8.2 – 8.7)	12.0 (10.4 – 14.4)	9.8 (7.1 – 13.3)	N/A	1.5^ (0.3 – 2.0)
James- Spring (May)	17.1 (16.3 – 18.5)	8.6 (7.3 – 9.0)	10.0 (8.7 – 16.2)	11.1** (10.0 – 14.0)	7.3 (2.7 – 35.0)	0.79**^ (0.5 – 1.0)
Barren- Summer (Sept)	24.6** (22.0 – 25.8)	8.2** (8.1 – 8.4)	7.4** (6.8 – 8.5)	15.5** (10.7 – 18.1)	4.3** (2.0 – 7.3)	N/A
Barren- Fall (Nov/Dec)	7.3 (1.7-10.9)	8.0 (7.6 – 8.3)	13.0 (10.9-15.2)	17.3 (15.6 – 18.7)	N/A	N/A
Barren- Winter (March)	5.2 (2.3 – 8.2)	8.6 (8.1 – 8.8)	8.8 (6.1 – 11.0)	15.4 (13.0 – 16.0)	N/A	0.9 (0.3 – 2.1)
Barren – Spring (June)	19.9 (17.1 – 23.0)	8.3 (7.5 – 8.8)	9.1 (7.0 – 12.0)	10.0 (9.0 - 15.0)	N/A	0.7 (0.2 – 1.2)

**Data not available at some locations.
^Water depth is too shallow at some locations for secchi-depth readings.
[1]Turbidity readings were not recorded at the majority of locations due to equipment inaccuracies (possibly due to instrumentation sensitivity).
N/A- No data available

Table 3-10: Calculated Averages & Ranges (in parentheses) of Existing Water Quality Conditions Measured at Stations in the Vicinity of James Island, Summer 2002 to Spring 2003

Sample Season	Nitrite (mg/l)	Ammonium (mg/l)	Ortho-Phosphate (mg/l)	Nitrate (mg/l)	Phaeophytin (*u*g/l)	Total Dissolved Phosphorus (mg/l)
Summer (2002)	N/A	N/A	N/A	N/A	N/A	N/A
Fall (2002)	0.010 (0.005 – 0.018)	0.009 (0.006 – 0.014)	0.003 (0.002 – 0.004)	0.053 (0.019 – 0.094)	3.666 (3.22 – 4.39)	0.013 (0.012 – 0.016)
Winter (2003)	0.011 (0.009 – 0.014)	0.019 (0.014 – 0.029)	0.004 (0.003 – 0.007)	0.649 (0.431 – 0.798)	1.629 (1.06 – 2.34)	0.009 (0.007 – 0.014)
Spring (2003)	0.011 (0.009 – 0.013)	0.012 (0.007 – 0.019)	0.003 (0.002 – 0.007)	0.262 (0.216 –0.310)	5.265 (3.05 – 6.96)	0.016 (0.012 – 0.021)
Sample Season	Particulate Phosphorous (mg/l)	Total Dissolved Nitrogen (mg/l)	Particulate Nitrogen (mg/l)	Particulate Carbon (mg/l)	Dissolved Organic Carbon (mg/l)	Chlorophyll-*a* 1(*u*g/l)
Summer (2002)	N/A	N/A	N/A	N/A	N/A	N/A
Fall (2002)	0.014 (0.013 – 0.016)	0.402 (0.36 – 0.53)	0.158 (0.132 – 0.186)	0.810 (0.647-0.97)	3.86 (3.55-4.40)	13.741 (12.12-15.03)
Winter (2003)	0.030 (0.012 – 0.145)	0.949 (0.80 – 1.06)	0.351 (0.145 – 1.66)	1.274 (0.8 – 2.2)	3.709 (3.27 – 4.09)	8.89 (5.39 – 19.48)
Spring (2003)	0.031 (0.027 – 0.038)	0.638 (0.55 – 0.71)	0.395 (0.348 – 0.47)	2.943 (2.45 – 3.51)	4.637 (4.40 – 5.05)	31.81 (26.19 – 44.01)

N/A- No data available

Table 3-11: Calculated Averages & Ranges (in parentheses) of Existing Water Quality Conditions Measured at Stations in the Vicinity of Barren Island, Summer 2002 to Spring 2003

Sample Season	Nitrite (mg/l)	Ammonium (mg/l)	Ortho-Phosphate (mg/l)	Nitrate (mg/l)	Phaeophytin (*u*g/l)	Total Dissolved Phosphorus (mg/l)
Summer (2002)	0.001 (0.001 – 0.003)	0.010 (0.006 – 0.02)	0.003 (0.003 – 0.005)	0.005 (0.003 – 0.013)	1.935 (1.34 – 2.81)	0.013 (0.013 – 0.017)
Fall (2002)	0.008 (0.005 – 0.009)	0.008 (0.007 – 0.010)	0.002 (0.002 – 0.003)	0.092 (0.045 – 0.154)	7.757 (6.04 – 9.57)	0.001 (0.009 – 0.011)
Winter (2003)	0.008 (0.007 –0.009)	0.013 (0.009 – 0.019)	0.0032 (0.002 – 0.008)	0.258 (0.199 – 0.387)	3.272 (2.26 – 4.42)	0.0092 (0.006 – 0.018)
Spring (2003)	0.0080 (0.006 - 0.010)	0.051 (0.015 – 0.138)	0.0076 (0.004 – 0.014)	0.173 (0.063 – 0.257)	5.659 (3.03- 8.26)	0.021 (0.014- 0.031)
Sample Season	Particulate Phosphorous (mg/l)	Total Dissolved Nitrogen (mg/l)	Particulate Nitrogen (mg/l)	Particulate Carbon (mg/l)	Dissolved Organic Carbon (mg/l)	Chlorophyll-*a* (*u*g/l)
Summer (2002)	0.02 (0.017 – 0.031)	0.312 (0.29 – 0.39)	0.197 (0.153 – 0.329)	1.045 (0.775 – 1.9)	4.78 (4.29 – 5.55)	5.837 (4.81 – 8.76)
Fall (2002)	0.017 (0.014 – 0.019)	0.42 (0.036 – 0.53)	0.263 (0.227 – 0.291)	2.305 (1.59 – 2.67)	4.602 (4.09 – 5.19)	19.476 (13.27 – 21.71)
Winter (2003)	0.017 (0.011 – 0.021)	0.57 (0.48 –.70)	0.30 (0.164 – 0.389)	2.8 (1.16 – 3.8)	4.4 (3.33 – 7.41)	20 (12.54 – 26.28)
Spring (2003)	0.038 (0.025 – 0.047)	0.53 (0.39 – 0.65)	.042 (0.22 – 0.542)	2.3 (1.2 – 2.97)	4.1 (3.66 – 4.61)	33 (9.59 – 53.88)

Table 3-12: Sediment Composition and Characteristics for Benthic Sampling Locations around James Island* (MPA, 2004h)

Station/Season	% Gravel	% Sand	% Clay/Silt	% Moisture
JAM-01/	0.53	93.77	5.70	26.6
JAM-02	1.05	94.21	4.74	28.1
JAM-03	0.34	93.95	5.71	27.2
JAM-04	0.00	83.20	16.80	28.7
JAM-05	0.41	97.27	2.32	24.6
JAM-06	0.97	95.70	3.33	22.6
JAM-07	0.75	96.62	2.63	23.7
JAM-08	0.42	94.23	5.35	27.1
JAM-09	0.22	94.83	4.95	25.1
JAM-10	0.00	35.95	64.05	24.9

*** See Figure 3-7 for location map.**

Table 3-13: Sediment Composition and Characteristics for Benthic Sampling Locations around Barren Island* (MPA, 2005a)

Station/Season	% Gravel	% Sand	% Clay/Silt	% Moisture
WSB-1/Summer 2002	0.7	57.6	41.7	58.4
WSB-1/Spring 2003	0.0	89.0	11.0	19.7
WSB-2/Summer 2002	0.0	98.0	2.0	34.1
WSB-2/Spring 2003	0.0	98.7	1.3	21.6
WSB-3/Summer 2002	4.6	80.5	14.9	29.5
WSB-3/Spring 2003	0.0	91.3	8.7	28.2
WSB-4/Summer 2002	0.2	94.9	4.9	31.7
WSB-4/Spring 2003	0.0	63.7	36.3	31.3
WSB-5/Summer 2002	1.1	95.6	3.3	27.4
WSB-5/Spring 2003	0.0	88.1	11.9	26.5
WB-6/Summer 2002	0.0	96.2	3.8	40.3
WB-6/Spring 2003	0.0	97.6	2.4	34.1
WB-7/Summer 2002	0.1	94.9	5.0	34.8
WB-7/Spring 2003	0.0	82.0	18.0	30.5
WB-8/Summer 2002	0.0	95.5	4.5	39.1
WB-8/Spring 2003	0.0	96.7	3.3	26.6
WB-9/Summer 2002	0.0	13.7	86.3	50.3
WB-9/Spring 2003	0.0	15.9	84.1	52.4
WB-10/Summer 2002	0.0	66.3	33.7	45.8
WB-10/Spring 2003	0.0	58.9	41.1	39.1

* See Figure 3-8 for location map.

Table 3-14: Ichthyoplankton Collected During Plankton Studies Near James Island Summer 2002 to Spring 2003. Numbers Reported in Average Number per 100m^3 (MPA, 2003e; MPA, 2003f; MPA, 2004g; MPA, 2004h)

Species and Lifestage	Summer 2002	Fall 2002	Winter 2003	Spring 2003
Atlantic menhaden egg		1.880		
Atlantic silverside larvae	2.745			16.658
Bay anchovy egg	2312.500			16241.721
Bay anchovy larvae	3.977	0.071		323.258
Blenny larvae	6.117	0.053		
Hogchoker egg	8.242			
Naked goby egg	0.217			
Naked goby larvae	35.890			
Northern pipefish larvae	1.603	0.544		
Seahorse larvae	0.165			
Skilletfish larvae	2.922			
Weakfish egg	7.900			481.658
Winter flounder larvae			3*	
*total number of individuals caught				

Table 3-15: Macrozooplankton Collected During Plankton Studies Near James Island Summer 2002 to Winter 2003 (MPA, 2003e; MPA, 2003f; MPA, 2004g)

Species	Summer 2002*	Fall 2002*	Winter 2003**
Amphipoda	34.908	1.571	
Bivalvia			0.333
Chaetognatha		18.083	
Cnidaria		0.175	
Copepoda		1203.388	1486.333
Cumacea		1.025	
Decapoda	134.942	6.186	1.333
Gastropoda		0.429	
Hydrozoa		0.058	0.083
Isopoda	2.133	0.133	
Nematoda	0.221		
Pelecypoda		5.446	
Polychaeta	0.646	2.579	
Scyphozoa			0.125
Syngnathidae	1.183		

*numbers reported in average number per 100m^3

**numbers reported as an average of total number of individuals

Table 3-16: Ichthyoplankton Collected During Plankton Studies Near Barren Island

Numbers Reported in Average per 100 m3 (MPA, 2003g; MPA, 2003a; MPA, 2004b)

Species and Lifestage	Summer 2002	Winter 2003	Spring 2003
Atlantic menhaden larvae		2*	
Atlantic silverside larvae	0.341		12.300
Bay anchovy adult			0.100
Bay anchovy egg			3,154.800
Bay anchovy larvae	0.331		1.300
Feather blenny larvae	4.770		1.000
Mullet larvae			0.400
Goby larvae	1.228		1.000
Northern pipefish juvenile			0.300
Northern pipefish larvae	0.944		3.800
Rough silverside egg			0.500
Rough silverside larvae			2.100
Lined seahorse larvae	0.143		
Weakfish egg			0.500
Unidentified fish egg		1*	

*total number of individuals caught

Table 3-17: Macrozooplankton Collected During Plankton Studies Near Barren Island

Numbers Reported in Average Number per 100 m^3 (MPA, 2003g; MPA, 2003a; MPA, 2004b)

Species	**Summer 2002***	**Winter 2003****	**Spring 2003****
Amphipoda	9.850	32.000	5.614
Bivalvia		14.000	0.550
Bryozoa			1.000
Cirripedia			12.967
Cnidaria	0.467		
Copepoda	37.550	1,361.000	176.478
Cumacea	4.558	4.000	1.350
Decapoda	172.796	1.000	6.643
Gastropoda	1.992		0.500
Hydrozoa		1.000	1.560
Insecta		1.000	0.100
Isopoda	8.575		1.450
Mysidacea	61.917	17.000	
Nematoda			0.200
Nudibranchia	3.108		
Ostracoda			0.400
Pelecypoda	3.717		
Platyhelminthes			2.700
Polychaeta	5.392	6.000	7.114
Scyphozoa		11.000	0.100
Tubellaria	0.875		

*numbers reported in average number per 100m^3

**numbers reported as an average of total number of individuals

Table 3-18: Benthic Community Taxa Identified at James Island, 2001-2003

(MPA, 2003e; MPA, 2004h)

James Island Species List		
Cnidaria (sea anemones)	**Amphipoda (beach fleas; scuds)**	**Chordata**
Edwardsia elegans	*Apocorophium lacustre*	**Acidacea**
Actiniaria	*Ampelisca abdita (four eyed amphipod)*	*Acidacea*
Platyhelminthes (flatworms)	*Ameroculodes*	**Rhynchocoela**
Planariidae	*Cymadusa compta (wave-diver tube-builder amphipod)*	*Anopla*
Stylochus ellipticus (oyster flatworm)	*Incisocalliope aestaurius*	*Lineidae*
Turbellaria sp. E(a)	*Leptocheirus plumulosus*	*Rhynchocoela*
	Microprotopus raneyi	**Branchiuran (barnacles)**
Nemertea (unsegmented worms)	*Mucrogammarus mucronatus*	*Balanus improvisus (bay barnacle)*
Amphiporidae sp.		**Mysidacea (mysid shrimp)**
Amphiporus bioculatus	**Isopoda (isopods)**	*Neomysis americana (opossum shrimp)*
Micrura leidyi (red ribbon worm)	*Edotea triloba (mounded-back isopod)*	*Americamysis almyra*
Carinoma tremaphorus	*Chiridotea coeca*	**Phoronida (horseshoe worms)**
	Cyanthura polita (slender isopod)	*Phoronis sp. (phoronid worm)*
Gastropoda (snails)	*Paracereis caudate (eelgrass)*	**Urochordata**
Acteocina canaliculata (barrel bubble snail)		*Molgula manhattensis (sea grapes)*
Sayella chesapeakea	**Annelida (segmented worms)**	**Arthropoda**
Haminoea solitaria (solitary bubble snail)	*Aricidea catherinae*	***Malacostraca***
Boonea impressa	*Capitellidae*	*Americoculodes edwardsi*
Hydrobia truncate	*Glycinde solitaria (chevron worm)*	*Ampelisoa*
Acetocina canaliculata	*Heteromastus filiformis (capitellid thread worm)*	*Ampithoe rubricata*
Editorium rubicola	*Hyperteone fauchakli*	*Ediota trioba*
Odostomia	*Polydora cornuta*	*Gammarus*
Odostomia iamimpresa	*Polydora websteri (b) (oyster mud worm)*	*Gammarusa mucronatus*
Odostomia producta	*Neanthes succinea*	*Microprotops raneyi*
Rictaxis punctostriatus	*Pectinaria gouldii (trumpet worm)*	*Psudoleptocum a minor*
Bivalvia (clams and mussels)	*Eteone heteropoda*	*Sphaeroma quadridentata*
Gemma gemma (gem clam)	*Eteone foliosa*	*Sphaeromatidae*
Macoma mitchelli	*Glycera dibranchiata*	**Ostracoda**
Macoma balthica (baltic clam)	Streblospio benedicti (barred-gilled mud worm)	*Eusarsiella zostericola*
Petricola pholadiformis (false angel wing)	*Marenzellaria viridis*	**Brachyura (true crabs)**
Mulinia lateralis (coot clam)	*Marenzellaria jonesi*	*Callinectes sapidus (blue crab)*
Mya arenaria	*Mediomastrus*	**Caridea (caridean shrimp)**
Tagelus divisus	*Mediomastus ambiseta*	*Crangon sapidus*
Alexa Lioca	*Mediomastus californiensis*	Cumcea
Ischadium recuruum	*Neredidae*	*Oxyurostylis smithi*
Lyonsia hyalina	*Leitocsoloplos spp.*	
Mactridae	*Leitoscoloplos robustus*	
Mycella planulata	*Scolelepis (Parascolelepis) texana*	
Mytilidae	*Podarkeopsis levifuscina*	
Teliina agilis	*Paraprionospio pinnata (fringe-grilled mud worm)*	
Oligochaeta (aquatic worms)	*Paraonis fulgens*	
Tubificoides spp.	*Tharyx sp. A Scolelepis (Para scolelepis) texana*	
	Phylodocidae	
	Spionidae	

Table 3-19: Benthic Community Taxa Identified at Barren Island, 2002-2003 (MPA, 2005a)

Barren Island Species List		
Cnidaria (sea anemones)	**Annelida (segmented worms)**	**Mysidacea (mysid shrimp)**
Anthozoa	**Polychaeta (bristle worms)**	*Neomysis americana (opossum shrimp)*
Edwardsia elegans (burrowing anemone)	*Eteone heteropoda (freckled paddle worm)*	*Americamysis almyra*
Platyhelminthes (flatworms)	*Glycera dibranchiata*	*Cyclaspis varians*
Stylochus ellipticus (oyster flatworm)	*Glycinde solitaria (chevron worm)*	**Isopoda (isopods)**
Turbellaria sp. E(a)	*Heteromastus filiformis (capitellid thread worm)*	*Chiridotea coeca*
Nemertea (unsegmented worms)	*Leitoscoloplos fragilis*	*Edotea triloba (mounded-back isopod)*
Amphiporus bioculatus	*Marenzellaria viridis*	*Ptilanthura tenuis*
Micrura leidyi (red ribbon worm)	*Mediomastus ambiseta*	*Paracereis caudata (eelgrass pill bug)*
Nemertinea(a)	*Monticellina dorsobranchialis*	*Erichsonella attenuata (elongated eelgrass isopod)*
Mollusca	*Neanthes succinea*	**Amphipoda (beach fleas; scuds)**
Gastropoda (snails)	*Paraonis fulgens*	*Acanthohaustorius millsi*
Acteocina canaliculata (barrel bubble snail)	*Paraprionospio pinnata (fringe-grilled mud worm)*	*Ameroculodes sp*
Haminoea solitaria (solitary bubble snail)	*Pectinaria gouldii (trumpet worm)*	*Ampelisca abdita (four-eyed amphipod)*
Nassarius vibex	*Polydora cornuta*	*Gammarus mucronatus*
Rictaxis punctostriatus	*Scolelepis (Parascolelepis)*	*Protohaustorius deichmannae*
Doridella obscura(a)	*Spiochaetopterus costarum*	*Apocorophium lacustre*
Gastropoda(a)	*Spiophanes bombyx*	*Listriella barnardi*
Odostomia engonia(a)	Streblospio benedicti (barred-gilled mud worm)	*Cymadusa compta (wave-diver tube-builder amphipod)*
Bivalvia (clams and mussels)	*Leitoscoloplos robustus*	*Microprotopus raneyi*
Bivalvia	*Eteone foliosa*	*Mucrogammarus mucronatus*
Gemma gemma (gem clam)	*Podarkeopsis levifuscina*	**Echinodermata**
Macoma balthica (baltic clam)	*Maldanidae*	**Holothuroidea**
Mulinia lateralis (coot clam)	*Loimia medusa (red-spotted worm)*	*Leptosynapta tenuis (white synapta)*
Mya arenaria	**Oligochaeta (aquatic worms)**	**Hemichordata**
Tellina agilis	*Oligochaeta(a)*	**Enteropneusta**
Tellinidae	*Tubificoides spp.*	*Saccoglossus kowalevskii (acorn worm)*
Parvilucina multilineata	*Naididae*	*Saccoglossus bromophenolosus*
Macoma mitchelli	**Hirudinea**	**Phoronida (horseshoe worms)**
Tagelus plebeius (stout razor clam)	*Calliobdella vivida*	*Phoronis sp. (phoronid worm)*
Geukensia demissa(a) (atlantic ribbed mussel)	**Crustacea**	**Ophiuroidea**
Lyonsia hyalina	**Brachyura (true crabs)**	*Ophiuroidea*
Petricola pholadiformis (false angel wing)	*Callinectes sapidus (blue crab)*	**Urochordata (tunicates)**
	Cirripedia	*Molgula manhattensis (sea grapes)*
	Balanus improvisus (bay barnacle)	**Cephalochordata**
	Cumacea (cumacean shrimp)	*Branchiostoma caribaeum*
	Leucon americanus	**Diptera (insects)**
	Oxyurostylis smithi	*Chronomidae larvae (midges)*
	Decapoda	
	Crangon septemspinosa	
	Ogyrides alphaerostris	

Table 3-20: Benthic Community Metric Scores by Location and Seasonal Survey at James Island, 2001-2003

Type of Metric	JAM-001			JAM-002			JAM-003			JAM-004			JAM-005		
	Fall 2001	Summer 2002	Spring 2003	Fall 2001	Summer 2002	Spring 2003	Fall 2001	Summer 2002	Spring 2003	Fall 2001	Summer 2002	Spring 2003	Fall 2001	Summer 2002	Spring 2003
Abundance (#/m^2)[a]	302,946	32,144	4,007	72,216	148,179	142,667	219,157	214,961	181,273	49,021	133,477	78,027	92,350	222,864	238,013
Shannon-Weiner Diversity[a][b]	0.142	0.269	2.13	0.071	0.151	0.13	0.068	0.087	0.04	0.436	0.249	0.76	0.067	0.079	0.06
Stress-Sensitive Taxa Abundance (%)	0.022	1.6	1.58	0.1	0.032	0.00	0.1	0.012	0.02	3.1[c]	0.64[c]	1.18	0.1	0.034	0.01
Stress –Indicative Taxa Abundance (%)	1.327	0.1	11.80	0.001	0.724	0.01	<0.01	0.313	0.00	0.85 [c]	2.28 [c]	1.44	0.04	0.049	0.00
Carnivore/Omnivore Abundance (%)	0.381	2.8	40.49	0.6	0.498	1.18	0.8	0.274	0.08	0.816	4.4	2.47	0.6	0.298	0.25

Type of Metric	JAM-006			JAM-007			JAM-008			JAM-009			JAM-010		
	Fall 2001	Summer 2002	Spring 2003	Fall 2001	Summer 2002	Spring 2003	Fall 2001	Summer 2002	Spring 2003	Fall 2001	Summer 2002	Spring 2003	Fall 2001	Summer 2002	Spring 2003
Abundance (#/m^2)[a]	251,307	351,145	201,787	98,266	139,011	261,760	356,000	205,116	238,140	191,821	221,293	137,633	4,304	45,906	9,800
Shannon-Weiner Diversity[a][b]	0.051	0.087	0.05	0.035	0.020	0.07	0.025	0.068	0.04	0.073	0.070	0.08	1,252	0.412	0.50
Stress-Sensitive Taxa Abundance (%)	0.1	0.002	0.00	0.1	0.004	0.00	0.03	0.003	0.00	0.2	0.049	0.01	1.9[c]	0.25[c]	0.07[c]
Stress–Indicative Taxa Abundance (%)	<0.01	0.433	0.00	0.01	0.019	0.00	<0.01	0.103	0.00	0.267	0.01	0.02	0.62[c]	6.3[c]	4.3[c]
Carnivore/Omnivore Abundance (%)	0.3	0.269	0.02	0.3	0.112	0.51	0.1	0.291	0.01	0.213	0.7	0.34	37.0	0.80	2.09

(a) Includes all species collected.
(b) Log used was log base e.
(c) Stations JAM-004 and JAM-010 are classified as high mesohaline mud and these metrics are not typically calculated for that habitat per Llanso, 2002.

Note: The B-IBI was derived using data from warmer months and is only indicated for the summer season. It is calculated here for spring and fall for comparative purposes only.

Table 3-21: Benthic Community Metric Scores by Location and Seasonal Survey at Barren Island, 2002-2003

Type of Metric	BAR -001			BAR -002			BAR -003			BAR-004			BAR-005		
	Summer 2002	Fall 2002	Spring 2003	Summer 2002	Fall 2002	Spring 2003	Summer 2002	Fall 2002	Spring 2003	Summer 2002	Fall 2002	Spring 2003	Summer 2002	Fall 2002	Spring 2003
Abundance (#/m^2)[(a)]	2,156.3	1,482.4	2,689.0	1,611.6	652.8	2,601.0	3,178.3	2,692.8	2,101.0	2,708.5	938.4	2,276.0	3,194.6	1,468.8	1,066.0
Shannon-Weiner Diversity[(a)(b)]	2.2	2.0	1.9	2.2	2.6	1.3	2.1	2.1	1.7	2.2	2.2	2.2	2.5	2.4	2.0
Stress-Sensitive Taxa Abundance (%)	48.5[(c)]	45.8[(c)]	45.3[(c)]	59.3	36.6	4.9	60.3	25.5	13.3	47.1	44.8	36.4	34.1	18.9	19.1
Stress –Indicative Taxa Abundance (%)	18.0[(c)]	27.9[(c)]	20.2[(c)]	3.8	11.6	16.7	6.2	12.4	23.0	3.0	0	5.1	3.6	2.4	16.2
Carnivore/Omnivore Abundance (%)	33.7	35.8	11.1	17.9	25.0	1.7	26.5	27.1	3.9	36.1	38.9	23.5	14.0	7.8	13.8

Type of Metric	BAR-006			BAR-007			BAR-008			BAR-009			BAR-010		
	Summer 2002	Fall 2002	Spring 2003	Summer 2002	Fall 2002	Spring 2003	Summer 2002	Fall 2002	Spring 2003	Summer 2002	Fall 2002	Spring 2003	Summer 2002	Fall 2002	Spring 2003
Abundance (#/m^2)[(a)]	7,576.6	1,128.1	4,064.0	1,560.6	1,700.0	1,129.0	1,938.0	2,930.8	1,995.0	3,129.4	1,611.6	1,556.0	683.4	2,074.0	1,066.0
Shannon-Weiner Diversity[(a)(b)]	1.5	2.5	2.1	2.5	2.3	2.1	2.3	2.2	1.8	1.7	1.7	2.3	2.3	1.9	2.1
Stress-Sensitive Taxa Abundance (%)	11.9	32.4	41.0	25.7	18.4	33.9	10.5	9.5	22.7	68.2[(c)]	13.9[(c)]	19.7[(c)]	26.7	19.7	27.6
Stress –Indicative Taxa Abundance (%)	2.3	8.3	32.6	1.2	0	8.5	3.9	0.7	17.9	4.8[(c)]	8.9[(c)]	8.3[(c)]	21.7	16.0	11.2
Carnivore/Omnivore Abundance (%)	79.9	17.4	25.8	22.2	16.8	29.5	35.1	24.3	23.4	14.0	27.2	37.9	28.5	28.2	19.2

(a) Includes all species collected.
(b) Log used was log base
(c) Stations BAR-001 and BAR-009 are classified as high mesohaline mud and these metrics are not typically calculated for that habitat per Llanso, 2002.

Note: The B-IBI was derived using data from warmer months and is only indicated for the summer season. It is calculated here for spring and fall for comparative purposes only.

Table 3-22: Benthic Community Metric B-IBI Scores by Location and Seasonal Survey at James Island, 2002-2003

Type of Metric	JAM-001			JAM-002			JAM-003			JAM-004			JAM-005		
	Fall 2001	Summer 2002	Spring 2003	Fall 2001	Summer 2002	Spring 2003	Fall 2001	Summer 2002	Spring 2003	Fall 2001	Summer 2002	Spring 2003	Fall 2001	Summer 2002	Spring 2003
Abundance (#/m^2)[(a)]	1	1	3	1	1	1	1	1	1	1	1	1	1	1	1
Shannon-Weiner Diversity[(a)(b)]	1	1	3	1	1	1	1	1	1	1	1	1	1	1	1
Stress-Sensitive Taxa Abundance (%)	1	1	5	1	1	5	1	1	5	1[(c)]	1[(c)]	5[(c)]	1	1	5
Stress –Indicative Taxa Abundance (%)	5	5	3	5	5	1	5	5	1	5[(c)]	5[(c)]	1[(c)]	5	5	1
Carnivore/Omnivore Abundance (%)	1	1	5	1	1	1	1	1	1	1	1	1	1	1	1
B-IBI[(d)]	1.8	1.8	3.8	1.8	1.8	1.8	1.8	1.8	1.8	1.8	1.8	1.8	1.8	1.8	1.8

Type of Metric	JAM-006			*JAM-007*			JAM-008			JAM-009			JAM-010		
	Fall 2001	Summer 2002	Spring 2003	Fall 2001	Summer 2002	Spring 2003	Fall 2001	Summer 2002	Spring 2003	Fall 2001	Summer 2002	Spring 2003	Fall 2001	Summer 2002	Spring 2003
Abundance (#/m^2)[(a)]	1	1	1	1	1	1	1	1	1	1	1	1	1	3	1
Shannon-Weiner Diversity[(a)(b)]	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Stress-Sensitive Taxa Abundance (%)	1	1	5	1	1	5	1	1	5	1	1	5	1[(c)]	1[(c)]	1[(c)]
Stress –Indicative Taxa Abundance (%)	5	5	1	5	5	1	5	5	1	5	5	1	5[(c)]	5[(c)]	5[(c)]
Carnivore/Omnivore Abundance (%)	1	1	1	1	1	1	1	1	1	1	1	1	1	5	1
B-IBI[(d)]	1.8	1.8	1.8	1.8	1.8	1.8	1.8	1.8	1.8	1.8	1.8	1.8	3	1.8	1.8

(a) Includes all species collected.
(b) Log used was log base e
(c) Stations JAM-004 and JAM-010 are classified as high mesohaline mud and these metrics are not typically calculated for that habitat per Llanso, 2002.
(d) Mean of the metric scores

Note: The B-IBI was derived using data from warmer months and is only indicated for the summer season. It is calculated here for spring and fall for comparative purposes only.

Table 3-23: Benthic Community Metric B-IBI Scores by Location and Seasonal Survey at Barren Island, 2002-2003

Type of Metric	BAR-001			BAR-002			BAR-003			BAR-004			BAR-005		
	Summer 2002	Fall 2002	Spring 2003	Summer 2002	Fall 2002	Spring 2003	Summer 2002	Fall 2002	Spring 2003	Summer 2002	Fall 2002	Spring 2003	Summer 2002	Fall 2002	Spring 2003
Abundance (#/m^2)[a]	5	3	5	5	1	5	3	5	5	5	1	5	3	3	3
Shannon-Weiner Diversity[a][b]	5	3	1	3	3	1	3	1	1	3	1	1	5	1	1
Stress-Sensitive Taxa Abundance (%)	3[c]	3[c]	3[c]	5	3	3	5	3	3	5	5	5	5	3	3
Stress –Indicative Taxa Abundance (%)	3[c]	5[c]	5[c]	5	3	1	5	3	3	5	5	3	3	5	3
Carnivore/Omnivore Abundance (%)	5	5	1	1	3	1	3	3	1	5	3	3	1	1	1
B-IBI[d]	4.2	3.8	3.0	3.8	2.6	2.2	3.8	3.0	2.6	4.6	3.0	3.4	3.4	2.4	2.2

Type of Metric	BAR-006			BAR-007			BAR-008			BAR-009			BAR-010		
	Summer 2002	Fall 2002	Spring 2003	Summer 2002	Fall 2002	Spring 2003	Summer 2002	Fall 2002	Spring 2003	Summer 2002	Fall 2002	Spring 2003	Summer 2002	Fall 2002	Spring 2003
Abundance (#/m^2)[a]	1	3	3	5	5	3	5	5	5	3	5	5	3	1	3
Shannon-Weiner Diversity[a][b]	1	3	1	5	1	1	5	1	1	3	1	3	1	5	3
Stress-Sensitive Taxa Abundance (%)	5	3	1	5	3	5	5	1	3	3[c]	1[c]	1[c]	1	3	3
Stress –Indicative Taxa Abundance (%)	3	5	5	3	5	3	3	5	3	3[c]	3[c]	3[c]	5	3	3
Carnivore/Omnivore Abundance (%)	5	1	3	3	1	3	5	3	3	3	5	5	5	3	3
B-IBI[d]	3.0	2.4	2.6	4.2	3.0	3.0	4.6	3.0	3.0	3.4	3.0	3.4	3.0	3.0	3.0

(a) Includes all species collected.
(b) Log used was log base e
(c) Stations BAR-001 and BAR-009 are classified as high mesohaline mud and these metrics are not typically calculated for that habitat per Llanso, 2002.
(d) Mean of the metric scores

Note: The B-IBI was derived using data from warmer months and is only indicated for the summer season. It is calculated here for spring and fall for comparative purposes only.

Table 3-24: Scientific and Common Names of Fishes that Occur in Mesohaline Areas of the Chesapeake Bay (USACE, 1996)

Common Name	Scientific Name
Family **Species**	**Family** **Species**
Requiem Sharks	Carcharhinidae
Bull Shark	*Carcharhinus leucas*
Sandbar Shark	*Cacharhinus plumbeus*
Eagle rays	Myliobatidae
Cownose ray	*Rhinoptera bonasus*
Sturgeons	Acipenseridae
Shortnose sturgeon	*Acipenser brevirostrum*
Atlantic sturgeon	*Acipenser oxyrhynchus*
Freshwater eels	Anguillidae
American eel	*Anguilla rostrata*
Herrings	Clupeidae
Blueback herring	*Alosa aestivalis*
Hickory shad	*Alosa mediocris*
Alewife	*Alosa psuedoharengas*
American shad	*Alosa sapidissima*
Atlantic menhaden	*Brevoortia tyrannus*
Atlantic herring	*Clupea harengus*
Gizzard shad	*Dorosoma cepedianum*
Threadfin shad	*Dorosoma petenense*
Anchovies	Engraulidae
Striped anchovy	*Anchoa hepsetu*
Bay anchovy	*Anchoa mitchilli*
Pikes	Esocidae
Chain pickerel	*Esox niger*
Lizardfishes	Synodontidae
Inshore lizardfish	Synodus foetens
Toadfishes	Batrachoidae
Oyster toadfish	*Opsanus tau*
Clingfishes	Gobiesocidae
Skilletfish	*Gobiesox strumosus*
Flyingfishes	Exocoetidae
Halfbeak	*Hyporhamphus unifasciatus*
Needlefishes	Belonidae
Atlantic needlefish	*Stongylura marina*
Killifishes	Cyprinodontidae
Sheepshead minnow	*Cyprinodon variegates*
Banded killifish	*Fundulus diaphanous*
Mummichog	*Fundulus heteroclitus*
Striped killifish	*Fundulus majalis*
Rainwater killifish	*Lucania parva*

Table 3-24: Continued.

Family Species	Family Species
Silversides Rough silverside Inland silverside Atlantic silverside	Atherinidae *Membras martinica* *Membras beryllina* *Menidia menidia*
Sticklebacks Fourspine stickleback Threespine stickleback	Gasterosteidae *Apeltes quadracus* *Gasterosteus aculeatus*
Pipefish and seahorses Lined seahorse Dusky pipefish Northern pipefish	Syngnathidae *Hippocampus erectus* *Syngnathus floridae* *Syngnathus fuscus*
Searobins Northern searobin	Triglidae *Prionotus carolinus*
Temperate basses White perch Striped bass	Percichthyidae *Morone americana* *Morone saxatilis*
Sea basses Black sea bass	Serranidae *Centropristis striata*
Perches Yellow perch	Percidae *Perca flavescens*
Bluefishes Bluefish	Pomatomidae *Pomatomus sal*
Cobias Cobia	Rachycentridae *Rachycentron canadum*
Jacks Blue runner Crevalle jack Lookdown Florida pompano	Carangidae *Caranx crysops* *Caranx hippos* *Selene vomer* *Trachinotus carolinus*
Porgies Scup	Sparidae *Stenotomus chrysops*
Drums Silver perch Spotted seatrout Weakfish Spot Atlantic croaker Black drum Red drum	*Sciaenidae* *Bairddiella chrysoura* *Cynoscion nebulosus* *Cynoscion regalis* *Leiostomus xanthurus* *Micropogonias undulatus* *Pogonias cromis* *Sciaenops ocellatus*
Mullets Striped mullet White mullet	Muglidae *Mugil cephalus* *Mugil curema*
Stargazers Northern stargazers	Uranoscopidae *Astroscopus guttatus*

Table 3-24: Continued.

Family Species	Family Species
Combtooth blennies	Blenniidae
Striped blenny	*Chasmodes bosquianus*
Feather blenny	*Hypsoblennius hentzi*
Gobies	Gobiidae
Darter goby	*Gobionellus bolesoma*
Naked goby	*Gobiosoma bosci*
Seaboard goby	*Gobiosoma ginsburgi*
Green goby	*Microgobius thalassinus*
Mackerels	Scombridae
Spanish mackerel	*Scomberomorus maculatus*
Lefteye flounders	Bothidae
Summer flounder	*Paralichthys dentatus*
Windowpane	*Scophthalmus aquosus*
Righteye flounders	Pleuronectidae
Winter flounder	*Pleuronectes americanus*
Soles	Soleidae
Hogchoker	*Trinectes maculates*
Tonguefishes	Cynoglossidae
Blackcheek tonguefish	*Symphurus plagiusa*
Puffers	Tetraodontidae
Northern puffer	*Sphoeroides maculates*
Porcupinefishes	Diodontidae
Striped burrfish	*Chilomycterus schoepfi*

Sources: Hildebrand and Shroeder 1928; Lippson and Lippson 1984; Lippson 1973; Setzler-Hamilton 1987; White 1989; Dovel 1971; Funderburk *et al*. 1991; Lippson and Moran 1975; MDNR Juvenile index and commercial landings database; John Gill, pers. comm., and EPA EMAP database

Table 3-25: Species Collected by Otter Trawl During Fisheries Studies near James & Barren Islands

Data Reported in Number of Each Species (MPA, 2003e; MPA, 2003f; MPA, 2004g; MPA, 2004h; MPA, 2003g; MPA, 2003h; MPA, 2003a; MPA, 2004b)

Species	James Island				Barren Island			
	Summer 2002	Fall 2002	Winter 2003	Spring 2003	Summer 2002	Fall 2002	Winter 2003	Spring 2003
Alewife						1		
Atlantic horseshoe crab				3				
Atlantic silverside				1		13		
Atlantic spadefish					3			
Bay anchovy	13	8			6,400	1		653
Black-fingered mud crab			1					
Blue Crab	9	11	1	53	12			
Blueback herring							1	
Bluefish					1			1
Feather blenny		1			1			
Green goby						8		
Hogchoker				1				
Lined seahorse					1			
Naked goby	2							
Northern pipefish	1							
Sand shrimp			5					
Silver hake				1				
Skilletfish						1		
Spot	2							
Striped anchovy					28			
Striped bass				1		1		1
Striped blenny					1			
Striped searobin								1
Summer flounder					2			
Weakfish					5			
Total	**27**	**20**	**7**	**60**	**6,454**	**25**	**1**	**656**

Table 3-26: Species Collected by Beach Seine During Fisheries Studies near James and Barren Islands

**Data Reported in Number of Each Species (MPA, 2003e; MPA, 2003f; MPA, 2004g; MPA, 2004h; MPA, 2003g; MPA, 2003h; MPA, 2003a; MPA, 2004b)

Species	James Island				Barren Island			
	Summer 2002	Fall 2002	Winter 2003	Spring 2003	Summer 2002	Fall 2002	Winter 2003	Spring 2003
American eel					1			1
Atlantic croaker	1			2				
Atlantic menhaden	13			27	2			
Atlantic needlefish	56							
Atlantic silverside	2273	66		450	1459	45	70	262
Atlantic spadefish					2			
Banded killifish								180
Bay anchovy	26	32		496	4090			251
Blackcheek toungefish	1	1			9			
Black drum					4			
Blue crab	132	24		5	108			197
Blueback herring	10							43
Bluefish				1				
Dagger blade grass shrimp				1				
Dusky pipefish								2
Green goby					4			
Halfbeak	1							
Hogchoker	2				19			6
Lined seahorse		1			1			
Mummichog	82	1			1	6	6	54
Naked goby	1	5			16			
Northern pipefish	8	24		3				
Rainwater killifish	13							
Red drum	2	83			137	55		
Sheepshead minnow	12	2						1
Silver perch		2			81			
Skilletfish	32	5			2	2		
Southern kingfish					166			
Spot	710				4			
Spotted seatrout		2			3			
Striped anchovy					16			
Striped bass	1	1			1	1	1	
Striped blenny					2			
Striped killifish		7			29	3	10	377
Striped mullet						3		
Summer flounder	7	2			2			5
Unknown clupiform								5
Weakfish					163			
White perch		10		3	5		1	
Winter flounder								23
Total	**3383**	**268**	**0**	**988**	**6327**	**115**	**88**	**1407**

Table 3-27: Species Collected by Gillnet During Fisheries Studies near James and Barren Islands.

Data Reported in Number of Each Species

(MPA, 2003f; MPA, 2004g; MPA, 2004h; MPA, 2003g; MP, 2003h; MPA, 2003a; MPA, 2004b)

Species	James Island			Barren Island			
	Fall 2002	Winter 2003	Spring 2003	Summer 2002	Fall 2002	Winter 2003	Spring 2003
Alewife			1	1			
Atlantic croaker	1		14	33			29
Atlantic herring		2				2	
Atlantic horseshoe crab			5				9
Atlantic menhaden	191	58	160	117	3	5	41
Blackcheek tonguefish				1			
Blue Crab	12		5	15	4		11
Blueback herring						12	
Bluefish	27			43			4
Gizzard shad	5						
Hogchoker	2		2	5			2
Inshore lizardfish				14			
Red drum				3			
Silver perch				27			
Southern kingfish	1			10			
Spot	16		8	99			66
Striped bass	25	16	29		4	65	8
Striped mullet	3						
Summer flounder			3	1			
Weakfish	18		8	54			1
White perch	6	8	2		7	5	1
Total	307	84	237	423	18	89	172

Table 3-28: Species Collected by Pop Net During Fisheries Studies near James and Barren Islands during the Spring and Late Season (September) 2003

Data Reported in Number of Each Species. (MPA, 2003b; MPA, 2003c; MPA, 2004d; MPA, 2004e)

Species	James Island		Barren Island	
	Spring 2003	Late Season 2003	Spring 2003	Late Season 2003
Atlantic needlefish	1		5	35
Atlantic silverside		2	28	31
Bay anchovy		5		135
Blue crab	3		10	4
Clam worm			3	
Eelgrass isopod			2	51
Feather blenny		1		
Fourspine stickleback				3
Grass shrimp	65	1	268	777
Naked goby				7
Scud	1		8	
Skilletfish				2
Striped anchovy				8
Weakfish			16	
Total	70	9	340	1,053

Table 3-29: Annual Commercial Harvest of Soft-shell Clams from the Mainstem Chesapeake Bay in Maryland (MPA, 2002c)

Year	Pounds	Dollars
1990	2,130,961	9,031,987
1991	1,700,978	5,394,833
1992	357,815	1,891,200
1993	1,042,191	4,560,454
1994	448,632	3,008,355
1995	447,957	2,492,406
1996	319,434	1,476,422
1997	252,231	1,680,477
1998	217,702	1,454,098
1999	148,161	1,011,631
2000	162,512	975,787

Table 3-30: Oyster Landings Data in Zone 129 (Figure 3-14) (MPA 2002c)

Year	Bushels Harvested
1990	6,500
1991	4,161
1992	902
1993	1
1994	495
1995	1,245
1996	291
1997	2,354
1998	7,618
1999	5,015
2000	2,089

Source: Lewis, 2001.

Table 3-31: Annual Commercial Harvest of Hard Shell Blue Crabs from the Little Choptank River and the Chesapeake Bay (MPA, 2003d)

	Little Choptank River (Zone 53)		Chesapeake Bay (Zone 27)	
Year	Pounds	Dollars	Pounds	Dollars
1995	1,076,134	1,080,107	7,949,893	6,662,148
1996	1,069,094	997,592	6,570,675	4,517,427
1997	1,067,648	977,539	9,199,809	6,753,100
1998	976,947	1,018,697	5,944,931	5,589,173
1999	1,103,349	1,236,273	6,549,544	5,331,922
2000	466,136	594,917	4,147,616	4,392,142

Table 3-32: Crab Pot Estimates Surrounding Barren Island, May through September 2003

			Number of Crab Pots			
2003 Survey Month	Harvest Area	Estimated Density	Total Number of Crab Pots	North [a]	West [b]	Southwest [c]
	(Ac)	(Pots/Acre)				
May	551	2	850	320	360	170
June	744	1	700	150	200	350
July	493	1	700	250	300	150
August	2,988	1	1,500	150	900	450
September	NA	NA	70	70	0	0

Notes:

NA – No harvest area calculated. Only one line of pots observed.

[a] North is defined as locations north of the Barren Island northern remnant shoreline.

[b] West is defined as locations west of the Barren Island western shoreline between the northern tip of the northern Barren Island remnant and the southern tip of the unnamed island south of Barren Island.

[c] Southwest is defined as locations south of the unnamed island located south of Barren Island.

Table 3-33: List of Terrestrial and Wetland Vegetation Observed at James Island, 2002-2003
(compiled from MPA, 2003e; MPA, 2003f; MPA, 2004g; MPA, 2004h)

Common Name	Scientific Name	Wetland Indicator Classification	Habitat	Summer 2002	Fall 2002	Winter 2003	Spring 2003
Macroalgae							
Sea Lettuce	***Ulva lactuca***	NL	*		X		
Herbaceous							
Field Garlic	*Allium vineale*	FACU-	F			X	X
Pearly Everlasting	*Anaphalis margaritacea*	NL	*		X		
Broomsedge Bluestem	*Andropogon virginicus*	FACU	*		X		
Common Milkweed	*Asclepias syriaca*	NL	*	X			
Perennial Saltmarsh Aster	*Aster tenuifolius*	OBL	H		X	X	X
Marsh Orach	*Atriplex patula*	FACW	F				X
Pennsylvania Bitter Cress	*Cardamine pensylvanica*	OBL	F			X	X
Broom Sedge	*Carex scoparia*	FACW	*		X		
Sedge Species	*Carex spp.*	---	F	X			X
Yellow Thistle	*Cirsium horridulum*	FACU-	F			X	X
Velvety Panic Grass	*Dichanthelium scoparium*	FACW	*			X	
Saltgrass	*Distichlis spicata*	FACW	B, L, H	X	X	X	X
Squarestem Spikerush	*Eleocharis quadrangulata*	OBL	FW		X	X	
Beaked Spikerush	*Eleocharis rostellata*	OBL	H			X	
White Snakeroot	*Eupatorium rugosum*	NL	*		X		
Seaside Spurge	*Euphorbia polygonifolia*	FACU	H		X	X	X
Fescue	*Festuca sp.*	---	*	X			
Canada Rush	*Juncus canadensis*	OBL	*		X		
Soft Rush	*Juncus effusus*	FACW+	*	X	X		
Black Needlerush	*Juncus roemerianus*	OBL	H	X	X	X	X
Bush Clover	*Lespedeza sp.*	---	*		X		
Wood Rush	*Luzula sp.*	---	*	X			
Wood Sorrel	*Oxalis stricta*	UPL	F				X
Switchgrass	*Panicum virgatum*	FAC	H, F	X	X	X	X
Common Reed	*Phragmites australis*	FACW	B, H	X	X	X	X
Pokeweed	*Phytolacca americana*	FACU+	F	X	X	X	X
Saltmarsh Fleabane	*Pluchea purpurescens*	FACW	*		X		
Pennsylvania Smartweed	*Polygonum pennsylvanica*	FACW	*	X		X	
Dotted Smartweed	*Polygonum punctatum*	OBL	FW		X		
Maryland Meadow Beauty	*Rhexia mariana*	OBL	*			X	
Common Glasswort	*Salicornia europaea*	OBL	B, L		X	X	X
Green Bulrush	*Scirpus atrovirens*	OBL	*		X		
Canby’s Bulrush	*Scirpus etuberculatus*	OBL	H			X	X
Saltmarsh Bulrush	*Scirpus robustus*	OBL	L, H		X	X	X
Elliott’s Goldenrod	*Solidago elliottii*	OBL	F				X
Flat-top Goldenrod	*Solidago graminifolia*	FACU+	*		X	X	
Seaside Goldenrod	*Solidago sempervirens*	FACW	*		X		

Table 3-33: Continued.

Common Name	Scientific Name	Wetland Indicator Classification	Habitat	Summer 2002	Fall 2002	Winter 2003	Spring 2003
Saltmarsh Cordgrass	*Spartina alterniflora*	OBL	B, L	X	X	X	X
Big Cordgrass	*Spartina cynosuroides*	OBL	B, L, H			X	X
Salt Meadow Cordgrass	*Spartina patens*	FACW+	B, L, H	X	X	X	X
Slough Cordgrass	*Spartina pectinata*	OBL	L			X	X
Sphagnum Moss	*Sphagnum sp.*	---	*			X	
Dandelion	*Taraxacum officinale*	FACU-	F			X	X
Sea Oats	*Uniola latifolia*	FACU-	F				X
Beach Clotbur	*Xanthium echinatum*	NL	*		X		
Unknown Grass			*				X
Unknown Snakeroot			*				X
Unknown Vetch			*				X
Ferns							
Hay Scented Fern	*Dennstaedtia punctilobula*	NI	*	X			
Sensitive Fern	*Onoclea sensibilis*	FACW	*	X			
Trees							
Red Maple	*Acer rubrum*	FAC	*		X		
Tree of Heaven	*Ailanthus altissima*	NI	F		X	X	X
Persimmon	*Diospyrus virginiana*	FAC-	F	X	X	X	X
American Holly	*Ilex opaca*	FACU+	F	X	X	X	X
American Red Cedar	*Juniperus virginiana*	FACU	F		X	X	X
Sweetgum	*Liquidambar styraciflua*	FAC	F	X	X	X	X
Black Gum	*Nyssa sylvatica*	FAC	*			X	
Princess Tree	*Paulowinia tomentosa*	NL	F		X		X
Loblolly Pine	*Pinus taeda*	FAC-	F	X	X	X	X
American Sycamore	*Platanus occidentalis*	FACW-	F	X	X	X	X
Bigtooth Aspen	*Populus grandidentata*	FACU-	F		X	X	X
Aspen	*Populus sp.*	---	F	X			
Black Cherry	*Prunus serotina*	FACU	F	X	X	X	X
Willow Oak	*Quercus phellos*	FAC+	F	X	X	X	X
Chestnut Oak	*Quercus prinus*	UPL	*			X	
Vines							
Virgin's Bower	*Clematis virginiana*	FAC	*		X		
Japanese Honeysuckle	*Lonicera japonica*	FAC-	F	X	X	X	X
Virginia Creeper	*Parthenocissus quinquefolia*	FACU	F	X			X
Greenbriar	*Smilax rotundifolia*	FAC	*	X	X		
Poison Ivy	*Toxicodendron radicans*	FAC	F	X	X		X
Shrubs							
Hercules' Club	*Aralia racemosa***		*	X	X		
Hercules' Club	*Aralia spinosa***	FAC	F				X
Groundsel Tree	*Baccharis halimifolia*	FACW	B, H, F		X	X	X
Hawthorn	*Crataegus spp.*	---	*			X	
Marsh Elder	*Iva frutescens*	FACW+	B, H	X	X	X	X

Table 3-33: Continued.

Common Name	Scientific Name	Wetland Indicator Classification	Habitat	Summer 2002	Fall 2002	Winter 2003	Spring 2003
Partridge-berry	*Mitchella repens*	FACU	*	X			
Wax myrtle	*Myrica cerifera*	FAC	B, F		X	X	X
Bayberry	*Myrica pennsylvanica*	FAC	*	X			
Multiflora Rose	*Rosa multiflora*	FACU	*			X	
Blackberry	*Rubus allegheniensis*	FACU-	F		X	X	X
Dewberry	*Rubus hispidus*	FACW	*			X	
Raspberry	*Rubus sp.*	---	*	X			
Deerberry	*Vaccinium stamineum*	FACU-	F				X

* - not specified in text
**-MPA, 2003e and MPA, 2003f list *A. racemosa* as the Latin name for Hercules' club, and MPA, 2004h *lists A. spinosa* as the Latin name.

Notes:
NL – Species was not listed on website (no data available).
NI – Classification not identified, but listed on website.
--- - Species was not specified for observed genus.
FAC = A plant species that sometimes (>33% to 66% of the time) is found in wetlands, but that may also be found commonly in uplands.
FACU = A plant species that is seldom (<33% of the time) is found in wetlands and that usually occurs in uplands.
FACW = A plant species that is usually (>66% to 99% of the time) is found in wetlands, but that may be found occasionally in uplands under natural conditions.
OBL = A plant species that is generally (>99% of time) found only in wetlands under natural conditions.
Negative sign (-) indicates a species less frequently found in wetlands.
Positive sign (+) indicates a species more frequently found in wetlands
B – Beach.
F – Forest.
FW – Fresh Water Marsh.
H – High Marsh.
L – Low Marsh.
O – Open Water.

Table 3-34: Plant Species of Barren Island (MPA, 2005a)

Common Name	Scientific Name	Wetland Indicator Classification	Habitat	Summer 2002	Fall 2002	Winter 2003	Spring 2003
Trees							
Red Maple	Acer rubrum	FAC	F, FW	X	X	X	X
Common Hackberry	*Celtis occidentalis*	FACU	U	X	X		X
Common Persimmon	*Diospyros virginiana*	FAC-	U	X	X	X	X
American Holly	*Ilex opaca*	FACU+	U	X	X	X	X
Eastern Red Cedar	*Juniperus virginiana*	FACU	U	X	X	X	X
Sweetgum	*Liquidambar styraciflua*	FAC	U, FW	X	X	X	X
Osage Orange	*Maclura pomifera*	UPL	U	X			X
White Mulberry	*Morus alba*	UPL	U	X			
Red Mulberry	*Morus rubra*	FACU	U	X			X
Black-Gum	*Nyssa sylvatica*	FAC	FW	X		X	X
Loblolly Pine	*Pinus taeda*	FAC	S, U	X		X	X
Sycamore	*Platanus occidentalis*	FACW-	F		X		
Eastern Cottonwood	*Populus deltoides*	FAC	U			X	X
Sweet Cherry	*Prunus avium*	NL	U			X	X
Black Cherry	*Prunus serotina*	FACU	U	X	X	X	X
Pin Oak	*Quercus falcate*	FACU-	F		X		
Willow Oak	*Quercus phellos*	FAC+	FW		X		
Black Locust	*Robinia pseudoacacia*	FACU-	U	X	X	X	X
Black Willow	*Salix nigra*	OBL	FW		X	X	X
Sassafras	*Sassafras albidum*	FACU-	U			X	X
Slippery Elm	*Ulmus rubra*	FAC-	FW	X	X		
Shrubs							
Groundsel Tree	*Baccharis halimifolia*	FACW	U	X	X	X	X
Hawthorn	*Crataegus spp.*	FACU	U				X
Marsh Elder	*Iva frutescens*	FACW+	S, U	X	X	X	X
Northern Bayberry	*Morella pensylvanica*	FAC	S, U		X	X	X
Wax myrtle	*Myrica cerifera*	FAC	U	X		X	X
Winged Sumac	*Rhus copallinum*	FACU	U		X		X
Prairie Rose	*Rosa setigera*	FACU	U			X	X
Herbaceous							
Field Garlic	*Allium vineale*	FACU-	U				X
Broom-Sedge	*Andropogon virginicus*	FACU	U	X	X	X	X
Common Milkweed	*Asclepias syriaca*	NL	U				X
Saltmarsh Aster	*Aster tenuifolius*	OBL	S	X		X	X
Marsh Orach	*Atriplex patula*	FACW	B	X			X
Sea Rocket	*Cakile edentula*	FACU	B				X
Saltmarsh Cockspur	*Cenchrus tribuloides*	UPL	B	X			
Bull Thistle	*Cirsium vulgare*	NL	U				X

Table 3-34: Continued.

Common Name	Scientific Name	Wetland Indicator Classification	Habitat	Summer 2002	Fall 2002	Winter 2003	Spring 2003
Saltgrass	*Distichlis spicata*	FACW	S	X	X	X	X
Walter's Millet	*Echinochloa walteri*	FACW+	FW	X	X		
Virginia Wild Rye	*Elymus virginicus*	FACW+	FW		X		
Saltmarsh Bulrush	*Fimbristylis castanea*	OBL	S	X			
Marsh Pennyworth	*Hydrocotyle umbellate*	OBL	FW				X
Bottlebrush Grass	*Hystrix patula*	NL	FW	X	X		
Soft Rush	*Juncus effusus*	FACW+	FW	X	X	X	X
Black Grass	*Juncus gerardii*	OBL	S			X	X
Black Needlerush	*Juncus roemerianus*	OBL	S	X	X	X	X
Path Rush	*Juncus tenuis*	FAC-	U		X		
Seashore Mallow	*Kosteletzskya virginica*	OBL	S	X			
Sea Lavender	*Limonium carolinianum*	OBL	S	X			
Japanese Stiltgrass	*Microstegium vimineum*	FAC	U, F	X			
Switchgrass	*Panicum virgatum*	FAC	S, F	X	X	X	X
Common Reed	*Phragmites australis*	FACW	S,U,FW	X	X	X	X
Pokeweed	*Phytolacca americana*	FACU+	U	X	X	X	X
Saltmarsh Fleabane	*Pluchea purpurascens*	FACW	S	X	X		
Pennsylvania Smartweed	*Polygonum pensylvanicum*	FACW	U				X
Dotted Smartweed	*Polygonum punctatum*	OBL	FW	X	X		
Pickerel Weed	*Ponterderia cordata*	OBL	FW				X
Wild Red Raspberry	*Rubus idaeus*	FAC-	U	X			
Common Glasswort	*Salicornia europaea*	OBL	S	X	X		X
Common Saltwort	*Salsola kali*	FACU	B	X	X		
Woolgrass	*Scirpus cyperinus*	FACW+	FW		X		X
Three Square Rush	*Scirpus americanus*	OBL	S			X	X
Saltmarsh Bulrush	*Scirpus robustus*	OBL	S	X	X	X	X
Giant Foxtail Grass	*Setaria faberi*	U	F	X	X	X	X
Marsh Bristlegrass	*Setaria parviflora*	FAC	FW		X		
Flat-top Goldenrod	*Solidago graminifolia*	NL	U		X		
Seaside Goldenrod	*Solidago sempervirens*	FACW	S, B	X	X		X
Saltmarsh Cordgrass	*Spartina alterniflora*	OBL	S	X	X	X	X
Big Cordgrass	*Spartina cynosuroides*	OBL	S	X	X		X
Salt Meadow Cordgrass	*Spartina patens*	FACW+	S	X	X	X	X
Common Chickweed	*Stellaria media*	FACU-	F			X	X
Sea-Blite	*Suaeda maritime*	OBL	B				X
Narrow Leaf-Cattail	*Typha augustifolia*	OBL	S	X		X	X
Common Cattail	*Typha latifolia*	OBL	FW	X	X		X

Table 3-34. Continued.

Common Name	Scientific Name	Wetland Indicator Classification	Habitat	Summer 2002	Fall 2002	Winter 2003	Spring 2003
Wood Vines							
Trumpet Creeper	*Campsis radicans*	FAC	U	X	X	X	X
Japanese Honeysuckle	*Lonicera japonica*	FAC-	U	X	X	X	X
Greenbrier	*Smilax rotundiflolia*	FAC	U	X	X	X	X
Poison Ivy	*Toxicodendron radicans*	FAC	U	X	X	X	X
Fox Grape	*Vitis labrusca*	FACU	U	X		X	X

* - not specified in text
**-MPA, 2003e and MPA, 2003f list *A. racemosa* as the Latin name for Hercules' club, and MPA, 2004h *lists A. spinosa* as the Latin name.
Notes:
NL – Species was not listed on website (no data available).
NI – Classification not identified, but listed on website.
--- - Species was not specified for observed genus.
FAC = A plant species that sometimes (>33% to 66% of the time) is found in wetlands, but that may also be found commonly in uplands.
FACU = A plant species that is seldom (<33% of the time) is found in wetlands and that usually occurs in uplands.
FACW = A plant species that is usually (>66% to 99% of the time) is found in wetlands, but that may be found occasionally in uplands under natural conditions.
OBL = A plant species that is generally (>99% of time) found only in wetlands under natural conditions.
Negative sign (-) indicates a species less frequently found in wetlands.
Positive sign (+) indicates a species more frequently found in wetlands
B – Beach.
F – Forest.
FW – Fresh Water Marsh.
H – High Marsh.
L – Low Marsh.
O – Open Water.

Table 3-35: List of Wildlife Species Observed at James Island 2002-2003

Common Name	Scientific Name	Observation	Habitat	Summer 2002	Fall 2002	Winter 2003	Spring 2003
Mammals							
Sika Deer	*Cervus nippon*	T	B	X	X		X*
River Otter	*Lutra canadensis*	S, T, V	B, S, F			X	X
White-tailed Deer	*Odocoileus virginianus*	T	B				X*
Muskrat	*Ondatra zibethicus*	S, T	B, S, F			X	X
Raccoon	*Procyon lotor*	S, T, V	B, S, F	X	X	X[b]	
Reptiles & Amphibians							
Eastern Mud Turtle	*Kinosternon subrubrum*	V	**				X[b]
Diamondback Terrapin	*Malaclemys terrapin*	V	B	X			X
Northern Brown Water Snake	*Nerodia sipedon*	V	B, O	X[b]	X		X
Rough Green Snake	*Opheodrys aestivus*	V	**		X		
Box Turtle	*Terrapene carolina*	V	**	X		X[a]	X[b]
Garter Snake	*Thamnophis sirtalis*	V	B	X[b]			
Invertebrates							
Mosquito	*Aedes sp.*	**	**				X
Bay Barnacle	*Balanus improvisus*	V	B, S			X[a]	X
Blue Crab	*Callinectes sapidus*	V	B, S, O	X	X	X[b]	X
Deerfly	*Chrysops spp.*	**	**			X	
Big Sand Tiger Beetle	*Cicindela formosa*	V	B			X	X
Eastern Oyster	*Crassostrea virginica*	V	B, S		X[a]	X	X[a]
Angel Wing	*Cyrtopleura costata*	**	**				X
Atlantic Ribbed Mussel	*Geukensia demissa*	V	B, S		X[a]	X[a]	X[a]
Horseshoe Crab	*Limulus polyphemus*	V	B, S	X[b]	X[b]	X[b]	X[b]
Marsh Periwinkle	*Littorina irrorata*	V	S			X	X
Praying Mantis	*Mantis religiosa*	V	**			X	X
Eastern melampus	*Melampus bidentatus*	V	B, S			X[a]	X[a]
Soft Shell Clam	*Mya arenaria*	V	B, S			X[a]	X[a]
False Angel Wing	*Petricola phoadiformis*	**	**			X	X
Atlantic Razor Clam	*Siliqua costata*	V	B, S			X[a]	X[a]
Black Fly	*Tabanus atratus*	**	**				X
Northern Dwarf Tellin	*Tellina agilis*	V	B, S			X[a]	X[a]
Marsh Fiddler Crab	*Uca pugnax*	V	S	X	X	X	X
Flying Ant		**	**			X	
Seaside Dragonlet	enice	V	**				X
Butterflies							
Mourning Cloak	*Nymphalis antiopa*	V	**			X	X
Monarch	*Danaus plexippus*	V	**				X
Red Admiral	*Vanessa atalanta*	V	**				X
Black Swallowtail	*Papilio polyxenes*	V	**				X

* - tracks found, unsure whether white-tail or sika deer? ** - not specified in text

Observation/Habitat Key:

S=Scat; T=Tracks; V=Visual; F=Forest; S=Salt Marsh; FW=Freshwater Marsh; O=Open Water; FO=Fly Over; MF=Mud Flat; B=Beach

[a] – shell only [b] – dead

Table 3-36: Non-Avian Wildlife Observed at Barren Island (MPA, 2005a)

Common Name	Scientific Name	Observation	Habitat	Summer 2002	Fall 2002	Winter 2003	Spring 2003
Mammals							
Muskrat	*Ondatra zibethica*	S	S			X	X
Racoon	*Procyon lotor*	S, T	F, S	X	X	X	X
Red Fox	*Vulpus fulva*	S, T, V	F, S			X	X
Sika Deer	*Cervus nippon*	T, V	F, FW				
Whitetail Deer	*Odocolleus virginianus*	S, T, V	F, S, FW	X	X	X	X
Reptiles & Amphibians							
Diamondback Terrapin	*Malclemys terrapin*	V	O, B	X*	X*		X
Eastern Box Turtle	*Terrapene carolina*	V	F	X	X		X
Eastern Mud Turtle	*Kinosternon subrubrum*	V	FW	X			X
Eastern Painted Turtle	*Chrysemys picta picata*	V	FW				X
Fowler's Toad	*Bufo fowleri*	V	FW				X
Narrow-mouthed Toad	*Gastrophryne carolinensis*	C	FW				X
Northern Red-bellied Turtle	*Pseudemys rubriventris*	V	FW				X
Northern Water Snake	*Nerodia sipedon*	V	SM		X**		
Spotted Turtle	*Clemmys guttata*	V	F			X	X
Invertebrates							
American Oyster	*Crassostrea virginica*	V	MF		X	X	X
Atlantic Ribbed Mussel	*Geukensia demissa*	V	S	X	X	X	X
Blue Crab	*Callinectes sapidus*	V	S	X	X	X	X
Ghost Crab	*Ocypoda quadrata*	S	B				X
Horseshoe Crab	*Limulus polyphemus*	V	B	X	X**		X
Marsh Periwinkle	*Littorina irrotata*	V	S	X	X	X	X
Marsh fiddler crab	*Uca pugnax*			X	X		
Mud snail	*Nassarius obsoletus*	V	MF				X
Red-jointed fiddler crab	*Uca minax*	V	S	X	X	X	X
Saltmarsh snail	*Melampus bidentatus*	V	S				X
Tiger beetle species	*Cicindela sp.*			X			
Wharf crab	*Sesarma cinereum*	V	MF				X
Butterflies							
Common Wood Nymph	*Cercyonis pegala*	V	FW	X			
Eastern tailed blue	*Everes comyntas*	V	FW	X			
Monarch	*Danaus plexippus*	V	FW	X			
Orange clouded sulphur	*Collas eurytheme*	V	FW	X			
Red spotted purple	*Limenitis arthemis*	V	FW	X			

Notes:
Observation/Habitat Key:
C=Call; S=Scat; T=Tracks; V=Visual
F=Forest; S=Salt Marsh; FW=Freshwater Marsh; O=Open Water; FO=Fly Over; MF=Mud Flat; B=Beach
*=Shell only
**=Dead

Table 3-37: Results of James Island Timed Avian Surveys

Avian Station Location		B-1					B-2				
Common Name	Scientific Name	Total	Summer 2002	Fall 2002	Winter 2003	Spring 2003	Total	Summer 2002	Fall 2002	Winter 2003	Spring 2003
Common Loon	*Gavia immer*	1		1			0				
Horned Grebe	*Podiceps auritus*	0					1		1		
Brown Pelican	*Pelecanus occidentalis*	6	3	3			0				
Great Blue Heron	*Ardea herodias*	0					3	1		1	1
Great Egret	*Ardea alba*	1	1				0				
Double-Crested Cormorant	*Phalacrocorax auritus*	1		1			0				
Mallard	*Anus platyrhynchos*	0					3				3
Mute Swan	*Cygnus olor*	2				2	2			2	
Canada Goose	*Branta canadensis*	0					2			2	
Surf Scoter	*Melanitta perspicillata*	3		3			0				
Black Scoter	*Melanitta nigra*	8		8			1		1		
White Winged Scoter	*Melanitta fusca*	0					2			2	
Bufflehead	*Bucephala albicollis*	16			16		63		28	35	
Long Tailed Duck	*Clangula hyemalis*	2			2		1			1	
Bald Eagle	*Haliaeetus leucocephalus*	3	1	1	1		1				1
Osprey	*Pandion haliaetus*	9	3		4	2	8	3		3	2
Sharp-Shinned Hawk	*Accipiter striatus*	1			1		0				
Laughing Gull	*Larus atricilla*	0					0				
Great Black-Backed Gull	*Larus marinus*	1		1			3		1	2	
Herring Gull	*Larus argentatus*	13		13			1		1		
Ring-Billed Gull	*Larus delawarensis*	1			1		5			5	
Sanderling	*Calidris alba*	0					12			12	
Royal Tern	*Sterna maxima*	2		2			0				
Common Tern	*Sterna hirundo*	0					0				
Forster's Tern	*Sterna forsteri*	1				1	0				
Spotted Sandpiper	*Actitis macularia*	0					1				1
Brown Creeper	*Certhia americana*	1		1			0				
American Crow	*Corvus brachyrhynchos*	2	1		1		3	1		2	
Tree Swallow	*Tachycineta bicolor*	4				4	1				1
Barn Swallow	*Hirundo rustica*	2				2	0				
Carolina Chickadee	*Poecile carolinensis*	1	1				0				
Brown Headed Cowbird	*Moluthrus ater*	0					0				
Eastern Bluebird	*Sialis sialis*	1			1		0				
Eastern Kingbird	*Tyrannus tyrannus*	1				1	0				
American Robin	*Turdus migratorius*	0					0				
Pine Warbler	*endroica pinus*	5	2		3		0				
Northern Cardinal	*Cardinalis cardinalis*	1	1				0				
Red-Winged Blackbird	*Agelaius phoeniceus*	0					1	1			
Common Grackle	*Quiscalus quiscula*	2				2	54	2		48	4
European Starling	*Sturnus vulgaris*	1				1	0				
Northern Flicker	*Colaptes auratus*	1			1		1		1		
TOTALS		**93**	**13**	**34**	**31**	**15**	**169**	**8**	**33**	**115**	**13**

Table 3-37: Continued.

Avian Station Location		B-3					B-4				
Common Name	**Scientific Name**	Total	Summer 2002	Fall 2002	Winter 2003	Spring 2003	Total	Summer 2002	Fall 2002	Winter 2003	Spring 2003
Common Loon	*Gavia immer*	0					0				
Horned Grebe	*Podiceps auritus*	0					1			1	
Brown Pelican	*Pelecanus occidentalis*	0					3		3		
Great Blue Heron	*Ardea herodias*	0					0				
Great Egret	*Ardea alba*	0					0				
Double-Crested Cormorant	*Phalacrocorax auritus*	0					0				
Mallard	*Anus platyrhynchos*	0					0				
Mute Swan	*Cygnus olor*	4	2			2	0				
Canada Goose	*Branta canadensis*	4			4		0				
Surf Scoter	*Melanitta perspicillata*	18			18		1			1	
Black Scoter	*Melanitta nigra*	0					2		2		
White Winged Scoter	*Melanitta fusca*	0					0				
Bufflehead	*Bucephala albicollis*	48		8	40		49		40	9	
Long Tailed Duck	*Clangula hyemalis*	0					4			4	
Bald Eagle	*Haliaeetus leucocephalus*	2	1	1			2		2		
Osprey	*Pandion haliaetus*	8	3		5		5				5
Sharp-Shinned Hawk	*Accipiter striatus*	0					0				
Laughing Gull	*Larus atricilla*	0					1	1			
Great Black-Backed Gull	*Larus marinus*	1		1			2	1	1		
Herring Gull	*Larus argentatus*	3		3			3		3		
Ring-Billed Gull	*Larus delawarensis*	4			4		0				
Sanderling	*Calidris alba*	0					0				
Royal Tern	*Sterna maxima*	2		2			0				
Common Tern	*Sterna hirundo*	2	1		1		0				
Forster's Tern	*Sterna forsteri*	0					2	2			
Spotted Sandpiper	*Actitis macularia*	0					2				2
Brown Creeper	*Certhia americana*	0					0				
American Crow	*Corvus brachyrhynchos*	0					0				
Tree Swallow	*Tachycineta bicolor*	0					0				
Barn Swallow	*Hirundo rustica*	3	1			2	2				2
Carolina Chickadee	*Poecile carolinensis*	0					0				
Brown Headed Cowbird	*Moluthrus ater*	1			1		0				
Eastern Bluebird	*Sialis sialis*	1	1				0				
Eastern Kingbird	*Tyrannus tyrannus*	0					3				3
American Robin	*Turdus migratorius*	0					0				
Pine Warbler	*Dendroica pinus*	0					0				
Northern Cardinal	*Cardinalis cardinalis*	0					0				
Red-winged Blackbird	*Agelaius phoeniceus*	3	3				0				
Common Grackle	*Quiscalus quiscula*	1	1				0				
European Starling	*Sturnus vulgaris*	0					0				
Northern Flicker	*Colaptes auratus*	0					1			1	
TOTALS		**105**	**13**	**15**	**73**	**4**	**83**	**4**	**51**	**16**	**12**

Table 3-37: Continued.

Avian Station Location		B-5					Combined Locations				
Common Name	Scientific Name	Total	Summer 2002	Fall 2002	Winter 2003	Spring 2003	Total	Summer 2002	Fall 2002	Winter 2003	Spring 2003
Common Loon	*Gavia immer*						1		1		
Horned Grebe	*Podiceps auritus*						2		1	1	
Brown Pelican	*Pelecanus occidentalis*						9	3	6		
Great Blue Heron	*Ardea herodias*						3	1		1	1
Great Egret	*Ardea alba*						1	1			
Double-Crested Cormorant	*Phalacrocorax auritus*						1		1		
Mallard	*Anus platyrhynchos*						3				3
Mute Swan	*Cygnus olor*						8	2		2	4
Canada Goose	*Branta canadensis*						6			6	
Surf Scoter	*Melanitta perspicillata*	157			157		179		3	176	
Black Scoter	*Melanitta nigra*	6		6			17		17		
White Winged Scoter	*Melanitta fusca*						2			2	
Bufflehead	*Bucephala albicollis*	1			1		177		76	101	
Long Tailed Duck	*Clangula hyemalis*	2			2		9			9	
Bald Eagle	*Haliaeetus leucocephalus*	2				2	10	2	4	1	3
Osprey	*Pandion haliaetus*	2	1	1			32	10	1	12	9
Sharp-Shinned Hawk	*Accipiter striatus*						1			1	
Laughing Gull	*Larus atricilla*						1	1			
Great Black Backed Gull	*Larus marinus*	1		1			8	1	5	2	
Herring Gull	*Larus argentatus*	9		9			29		29		
Ring-billed Gull	*Larus delawarensis*	2			2		12			12	
Sanderling	*Calidris alba*						12			12	
Royal Tern	*Sterna maxima*	2		2			6		6	0	
Common Tern	*Sterna hirundo*						2	1		1	
Forster's Tern	*Sterna forsteri*						3	2			1
Spotted Sandpiper	*Actitis macularia*						3				3
Brown Creeper	*Certhia americana*						1		1		
American Crow	*Corvus brachyrhynchos*						5	2		3	
Tree Swallow	*Tachycineta bicolor*						5				5
Barn Swallow	*Hirundo rustica*						7	1			6
Carolina Chickadee	*Poecile carolinensis*						1	1			
Brown Headed Cowbird	*Moluthrus ater*	1			1		2			2	
Eastern Bluebird	*Sialis sialis*						2	1		1	
Eastern Kingbird	*Tyrannus tyrannus*						4				4
American Robin	*Turdus migratorius*	2			2		2			2	
Pine Warbler	*Dendroica pinus*	1	1				6	3		3	
Northern Cardinal	*Cardinalis cardinalis*						1	1			
Red-Winged Blackbird	*Agelaius phoeniceus*						4	4			
Common Grackle	*Quiscalus quiscula*	1				1	58	3		48	7
European Starling	*Sturnus vulgaris*						1				1
Northern Flicker	*Colaptes auratus*	2			2		5		1	4	
TOTALS		**191**	**2**	**19**	**167**	**3**	**641**	**40**	**152**	**402**	**47**

Table 3-38: Bird Species Observed during Site Visits to James Island

Common Name	Scientific Name	Season and Number Observed			
		Summer 2002	Fall 2002	Winter 2003	Spring 2003
Common Loon	*Gavia immer*		X		X
Horned Grebe	*Podiceps auritus*		X	X	
Brown Pelican	*Pelecanus occidentalis*	X	X		X
Double-Crested Cormorant	*Phalacrocorax auritus*	X	X	X	X
Green Heron	*Butorides virescens*	X			
Great Egret	*Ardea alba*	X			
Great Blue Heron	*Ardea herodias*	X		X	X
Mute Swan	*Cygnus olor*	X	X	X	X
Snow Goose	*Chen caerulescens*				X
Canada Goose	*Branta canadensis*	X	X	X	X
Mallard	*Anas platyrhynchos*				X
Black Scoter	*Melanitta nigra*		X		
White-Winged Scoter	*Melanitta fusca*		X	X	
Surf Scoter	*Melanitta perspicillata*		X	X	X
Long-Tailed Duck	*Clangula hyemalis*			X	
Bufflehead	*Bucephala albeola*		X	X	X
Red-Breasted Merganser	*Mergus serrator*		X		
Turkey Vulture	*Cathartes aura*		X		
Osprey	*Pandion haliaetus*	X	X	X	X
Bald Eagle	*Haliaeetus leucocephalus*	X	X	X	X
Sharp-Shinned Hawk	*Accipiter striatus*		X	X	
American Kestrel	*Falco sparverius*			X	
Semi-Palmated Plover	*Charadrius semipalmatus*				X
Killdeer	*Charadrius vociferus*	X	X		
Greater Yellowlegs	*Tringa melanolueca*				X
Spotted Sandpiper	*Actitis macularia*				X
Ruddy Turnstone	*Arenaria interpres*				X
Sanderling	*Calidris alba*			X	
Dunlin	*Calidris alpina*				X
Least Sandpiper	*Calidris minutilla*				X
Laughing Gull	*Larus atricilla*	X			X
Ring-billed Gull	*Larus delawarensis*			X	X
Herring Gull	*Larus argentatus*		X		X
Great Black-Backed Gull	*Larus marinus*	X	X	X	
Royal Tern	*Sterna maxima*		X		X
Forster's Tern	*Sterna forsteri*	X	X		X
Common Tern	*Sterna hirundo*	X		X	X
Least Tern	*Sterna antillarum*				
Mourning Dove	*Zenaida macroura*			X	
Barred Owl	*Strix varia*				X
Northern Flicker	*Colaptes auratus*		X	X	X
Downy Woodpecker	*Picoides pubescens*		X		
Hairy Woodpecker	*Picoides villosus*		X		
Eastern Phoebe	*Sayornis phoebe*		X	X	

Table 3-38: Continued.

Eastern Kingbird	*Tyrannus tyrannus*	**X**			**X**
Blue Jay	*Cyanocitta cristata*		**X**		**X**
American Crow	*Corvus brachyrhynchos*	**X**	**X**	**X**	**X**
Tree Swallow	*Tachycineta bicolor*				**X**
Northern Rough-Winged Swallow	*Stelgidopterix serripennis*				**X**
Barn Swallow	*Hirundo rustica*	**X**			**X**
Tufted Titmouse	*Baeolophus bicolor*		**X**		
Carolina Chickadee	*Poecile carolinensis*	**X**	**X**	**X**	**X**
Brown Creeper	*Certhia americana*		**X**	**X**	
House Wren	*Troglodytes aedon*				**X**
Carolina Wren	*Thryothorus ludovicianus*	**X**		**X**	
Golden-Crowned Kinglet	*Regulus satrapa*			**X**	
Eastern Bluebird	*Sialia sialis*	**X**		**X**	**X**
American Robin	*Turdus migratorius*			**X**	
Gray Catbird	*Dumetella carolinensis*				**X**
European Starling	*Sturnus vulgaris*				**X**
Yellow-Rumped Warbler	*Dendroica coronata*			**X**	
Pine Warbler	*Dendroica pinus*	**X**		**X**	**X**
Yellow Warbler	*Dendroica petechia*				**X**
Louisiana Waterthrush	*Seiurus motacilla*			**X**	
Song Sparrow	*Melospiza melodia*			**X**	
Swamp Sparrow	*Melospiza georgiana*			**X**	
Northern Cardinal	*Cardinalis cardinalis*			**X**	**X**
Red-Winged Blackbird	*Agelaius phoeniceus*				**X**
Common Grackle	*Quiscalus quiscula*			**X**	**X**
Brown-Headed Cowbird	*Molothrus ater*			**X**	**X**
American Goldfinch	*Carduelis tristis*				**X**
TOTAL NUMBER OF SPECIES	**72**	**21**	**29**	**35**	**44**

Table 3-39: Results of the Barren Island Avian Quantitative Surveys (MPA, 2005a)

Avian Location		**A-1**					**A-2**			
Year	Total	**2002**		**2003**		Total	**2002**		**2003**	
Common Name Season		Summer	Fall	Winter	Spring		Summer	Fall	Winter	Spring
American Goldfinch	**2**		2							
American Crow										
Bald Eagle	**1**	1				**3**	1	2		
Barn Swallow										
Boat Tail Grackle										
Brown Pelican	**14**		14			**20**		17		3
Bufflehead	**17**		17			**7**		7		
Canada Goose	**3**		3							
Carolina Chickadee										
Carolina Wren						**1**		1		
Common Egret										
Common Grackle										
Common Loon	**4**		3	1		**2**		2		
Common Tern	**10**				10	**1**				1
Double Crested Cormorant	**22**	4			18	**15**	11			4
Downy Woodpecker						**1**		1		
Dunlin										
Fish Crow						**1**				1
Forster's Tern	**2**	1			1	**2**	1			1
Gadwall										
Golden Crowned Kinglet										
Great Black Backed Gull	**2**		2			**7**	1	4	2	
Great Blue Heron	**2**		1		1	**9**				9
Great Egret						**2**	1			1
Herring Gull	**9**	9				**26**	11	8	4	3
Laughing Gull	**1**	1								
Mute Swan	**2**				2					
Northern Cardinal										
Northern Gannet	**5**		5							
Oldsquaw	**1**			1						
Osprey						**3**				3
Peregrine Falcon						**1**	1			
Red-Throated Loon	**1**		1							
Ring-Billed Gull										
Red-Winged Blackbird										
Royal Tern	**1**				1					
Semipalmated Sandpipers										
Surf Scoter										
Tree Swallow						**2**				2
Tundra Swan										
Turkey Vulture										
Willet										
Winter Wren										
Yellow-Rumped (Myrtle) Warbler										
Yellow-Shafted Flicker						**2**				2
Unidentified ducks	**20**		20							
Unidentified shorebirds										
Species Count	**17**	5	10	2	6	**17**	7	8	2	11
TOTAL	**119**	16	68	2	33	**105**	27	42	6	30

Table 3-39: Continued.

Avian Location	A-3					A-4				
Year	Total	2002		2003		Total	2002		2003	
Common Name Season		Summer	Fall	Winter	Spring		Summer	Fall	Winter	Spring
American Goldfinch										
American Crow						**3**			2	1
Bald Eagle	**5**	2		2	1	**2**	1	1		
Barn Swallow						**1**				1
Boat Tail Grackle						**2**				2
Brown Pelican	**274**	4	262		8					
Bufflehead	**14**		14			**5**		5		
Canada Goose						**11**		11		
Carolina Chickadee						**1**			1	
Carolina Wren						**3**	1		2	
Common Egret										
Common Grackle	**4**				4					
Common Loon	**2**		1	1						
Common Tern	**5**				5					
Double Crested Cormorant	**118**	3	77	2	36	**4**	1	2		1
Downy Woodpecker						**1**	1			
Dunlin										
Fish Crow						**1**				1
Forster's Tern	**8**		8			**2**	2			
Gadwall										
Golden Crowned Kinglet						**1**		1		
Great Black Backed Gull	**10**	1	9			**15**	9	6		
Great Blue Heron	**14**			6	8	**34**			6	28
Great Egret						**58**	1			57
Herring Gull	**9**	7		1	1	**11**	9			2
Laughing Gull						**1**	1			
Mute Swan						**377**	106	270		1
Northern Cardinal						**1**			1	
Northern Gannet										
Oldsquaw										
Osprey	**1**				1	**2**				2
Peregrine Falcon										
Red-Throated Loon										
Ring-Billed Gull										
Red-Winged Blackbird										
Royal Tern	**1**				1	**3**	3			
Semipalmated Sandpipers										
Surf Scoter	**7**		7							
Tree Swallow	**2**				2					
Tundra Swan	**7**		7							
Turkey Vulture						**100**		100		
Willet						**2**			2	
Winter Wren						**1**		1		
Yellow-Rumped (Myrtle) Warbler						**1**		1		
Yellow-Shafted Flicker										
Unidentified ducks						**5**	5			
Unidentified shorebirds										
Species Count	**15**	5	8	5	10	**26**	12	10	6	10
	481	17	385	12	67	**648**	140	398	14	96

Table 3-39: Continued.

Avian Location	A-5					Combined Locations				
Year	Total	2002		2003		Total	2002		2003	
Common Name Season		Summer	Fall	Winter	Spring		Summer	Fall	Winter	Spring
American Goldfinch						**2**		2		
American Crow	**10**	7			3	**13**	7		2	4
Bald Eagle	**2**		2			**13**	5	5	2	1
Barn Swallow						**1**				1
Boat Tail Grackle	**10**				10	**12**				12
Brown Pelican	**1**					**309**	5	293		11
Bufflehead	**3**		3			**46**		46		
Canada Goose	**2**		2			**16**		16		
Carolina Chickadee						**1**			1	
Carolina Wren						**4**	1	1	2	
Common Egret	**3**				3	**3**				3
Common Grackle	**14**				14	**18**				18
Common Loon						**8**		6	2	
Common Tern						**16**				16
Double Crested Cormorant	**11**	11				**170**	30	79	2	59
Downy Woodpecker						**2**	1	1		
Dunlin	**5**			5		**5**			5	
Fish Crow	**4**				4	**6**				6
Forster's Tern	**5**	1	4			**19**	5	12		2
Gadwall	**2**		2			**2**		2		
Golden Crowned Kinglet						**1**		1		
Great Black Backed Gull	**93**		93			**127**	11	114	2	
Great Blue Heron	**11**	1	1		9	**70**	1	2	12	55
Great Egret	**14**	2			12	**74**	4			70
Herring Gull	**21**		16	5		**76**	36	24	10	6
Laughing Gull	**2**	2				**4**	4			
Mute Swan	**152**	4	86	60	2	**531**	110	356	60	5
Northern Cardinal						**1**			1	
Northern Gannet						**5**		5		
Oldsquaw						**1**			1	
Osprey	**2**				2	**8**				8
Peregrine Falcon						**1**	1			
Red-Throated Loon						**1**		1		
Ring-Billed Gull	**1**			1		**1**			1	
Red-Winged Blackbird	**10**				10	**10**				10
Royal Tern	**1**	1				**6**	4			2
Semipalmated Sandpipers	**15**			15		**15**			15	
Surf Scoter						**7**		7		
Tree Swallow	**3**				3	**7**				7
Tundra Swan	**5**		5			**12**		12		
Turkey Vulture	**36**		36			**136**		136		
Willet						**2**			2	
Winter Wren						**1**		1		
Yellow-Rumped (Myrtle) Warbler						**1**		1		
Yellow-Shafted Flicker						**2**				2
Unidentified ducks						**25**	5	20		
Unidentified shorebirds	**6**		6			**6**		6		
Species Count	**27**	9	11	5	11	**45**	16	23	16	20
TOTAL	**444**	30	256	86	72	**1,797**	230	1,149	120	298

Table 3-40: All Bird Species Observed at Barren Island. (MPA, 2005a)

Order	Common Name	Scientific Name	Status	Habitat	Summer 2002	Fall 2002	Winter 2003	Spring 2003
Anseriforms	Mallard	hos	R	O,S,FW			X	X
	American Black Duck	*Anas rubripes*	WR,R?	O,M		X		
	Gadwall	*Anas streptera*	WR?	O		X		
	Canada Goose	*Branta Canadensis*	WR,R?	O		X		
	Bufflehead	*Bucephala albeola*	WR,M	O		X		
	Oldsquaw	*Clangula hyemalls*	WR,M, R*	O,FO		X	X	X
	Tundra Swan	*Cyngus columblanus*	WR,M	O		X		
	Mute Swan	*Cyngus olor*	R	O	X	X	X	X
	Black Scoter	*Melanitta nigra*	WR,M	O		X		
	Surf Scoter	*Melanitta perspicillata*	WR,M	O		X	X	
Apodiformes	Ruby Throated Hummingbird	*Archilochus colubris*	M	F	X			
Charadriformes	Sandering	*Caildris alba*	M	SH	X	X		
	Dunlin	*Caildris alpina*	W,M	MF			X	
	Western Sandpiper	*Caildris mauri*	M	SH	X			
	Least Sandpiper	*Caildris minutilla*	M	SH	X			
	Semi-Palmated Sandpiper	*Caildris pusilla*	M	SH,MF	X		X	
	Willet	*Catoptrophorus semipalmatus*	R	MF,SH, FO			X	X
	Semi-Palmated Plover	*Charadrius semmipalmatus*	M	SH	X			
	Wilson's Plover	*Charadrius wilsonia*	M	SH	X			
	American Oystercatcher	*Haematopus pallatus*	R	SH,MF				X
	Herring Gull	*Larus argentatus*	R	S,MF,SH	X	X	X	X
	Laughing Gull	*Larus atricilla*	R	SH,O	X		X	
	Ring-Billed Gull	*Larus delawarensis*	W,M	O,FO			X	
	Great Black-Backed Gull	*Larus marinus*	R	SH,O,FO	X	X	X	
	Black-Bellied Plover	*Pluvialis squatarola*	M	SH	X			
	Caspian Tern	*Sterna caspia*	SR/M	SH,O	X			
	Forster's Tern	*Sterna fosteri*	SR/R	SH,O	X	X		X
	Common Tern	*Sterna hirundo*	S	O,SH				X
	Royal Tern	*Sterna maxima*	SR	S,FW,SH,O	X			X
	Lesser Yellowlegs	*Tringa flavipes*	M	SH	X			
	Greater Yellowlegs	*Tringa melanoleuca*	M	SH	X			
Clconiformes	Great Egret	*Ardea albus*	R	SH,MF,S	X			X
	Great Blue Heron	*Ardea herodias*	R	F,S,MF,SH	X	X	X	X
	American Bittern	*Botaurus lentiginosus*	WR,R?	M		X		
	Green Heron	*Butorides virescens*	S,R?	SH,FW	X			X
	Turkey Vulture	*Cathartes aura*	SR/R	FO	X	X		
	Snowy Egret	*Egretta thula*	R	S,FW,SH	X			X

Table 3-40: Continued.

Order	Common Name	Scientific Name	Status	Habitat	Summer 2002	Fall 2002	Winter 2003	Spring 2003
Coraciformes	Belted Kingfisher	*Ceryle alcyon*	R?,M?	M		X		
Cucuiformes	Yellow-Billed Cukoo	*Coccyzus americanus*	S	F				X
Falconiformes	Sharp-Shinned Hawk	*Accipiter striatus*	R/M	F,FO	X			
Falconiformes	Northern Harrier	*Circus cyaneus*	WR,M	M		X		
	Peregrine Falcon	*Falco peregrinus*	M	SH,FO	X			
	Bald Eagle	*Halliaeetus leucocephalus*	R	SH,F,FO	X	X	X	X
	Osprey	*Pandlon hallaetus*	R	SH,F,FO	X		X	X
Gaviformes	Common Loon	*Gavia immer*	WR,M	O		X	X	
	Red-Throated Loon	*Gavia stellata*	WR,M	O		X		
Gruiformes	Clapper Rail	*Rallus longirostris*	R	SH				X
Passeriformes	Red Winged Blackbird	*Agelaius phoeniceus*	R	FW,SH,F			X	X
	Saltmarsh Sharp-Tailed Sparrow	*Ammodramus caudacutus*	R	S			X	
	Seaside Sparrow	*Ammodramus maritimus*	R	M,S	X		X	
	Northern Cardinal	*Cardinalis cardinalis*	R	F	X	X	X	X
	American Goldfinch	*Carduelis tristis*	R	FO,F		X	X	X
	Veery	*Catharus fuscescens*	M	F	X			
	Hermit Thrush	*Catharus guttatus*	M	F	X			
	Swainsons Thrush	*Catharus ustulatus*	M	F	X			
	Sedge Wren	*Cistothorus platensis*	W	FW				X
	American Crow	*Corvus brachyrhynchos*	R	F,SH,FO	X	X	X	X
	Fish Crow	*Corvus ossifragus*	R	S,F,FW				X
	Black Throated Blue Warbler	*Dendroica caerulescens*	M	F	X			
	Yellow-Rumped Warbler	*Dendroica coronata*	WR,M,	F		X		X
	Magnolia Warbler	*Dendroica magnolia*	M	F	X			
	Yellow Warbler	*Dendroica petechia*	SR/M	F,S,FW	X			X
	Pine Warbler	*Dendroica pinus*	SR/R	F	X			
	Gray Catbird	*Dumetella carolinensis*	R	F	X			X
	Acadian Flycatcher	*Empidonax virescens*	SR/M	F	X			
	Common Yellowthroat	*Geothlypis trichus*	SR/R	M,SH,F	X			X
	Barn Swallow	*Hirundo rustica*	SR/M	O,SH,FW	X			X
	Wood Thrush	*Hylocichla mustelina*	M	F	X			
	Yellow-Breasted Chat	*Icteria virens*	M	F	X			
	Dark-Eyed Junco	*Junco hyemalis*	WR,M	M,F		X	X	
	Swamp Sparrow	*Melospiza georgianna*	WR,M	F		X		
	Song Sparrow	*Melospiza melodia*	R?, WR	F		X		
	Northern Mockingbird	*Mimus polyglottos*	R	F				X

Table 3-40: Continued.

Order	Common Name	Scientific Name	Status	Habitat	Summer 2002	Fall 2002	Winter 2003	Spring 2003
	Black-And-White Warbler	*Mniotilta varia*	M	F	X			
	Tufted Titmouse	*Parus bicolor*	R	F			X	X
	Fox Sparrow	*Passerella iliaca*	WR,M	F		X		
	Eastern Towhee	*Pipilo erythrophthalmus*	R	F				X
	Carolina Chickadee	*Poecile carolinensis*	R	F	X	X	X	X
	Blue-Gray Gnatcatcher	*Polioptila caerulea*	SR/M	F	X			X
	Boat-Tailed Grackle	*Quiscalus major*	R	F,S,SH	X		X	X
	Common Grackle	*Quiscalus quiscula*	R	SH,F				X
	Ruby-Crowned Kinglet	*Regulus calendula*	WR,M	F		X		
	Golden-Crowned Kinglet	*Regulus satrapa*	WR,M	F		X		
	Eastern Phoebe	*Sayornis phoebe*	SR/M	F	X			
	Ovenbird	*Seiurus aurocapillus*	M	F	X			
	Louisiana Waterthrush	*Seiurus motacilla*	M	F	X			
	American Redstart	*Setophaga ruticilla*	M,S	F	X			X
	Eastern Bluebird	*Sialis sialis*	R	F		X		

Notes:
Status/Habitat Key:
M = migrant; R = year-round resident; S = summer resident; W = winter resident; ? = uncertain classification;
F=Forest; S=Salt Marsh; FW=Freshwater Marsh; M = Marsh; O=Open Water; FO=Fly Over; MF=Mud Flat; SH=Shore.
* – injured wing

Table 3-41: Rare, Threatened, and Endangered Species Utilizing James Island, 2002-2003

Common Name	Scientific Name	State Status	Federal Status	Status for Breeding Only	Summer 2002	Fall 2002	Winter 2003	Spring 2003
Plants								
Pearly everlasting	*Anaphalis margaritacea*	S3				X		
Yellow thistle	*Cirsium horridulum*	S3					X	X
Beaked spikerush	*Eleocharis rostellata*	S2?					X	
Canby's bulrush	*Scirpus etuberculatus*	S1/E					X	X
Elliott's goldenrod	*Solidago elliottii*	S3						X
Invertebrates								
Big sand tiger beetle	*Cicindela formosa*	SU					X	X
Avian								
Sharp-Shinned Hawk	*Accipiter striatus*	S1S2B		X		X	X	
Spotted Sandpiper	*Actitis macularia*	S3S4B		X				X
Northern Harrier *	*Circus cyaneus*	S2B		X				
Bald Eagle	*Haliaeetus leucocephalus*	S2S3B/T	M	X	X	X	X	X
Dark-Eyed Junco *	*Junco hyemalis*	S2B		X				
Laughing Gull	*Larus atricilla*	S1B		X	X			X
Brown Pelican	*Pelecanus occidentalis*	S1B		X	X	X		X
Double-Crested Cormorant	*Phalacrocorax auritus*	S1B		X	X	X	X	X
Golden-Crowned Kinglet	*Regulus satrapa*	S2B		X			X	
Yellow-Bellied Sapsucker *	*Sphyrapicus varius*	SHB		X				
Least Tern	*Sterna antillarum*	S2B/T		X				X
Royal Tern	*Sterna maxima*	S1B/E		X		X		X

Notes:
S1- Highly State Rare
S2- State Rare
S3- Watch List-Rare to uncommon
SU- Possibly Rare-status uncertain
S2?- State Rare, rank questionable
LT- Threatened (Federal)
LE- Endangered (Federal)
/E- Endangered (State)
S1B- Highly State Rare for breeding
S2B - State Rare for breeding
S1S2B- Highly State Rare to rare for breeding
S2S3B- State Rare on Watch List for breeding
S3S4B- Watch List-Rare to uncommon to apparently secure for breeding
SHB- Historically from State (not verified for an extended period) for breeding
SXB- Believed extirpated in State for breeding
/I- In Need of Conservation (State)
/T- Threatened (State)
M-in five year monitoring phase following delisting
* - Species observed during an extra site visit conducted in the fall of 2001 and is included in the MPA (2003e) quarterly report.

Table 3-42: Rare, Threatened, and Endangered Species Utilizing Barren Island, 2002-2003

Common Name	Scientific Name	State Status	Federal Status	Status for Breeding Only	Summer 2002	Fall 2002	Winter 2003	Spring 2003
Invertebrates								
Tiger beetle species	*Cicindela sp.*	SU			X			
Amphibians								
Narrow-mouthed toad	*Gastrophryne carolinensis*	S1S2/E						X
Avian								
Sharp-Shinned Hawk	*Accipiter striatus*	S1S2B		X	X			
Saltmarsh Sharp-Tailed Sparrow	*Ammodramus caudacutus*	S3B		X			X	
Gadwall	*Anas streptera*	S2B		X		X		
American Bittern	*Botaurus lentiginosus*	S1S2B/I		X		X		
Hermit Thrush	*Catharus guttatus*	S3S4B		X	X			
Swainson's Thrush	*Catharus ustulatus*	SXB		X	X			
Wilson's Plover	*Charadrius wilsonia*	S1B/E		X	X			
Northern Harrier	*Circus cyaneus*	S2B		X		X		
Sedge Wren	*Cistothorus platensis*	S1B/E		X				X
Black-Throated Blue Warbler	*Dendroica caerulescens*	S3S4B		X	X			
Magnolia Warbler	*Dendroica magnolia*	S3S4B		X	X			
Peregrine Falcon	*Falco peregrinus*	S2/I			X			
American Oystercatcher	*Haematopus palliatus*	S3B		X				X
Bald Eagle	*Haliaeetus leucocephalus*	S2S3B/T	M	X	X	X	X	X
Dark-Eyed Junco	*Junco hyemalis*	S2B		X		X	X	
Laughing Gull	*Larus atricilla*	S1B		X	X		X	
Brown Pelican	*Pelecanus occidentalis*	S1B		X	X	X		X
Double-Crested Cormorant	*Phalacrocorax auritus*	S1B		X	X	X	X	X
Golden-Crowned Kinglet	*Regulus satrapa*	S2B		X		X		
Royal Tern	*Sterna maxima*	S1B/E		X	X			X
Winter Wren	*Troglodytes troglodytes*	S2B		X		X		

Notes:
S1- Highly State Rare
S2- State Rare
S3- Watch List-Rare to uncommon
SU- Possibly Rare-status uncertain
S2?- State Rare, rank questionable
LT- Threatened (Federal)
LE- Endangered (Federal)
/E- Endangered (State)
S1B- Highly State Rare for breeding
S2B - State Rare for breeding
S1S2B- Highly State Rare to rare for breeding
S2S3B- State Rare on Watch List for breeding
S3S4B- Watch List-Rare to Uncommon to apparently secure for breeding
SHB- Historically from State (not verified for an extended period) for breeding
SXB- Believed extirpated in State for breeding
/I- In Need of Conservation (State)
/T- Threatened (State)
M-in five year monitoring phase following delisting

Table 3-43: Distribution of Incidental Captures of Sea Turtles Among 2003 Net Sites. Numbers in Parentheses Indicate Recaptures (Kimmel, 2004).

Net Site	# of nets	Loggerhead	Kemp's ridley	Total
NW of Hoopers Island	3	8 (1)	5 (1)	13
Pokomoke Sound	1	2	-	2
Fishing Bay	1	-	1	1
Choptank River	1	1	1	2
Kent Island	2	2 (1)	-	2
Totals	**8**	**13 (2)**	**7 (1)**	**20 (3)**

Table 3-44: Dorchester County Regional Population Growth by County Subdivision, 1990-2000 (UMCES, 2004b)

County Subdivision	1990 Census	% of County Population	2000 Census	% of County Population	1990-2000 % change
Near James					
Taylors Island	269	0.9%	270	0.9%	0.4%
Neck	916	3.0%	934	3.0%	2.0%
Madison	401	1.3%	557	1.8%	38.9%
Near Barren					
Hoopers Island	640	2.1%	587	1.9%	-8.3%
Other					
Fork	1,825	6.0%	1,881	6.1%	3.1%
East New Market	2,023	6.7%	2,233	7.3%	10.4%
Vienna	929	3.1%	908	3.0%	-2.3%
Lakes	478	1.6%	402	1.3%	-15.9%
Cambridge	13,913	46.0%	13,261	43.2%	-4.7%
Church Creek	567	1.9%	615	2.0%	8.5%
Straits	521	1.7%	479	1.6%	-8.1%
Drawbridge	82	0.3%	85	0.3%	3.7%
Williamsburg	1,026	3.4%	1,180	3.8%	15.0%
Bucktown	482	1.6%	464	1.5%	-3.7%
Linkwood	2,591	8.6%	2,698	8.8%	4.1%
Hurlock	3,272	10.8%	3,806	12.4%	16.3%
Salem	222	0.7%	228	0.7%	2.7%
Elliott	79	0.3%	86	0.3%	8.9%

Table 3-45: Employment Sectors of Dorchester County in 2000

	Dorchester County		Maryland		United States	
	Individuals	%	Individuals	%	Individuals	%
Employed Population	14,225	-	2,608,457	-	129,721,512	-
Services	4,177	29.4	1,007,608	38.6	44,225,526	34.1
Manufacturing	2,788	19.6	189,327	7.3	18,286,005	14.1
Wholesale & Retail Trade	2,206	15.5	345,960	13.3	19,888,473	15.3
Agriculture, Forestry, Mining, Fishing	587	4.1	16,178	0.6	2,426,053	1.9
Construction	1,335	9.4	181,280	9.4	8,801,507	6.8
Transportation & Utilities	715	5.0	127,294	4.9	6,740,102	5.2
Information & Finance	784	5.5	289,510	11.1	12,931,536	10.0
Arts, Entertainment & Tourism	819	5.8	177,384	6.8	10,210,295	7.9
Public Administration	814	5.7	273,959	10.5	6,212,015	4.8

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4 PLAN FORMULATION

4.1 GOALS, OBJECTIVES AND CONSTRAINTS*

After the problems and opportunities are defined (Section 2), the next task is to define the study planning objectives and the constraints that will guide efforts to solve these problems and achieve these opportunities. According to ER 1105-2-100, planning objectives are statements that describe the desired results of the planning process by solving the problems and taking advantage of the opportunities identified. Constraints are restrictions that limit the planning process. Constraints that need to be considered include resource constraints, including focused value judgments over which fishery and social impacts would be acceptable/unacceptable, and legal and policy constraints. Resource constraints are those associated with limits on knowledge, expertise, experience, ability, data, information, money and time. Legal and policy constraints are those defined by law, Corps policy and guidance. Plans should be formulated to meet the study objectives and to avoid violating the constraints.

4.1.1 Federal Objective

As stated in Section 1, ecosystem restoration is a primary mission of the Corps' Civil Works program. According to ER 1105-2-100, the Corps' objective in ecosystem restoration planning is to contribute to national ecosystem restoration (NER) by increasing the net quantity and/or quality of desired ecosystem resources. NER measurements are based on changes in the quality of ecological resource as a function of improvement in habitat quality and/or quantity expressed in non-monetary units. Ecosystem restoration plans developed as part of the plan formulation process in this study are formulated and evaluated in terms of their net contributions to increases in ecosystem value (NER outputs). Therefore, one of the primary objectives of this study is to identify the NER plan that best meets the specific goals, objectives and constraints developed by the PDT.

Although the intent of this study is to meet the NER objective by identifying island restoration opportunities, the beneficial use of dredged material does contribute to national economic development (NED), as it addresses federal channel maintenance requirements within the Chesapeake Bay. The alternative plans were formulated to assure that dredged material placement meets the needs outlined in the Federal DMMP and is in accordance with Corps guidance on beneficial use projects. In order to meet these needs, the proposed project should provide the capability of receiving 30 to 70 mcy of clean dredged material over a 20-year period (3.2 mcy/y).

4.1.2 Period of Analysis*

The planning period of analysis for specifying problems and opportunities was based on the 20-year placement needs addressed in the Federal and State DMMPs projected from 2005 to 2025 as well as the projected loss of island habitat within the study area. The goals and objectives developed by the PDT were based on a 50-year period of analysis from 2010 through 2059. The longer period was necessary to take into consideration the extended construction period and expected NER outputs of a large island restoration project within the Mid-Chesapeake Bay.

4.1.3 Goal*

The goal of the November 2002 PMP at the initiation of this study was "to restore valuable aquatic and terrestrial resting, nesting, foraging, and nursery habitat that have been lost in the Chesapeake Bay for many migratory birds, fish, and wildlife species through the beneficial use of dredged material (USACE, 2002). In reviewing past restoration planning efforts on Poplar Island, as well as the Federal DMMP process, the goal for this feasibility study was refined to focus not only on the footprint of the proposed island, but the island ecosystem and related processes as whole. The PDT agreed upon the following goal in October of 2003:

> *The goal of the Mid-Chesapeake Bay Island Restoration Study is to restore and protect valuable but threatened Mid-Chesapeake Bay island ecosystems through the beneficial use of dredged material.*

4.1.4 Objectives and Constraints*

Based on the institutional, technical, and public significance of these island resources outlined in section 2.3, the PDT developed the following objectives and constraints at the beginning of feasibility plan formulation process. They are based upon the November 2002 PMP and initial PDT meetings held in 2003.

4.1.4.a Objectives

1. Restore and protect marsh, aquatic, and terrestrial island habitat for fish, reptiles, amphibians, birds, and mammals.
2. Protect existing island ecosystems, including sheltered embayments to prevent further loss of island habitat.
3. Provide capacity for placement of dredged material (3.2 mcy/yr). (Federal DMMP identified a need to place 30 to 70 million cubic yards of material over a 20-year period.)
4. Increase wetlands acreage in the Chesapeake Bay watershed to assist in meeting the C2K goals.
5. Decrease local erosion and turbidity.
6. Promote conditions to establish and protect submerged aquatic vegetation.
7. Promote conditions that support oyster recolonization.

4.1.4.b Constraints

While additional environmental, engineering, and legal constraints are discussed and used during the plan formulation process, the PDT identified these as most critical. The final recommended plan should be judged against these constraints in addition to the objectives to ensure all are met. Other constraints identified by the PDT were used as filtering criteria at various points in the plan formulation process, and identified as such.

1. Minimize impacts to existing fisheries nursery, feeding, and protective habitats;
2. Minimize impacts to rare, threatened, and endangered species and their habitat;

3. Minimize impacts to existing commercial fisheries;
4. Minimize establishment of invasive species to maximum extent possible;

Based on lessons learned from PIERP, recommendations of the Federal DMMP, and results of initial conditions investigations at selected project sites, some modifications of these objectives and constraints were made as part of the plan formulation process to include timing to achieve benefits, estimated dredged placement shortfalls, and two years worth of seasonal existing conditions data. The remainder of Section 4 is written chronologically, and attempts to capture these refinements as they occurred. Each of these objectives was revisited to evaluate all alternative plans that meet the minimum restoration requirements and constraints, as outlined in this section of the report.

4.2 ALTERNATIVE DEVELOPMENT AND ANALYSIS METHODOLOGY

The remainder of this section documents the iterative planning process followed by the PDT to arrive at a recommended plan to satisfy the goal and objectives outlined in Section 4.1. The plan formulation process was managed using a series of monthly meetings of the PDT from December 2002 through June 2006. Some members of the PDT also participated in a Plan Formulation Workgroup, to assist in developing the array of alternatives for evaluation by the PDT as well as the habitat criteria used to determine the ecological benefits and conduct the incremental analysis of alternatives.

To ensure consistency among various dredged material placement efforts going on concurrently with this study, many PDT members also participated in the development of the state of Maryland's DMMP; the Federal DMMP; and the General Reevaluation Report (GRR) for PIERP expansion. As stated in Section 1, these studies were conducted concurrently. The plan formulation process described in this section is described chronologically, and attempts to capture those elements of the federal and state DMMP process, as well as the final recommended plan of the PIERP GRR as appropriate.

The PDT developed and analyzed alternatives using the USACE six step planning process (ER 1105-2-100) previously described in Section 1. Again, these steps are:

1. Identify problems and opportunities;
2. Inventory and forecast conditions;
3. Formulate alternative plans;
4. Evaluate plans;
5. Compare alternative plans; and
6. Select a plan.

Although described as steps, this process is iterative, requiring refinement as plans are formulated, data are gathered, and then applied to the proposed designs (Figure 4-1). This iterative process of comparing and screening out potential alternatives to determine the recommended plan is presented sequentially in this section. Due to the large study area and numerous islands within it, some intermediary steps were added prior to formulating alternative plans, specifically screening and ranking of the islands. Building upon the six step planning process, Figure 4.2 illustrates the plan formulation process used to select the recommended plan, including the screening and ranking process of potential island restoration sites and the use of GIS in the screening process.

Ecosystem outputs were quantified using the Island Community Units (ICUs) methodology developed by USACE Baltimore. The Planning Center of Expertise (PcX) for Ecosystem Restoration (Mississippi Valley Division) conducted review of this planning model. The Island Community Units Model was used to evaluate and compare project alternatives. Rigorous Independent Technical Review of the model was conducted in accordance with EC 1105-2-407 and the Protocols for Certification of Planning Models (July 2007). Discussion of the process, reviewer comments, and responses are available in Appendix N, Attachment B.

4.2.1 Integration with Federal and State DMMP Process

4.2.1.a Federal DMMP

The plan formulation outlined in this section begins where the Federal DMMP's plan formulation process concluded. Specifically, the alternatives developed in the plan formulation process for this study address the Federal DMMP's recommendation to identify a large island restoration project within the Mid-Chesapeake Bay study area.

For analysis, the Federal DMMP divided the Chesapeake Bay into four regions:

- Upper Bay- the regions of the Chesapeake Bay and its tributaries above the Chesapeake Bay Bridge.
- Baltimore Harbor- the Patapsco River and its tributaries west of the North Point- Rock Point Line.
- Middle Bay- the region of the Chesapeake Bay and its tributaries from the Chesapeake Bay Bridge south to the Virginia state line.
- Lower Bay- the region of the Chesapeake Bay and its tributaries south of the Virginia state line.

The Federal DMMP considered 79 alternatives ranging from existing placement sites, new placement sites, beneficial use sites, and innovative use sites. The 79 alternatives were combined into groups, or suites of alternatives. Each suite was a combination of alternatives that together met the dredged placement capacity need for one or more geographic subarea. The suites covered an evaluation of restoration at all islands in the Chesapeake Bay. Over 14,000 suites were considered.

The recommended plan proposed by the Federal DMMP to meet dredged material placement needs in the Chesapeake Bay is multi-faceted, including a large island restoration project in the Mid-Chesapeake Bay region (USACE, 2005a). Consequently, the Federal DMMP analysis determined that only large island restoration i.e., islands whose historic acreage was greater than 200 ac, could cost-effectively accommodate the needed dredged material placement capacity.

4.2.1.b State of Maryland DMMP

A method established by BEWG and a list of State proposed dredged material placement sites were used to evaluate the environmental suitability of specified islands for large island restoration using dredged material. A description of the method follows. The recommendations of the evaluation are presented in Appendix B, Section B.2.2.

The State's DMMP Executive Committee is responsible for reviewing and recommending options to meet the short-term and long-term placement capacity requirements for maintenance and new work dredging projects in Maryland. The Executive Committee tasked the BEWG with developing and evaluating alternatives, based on the following hierarchy of preference:

- Beneficial use and innovative reuse of dredged material,
- Upland sites and other environmentally sound confined capacity,
- Expansion of existing dredged material placement capacity other than Hart-Miller Island and Pooles Island, and
- Other dredged material placement options to meet long-term placement needs, with the exception of unconfined placement sites.

Under this direction, the BEWG developed a system to compare alternatives in order to determine the most feasible means to manage 20 years of dredged material using three quantitative (environmental impact, capacity, cost) and two qualitative (technical/logistical risk and acceptability risk) criteria. Of these five criteria, the environmental impact criteria were utilized to determine environmental suitability of placement options.

The BEWG environmental impact criteria were in the form of 52 parameters related to the environmental suitability of proposed placement options. The parameters were divided into 10 categories based upon similar attributes: (1) water quality, (2) shallow water habitat, (3) wetlands, (4) aquatic biology, (5) rare/threatened/endangered species, (6) waterbirds, (7) terrestrial, (8) physical parameters, (9) human use attributes, and (10) beneficial attributes. The BEWG then assigned each parameter a weighting factor based upon the consensus of the group. To evaluate alternatives each parameter was assigned a raw score of +1 (potential positive impact), 0 (neutral impact), or -1 (potential negative impact) for each alternative under consideration based upon existing data and historical information, as well as the collective experience and knowledge of the BEWG and the technical study team. Placement options were ranked from highest (most environmentally suitable) to lowest (least environmentally suitable) based on the final normalized score of the 52 factors.

4.3 *ISLAND RESTORATION SITE SELECTION

4.3.1 Study Area Screening Process

There are 105 named islands listed in the 2002 Maryland State Archives island database within the Mid-Chesapeake Bay study area. The full list of islands, ordered by county, is available in Table 4-1. To narrow down the number of potential alternatives, an initial screening of all 105 islands within the study area was conducted. Using best professional judgment and existing technical information, the PDT determined whether or not each island met each of the following screening criteria:

1. Maximize restoration potential based on conclusion of Federal DMMP that only large island restoration can cost-effectively accommodate the needed dredged material placement capacity;
2. Must have convenient land access for staging areas;
3. Must not unduly interfere with existing navigation;
4. Minimize hydraulic impacts to environmentally sensitive areas;
5. Minimize shoreline impacts (e.g. increased sedimentation or erosion);
6. Minimize shallow water impacts (SAV, fishing habitat)
7. Avoid potential munitions and explosives of concern (MEC);
8. Must not be part of an existing USACE/ MPA project or study;
9. Avoid major population centers;
10. Landowners support for restoration must be acquired for islands that are currently State or Federally managed as a wildlife area;
11. Must be within authorized study area; and
12. Island location is known and available on recent maps.

This initial screening eliminated 83 of the islands that did not meet all of the above criteria, leaving 22 eligible islands for restoration. Two of the remaining 22 islands, Clay and Sandy Islands, were eliminated due to MDNR's opinion that these islands would not be significantly useful to migrating waterbirds. The 20 remaining islands were carried forward to the next step in the plan formulation process. Table 4-1 presents the results of this initial screening process and the combination of remaining islands carried forward to the next step in the process, the ranking of the islands.

4.3.2 Island Ranking Process

The 20 remaining islands were combined into 8 island/island complexes based on their historic inclusion as larger complexes (archipelagos). The final 8 island/island complexes were: Barren (2 islands), Holland (4 islands), Hoopers (4 islands), James, Ragged, Little Deal, and Smith (4 islands), and South Marsh (3 islands). Island groupings are designated in the second column of Table 4-1.

The next step in the process was to develop criteria to rank the remaining 8 island/island complexes with the ultimate goal of choosing the top one or two islands/island complexes for detailed plan formulation and evaluation. The engineering suitability of these 8 island options was evaluated using criteria developed by the Mid-Bay PDT. These results were then compared to the environmental suitability of island restoration options determined by an evaluation of the State DMMP placement options using the BEWG method (described in Section 4.2.1.b).

4.3.2.a Engineering Suitability

Each potential island/island complex was evaluated using engineering criteria specified by the PDT, many of which were based on lessons learned in the design and construction PEIRP. Use of engineering criteria identified those islands/island complexes that are physically best suited for restoration. Criteria used for this ranking were: possible restoration size; possible capacity; foundation material; borrow material found on site; water depth of site range; length needed for access channels; mean tidal range; stone size necessary for shoreline protection of restored island; hauling distance of dredged material; and potential for finding MEC. These criteria were ranked and weighted based on discussions with the PDT and input from on-going efforts with the BEWG (see Tables 4-2 and 4-3). A range of scores representing suitability was determined for each criterion and assigned to the 8 island/island complexes using best professional judgment and reconnaissance information collected on each island (MPA, 2002).

Final ranking of island/island complexes (highest to lowest score), based on engineering suitability, is: James (77), Barren (74), Hoopers (49), Ragged (49), Holland (47), Smith (45), South Marsh (39), and Little Deal (29) (see Appendix B for complete scoring results). Two islands ranked highest against these criteria and well above the other candidates: James Island and Barren Island. The full ranking is presented in Table 4-4.

4.3.2.b Environmental Suitability

The environmental suitability of the placement of dredged material for island restoration was evaluated using the BEWG method introduced in Section 4.2.1.b and 28 placement sites originally proposed by the State DMMP. Within the 28 proposed State DMMP alternatives were six options for island restoration. The BEWG ranked the 28 alternatives based on environmental factors.

The results of the BEWG ranking are presented in Table 4-4. The 28 alternatives plus the full analysis is provided in Appendix B. Of all the island alternatives evaluated by the State DMMP, Barren Island ranked highest. James Island was the next ranked island alternative. This analysis identified that both Barren and James Island ranked high amongst all State DMMP alternatives and were environmentally suitable with respect to impacts for restoration using dredged material.

4.3.2.c Island Ranking Results

The BEWG analysis came to the same conclusion as the Mid-Bay PDT, ranking Barren and James Island with the greatest suitability for restoration (Table 4-4). In order to solicit input and get public feedback on the ranking of the islands, a series of public scoping meetings was conducted in February and March 2003 (see Appendix G, Public Involvement). The results of these meetings indicated that public preference was also for James and Barren Islands with Hoopers still a potential restoration site, though not as highly ranked, because it is a populated area. Pros and cons of the 8 island/island complexes as expressed by the public are provided in Appendix G, Public Involvement, Attachment C.

Given the BEWG analysis and public support, James and Barren Islands were selected for detailed alternative development by the Mid-Bay PDT. It should be noted that even though some sites were eliminated from further analysis during this feasibility study, it does not mean that there would not be benefits to implementing improvements at those sites. Many of the island complexes that are not carried forward via this feasibility study may be more appropriate for and can be implemented at another time by other agencies represented on the BEWG.

4.4 FORMULATE ALTERNATIVES

After James and Barren Islands were selected as the potential island restoration sites, the PDT formulated a set of alternatives designed to restore lost and protect remaining island habitat at James and Barren through the beneficial use of dredged material. In order to facilitate the formulation and evaluation of these alternatives, a Plan Formulation Workgroup was formed consisting of representatives from MDNR, MES, MPA, NOAA NMFS, NOAA Chesapeake Bay Program, USACE, USFWS CBFO, and USFWS Blackwater NWR. The steps taken to formulate and screen alternatives for Cost Effective/Incremental Cost Analysis (CE/ICA) were (1) identify suitable island alignments; (2) develop alternatives as a combination of a potential alignment and an upland to wetland ratio; (3) screen alternatives based on constructability (Section 4.4.5.a), capacity (4.4.5.b), location of borrow areas (4.4.5.c), agency preferences/environmental benefits (4.4.5.d), and cost per habitat (4.4.5.e); and (4) refine the screening based on (1) PDT consensus (Section 4.4.6.b.1); (2) refined upland to wetland ratios (4.4.6.b.2); (3) a dredged material placement analysis (4.4.6.b.3); and (4) additional geotechnical investigations (4.4.6.b.4).

The first step towards developing alternatives was to identify potential island alignments by using engineering and ecological design considerations (Section 4.4.1). Alternatives were defined to vary by size, orientation, and boundary location. An important tool used by the Plan Formulation Workgroup and the PDT for this endeavor and throughout the plan formulation process was GIS. GIS analyses were performed during the alternative screening and formulation process to determine the location of suitable alignments based on the engineering and ecological design considerations as determined by the Plan Formulation Workgroup and approved by the PDT. The ultimate goal of the Mid-Chesapeake Bay Islands GIS database was for it to function as a plan formulation tool and transition into an engineering design tool. Additional details on the GIS analysis are provided in Appendix C: Engineering and Design Analysis, some of which is restated below in section 4.4.2. Once suitable island alignments were identified, alternatives were developed using either a James or Barren alignment or a combination of alignments for both islands, in conjunction with variable upland to wetland ratios.

4.4.1 *Design Criteria and Constraints

Engineering and ecological design considerations were identified to guide formulation and design of suitable alignments. The considerations are outlined below.

4.4.1.a Engineering Design Considerations

1. Dredged material construction sequencing (i.e. only upland areas should be built over borrow areas);
2. Depth to substrate (an ideal water depth exists for dike construction);
3. Substrate type (substrate types are acceptable for cell construction); and
4. Navigational limitations (i.e. Bay pilot staging area, military restrictions).

4.4.1.b Ecological Design Considerations

1. Natural oyster bar (NOB) locations (avoid);
2. SAV locations (avoid);

3. Size of upland (not as a function of islands/hammocks);
4. Size of wetland cells/ wetland type ratios;
5. Amount of tidal gut or open water;
6. Island/hammock size;
7. Distance between islands/hammock; and
8. Distance of the project footprint from the existing island remnants.

4.4.2 GIS Analysis

Prior to the initiation of this study, the MPA in support of their State DMMP efforts and to provide information to the BEWG developed a series of reconnaissance reports for several island sites, including James and Barren Island. For James Island, 5 alignments were proposed, ranging in size from 979 to 2202 ac (MPA, 2002a). For Barren Island, 2 alignments were proposed, 1000 and 2000 ac (MPA, 2002d). See Figures B-1 and B-2 in Appendix B: Plan Formulation, for reconnaissance level alignments originally considered.

Based on feedback on the design considerations from the Plan Formulation Workgroup and the PDT in September 2003, it was determined that the alignments proposed by MPA needed to be revisited to include additional engineering and ecological constraints. In order to include these constraints and determine the optimum location for proposed alignments, the engineering and ecological design considerations were translated into GIS data layers. The data layers were overlaid to identify the areas that satisfied the design considerations. For the initial concept level planning stage, it was decided that all of the engineering considerations could generate GIS data for analysis. For the ecological considerations, only SAV and NOB locations were considered as part of the GIS analysis. The remaining design criteria were too specific to apply at the conceptual level planning stage, and would be used once an alignment and site were located and incorporated into the AMP.

The GIS overlay analysis was performed for each of the two sites (James Island and Barren Island). The analysis was based upon eight equally weighted engineering and environmental factors that were used to determine the optimal alignment locations at both sites. Table 4-5 lists these factors and the values attributed to each in the GIS analysis. A detailed description of each of these factors is provided below.

4.4.2.a Proximity to existing island remnants

Experience gained from PIERP indicated that the optimal separation between existing island remnants and the project footprint is approximately 250 to 500 ft. Smaller separations may restrict tidal flow and limit the establishment of certain desirable habitats. Greater separations could result in increased erosion from wave energy.

4.4.2.b Proximity to natural oyster bars (NOBs)

Construction activity in and around NOBs has the potential for negative impact on existing oyster habitat. Locations further away from existing NOBs were deemed more optimal than locations within and directly adjacent to the legally defined limits of NOBs. A minimal distance of 500 ft was set and agreed upon by the PDT as this is the current distance used at Poplar Island restoration site. Current state regulations state a buffer of NOBs of 500 yards for dredging activities, whereas 500 ft was deemed acceptable for dike construction because once the toe dike is constructed it will contain any dredged material placed during construction of the islands. A time of year restriction is in place on hydraulic dredging of sand for dike construction.

4.4.2.c Presence of submerged aquatic vegetation

SAV beds are a critical component of a healthy Chesapeake Bay. Any area falling within the limits of an existing SAV bed (as determined by the 2001 SAV survey conducted by the Virginia Institute of Marine Science) was specified as an unacceptable project location. Survey results from 2001 were used. Although there is substantial yearly variation in location and size, SAV beds were more expansive during 2001 than in any other recent year.

4.4.2.d Foundation material

The cost of containment dikes and breakwaters for the various alternatives will be affected by the foundation conditions. Suitable conditions would include foundation material consisting of sand with minor silt or clay content, silty or clayey sand, and stiff clay materials with high shear strength and low compressibility characteristics. Unsuitable conditions would include very soft clay and silt materials where both shear strength and compressibility are unacceptable.

4.4.2.e Quality of on-site borrow material

Project cost is affected by the quality of materials available for dike construction. Suitable borrow material includes material that consists of sand with less than 50% silt and clay fines. Higher quality borrow material has a smaller percentage of silt and clay fines than lower quality borrow. Unsuitable borrow consists of material containing more than 50% silt and clay fines.

4.4.2.f Constructability of a perimeter dike with a toe dike

Project costs can be impacted by the difficulty of construction resulting from environmental conditions such as water depth. Experience constructing Poplar Island has shown that the optimal water depth for the construction of a perimeter dike with toe dike is between 5 and 8 feet. Construction of this type of dike becomes more difficult in water that is shallower than 5 feet and deeper than 8 feet.

4.4.2.g Constructability of a perimeter dike without a toe dike

Experience with Poplar Island has shown that the optimal water depth for the construction of a perimeter dike without a toe dike is less than 2 feet. Construction of this type of dike becomes more difficult in water that is deeper than 2 feet. Perimeter dikes without a toe dike are used in sheltered areas (typically the eastern shoreline of restored islands) where smaller stone is used for armoring.

4.4.2.h Navigation restrictions

Areas identified as restricted on nautical charts were determined to be unacceptable locations for the proposed project. Dredge spoil areas were also deemed to be less than optimal since they may contain unsuitable foundation material. Unrestricted areas were considered to be the most optimal location for the project.

4.4.2.i GIS Results

The GIS data layers for each design consideration for Barren and James are included in Appendix B: Plan Formulation, Figures B-3 to B-11. The composite suitability score for each island is presented in Figures 4-3 and 4-4 within this section (The alignment shown in each figure is only shown to provide a spatial perspective). Those areas resulting in a higher rating (shown in blue) were considered the ideal location for all alignments proposed at Barren and James.

Areas to the northeast and south of the existing Barren Island were the least suitable, primarily due to navigation restrictions and poor foundation material. Looking at individual criteria, portions of the waters surrounding Barren Island were less than ideal for island restoration for multiple reasons: the northern waters fall within a navigation restriction, NOBs exist to the northwest and southeast of Barren Island, SAV beds are found east and southeast of the existing island, poor foundation material was identified in the southeast, and poor borrow material for dike construction extends over the eastern half of the entire area. Alternatively, an area to the northwest of James Island was determined to be the least suitable due primarily to poor foundation material. Oyster bars are located to the north and east of James Island. SAV beds are found in small areas off the eastern shoreline of existing James Island. As a result, there is no area restricted due to SAV beds. Poor borrow material for dike construction is found throughout the area except for a portion of the bottom to the north and northwest of James Island.

4.4.3 *Proposed Alignments

The alignments proposed by MPA were compared to those areas that had the highest suitability factor rating from the GIS analysis. The original proposed alignments were revised by the PDT based on the GIS analysis of engineering and environmental criteria as well as input from the resource agency team members. The original two Barren alignments were transformed into four proposed alignments. The original five alignments for James were carried forward, with some minor modifications based on the composite suitability score. The final alignments are depicted in Figures 4.5 and 4.6. Descriptions of each alignment proposed by the Plan Formulation Workgroup and approved by the PDT are provided below.

4.4.3.a James Alignment 1

Alignment 1 is the smallest of the James Island alignments. It is bounded by James Island to the east and extends roughly parallel to the existing James Island remnants. The estimated size of the alignment is 978 ac.

4.4.3.b James Alignment 2

Alignment 2 is bounded by James Island to the east, deep water to the west, a NOB to the north, and a local navigation channel to the south. The estimated size of the alignment is 2,126 ac.

4.4.3.c James Alignment 3

Alignment 3 is bounded by James Island to the east, NOB to the north, and Taylors Island to the south. Gahagan, Bryant & Associates (GBA) estimated the size of the alignment at 1,586 ac.

4.4.3.d James Alignment 4

Alignment 4 is bounded by James Island to the east, deep water to the west, NOB to the north, and almost connects to Taylors Island to the south. The estimated size of this alignment is 2,200 ac.

4.4.3.e James Alignment 5

Alignment 5 is bounded by James Island to the east, NOB to the north, deep water to the west, and a local navigation channel to the south. The estimated size of this alignment is 2,072 ac.

4.4.3.f Barren Alignment A

Alignment A has a boundary of Barren Island to the east. A tidal gut of 200 feet to 500 ft is provided between the existing and proposed islands. The total site is approximately 1,330 ac.

4.4.3.g Barren Alignment B

Alignment B is the largest layout at Barren and a variation to alignment A. The eastern dike and tidal gut are identical to alignment A. However, the western boundary has been shifted further west to provide additional storage capacity. The total site is approximately 2,059 ac. Upon further evaluation, this alignment was deemed not suitable by the natural resource agencies due to the amount of productive fisheries that would be impacted and was not carried forward as an alternative.

4.4.3.h Barren Alignment C

Alignment C is a variation to alignment B in that the western boundary and southern boundaries have been reduced to provide an island larger than alignment A, but smaller than alignment B. The total site is approximately 1,172 ac.

4.4.3.i Barren Alignment D

Alignment D is the smallest layout, and proposed as potentially an all wetland plan and a variation to alignment A. The eastern boundary is the same, but the western boundary has been shifted east to provide an average alignment width of 1,600 feet. The total site is approximately 684 ac.

4.4.4 *Proposed Alternatives

The alignments in Figures 4-5 and 4-6 were used to develop an array of alternatives for comparison purposes. In total, 29 different alignment combinations were considered in conjunction with a range of upland/wetland ratios at one or both island locations to produce 145 potential alternatives. The 29 alignments are the result of 4 independent Barren alignments, 5 independent James alignments, and 20 alignments that combine an alignment at Barren with one at James. The upland/wetland ratios originally evaluated were:

- 100% uplands
- 100% wetlands
- 70 % uplands/ 30 % wetlands
- 50% uplands/ 50% wetlands
- 30% uplands/ 70% wetlands

These ratios were thought to be representative of the range of options possible at each site. This ratio is a critical component of the plan formulation process due to the need to meet both the objectives of restoring island ecosystem habitat and maximizing dredged material placement capacity. While some of these ratios might not meet all objectives as stand alone options, a combined island alternative could possibly meet all objectives due to the benefits achieved at both sites and additional dredged material placement capacity. The list of 145 potential alternatives considered for screening is presented in Table 4-6.

4.4.5 *Screening of Proposed Alternatives

Given the number (145) of alternatives, screening criteria were applied to the alternatives prior to carrying out a detailed evaluation of environmental benefits and assignment of costs for the proposed plans. This screening was based on field data and surveys collected during the study as of the 2004 fall survey season, best professional judgment on the feasibility of implementing a proposed alternative, and natural resource agency preferences as voiced by PDT members. The screening criteria applied to the array of alternatives were: constructability; capacity; cost (preliminary); location of borrow areas; agency preferences/environmental benefits; and cost per habitat output (preliminary). Due to the extent of analysis and data input required to calculate the costs and specific habitat outputs, a preliminary analysis was used for this initial screening. The same analysis was performed on each alternative, and therefore, did not affect the final outcome of the screening in favor of one alternative over another. A detailed description of the screening criteria is provided below. More precise costs and a more elaborate method for quantifying environmental benefits were used to evaluate the alternatives that made it through to final evaluation.

4.4.5.a Constructability

Using best professional judgment and experience gained at Poplar Island, the PDT identified those alternatives that would be too difficult to construct due to size, placement limitations, and potential success of achieving the proposed benefits. It was deemed that all alternatives proposing 100% wetlands at one or both sites would not be feasible to construct as borrow areas would have to be outside the footprint and upland cells are needed for proper wetland cell development. These potential alternatives would not meet the objectives of minimizing impacts to shallow water habitat, nor would they meet the dredged material placement capacity required. Based on lessons learned at Poplar Island and geotechnical analysis, wetlands should not be developed over borrow areas to ensure the successful placement of material. To the maximum extent practicable, borrow materials for dike construction will be obtained from within the upland portion of the project footprint, and upland cells will be located over the most productive borrow sources. Note that after this initial screening, some members of the PDT disagreed about whether or not wetlands could successfully be created over borrow areas. This concern does not significantly affect the plan formulation process at this point as alternatives containing only wetlands would not satisfy dredged material capacity needs. Further, a certain portion of uplands is required to manage dredged material placement for proper wetland development. If it becomes necessary to obtain additional borrow materials within wetland cells, such excavations will be completed to a uniform depth across the entire wetland cell, and the total excavation depth will be minimized. Additional analysis will be conducted to address the potential for wetland construction over borrow areas.

4.4.5.b Capacity/Dredged Material Placement

Based on the preliminary results of the Federal DMMP during this point of the planning process, dredged material placement capacity for any proposed alternative would need to be sufficient for a 20 year lifespan for a total of 30 to 70 mcy of material. The site must be capable of accommodating annual dredged material placement of 3.2 mcy/y for most of the project life without overloading wetland cells and with minimal overloading of upland cells. Alternatives that did not provide 25 to 75 mcy (30 to 70 mcy $\pm$5 mcy) were eliminated. A preliminary engineering analysis also showed that it is necessary to retain approximately 75 to 80% of the total site placement capacity within the upland cells for the latter project years to assure that upland placement capacity lasts through placement in all wetland cells. As a result of this calculation, 70% wetland/30% upland alternatives were screened from further consideration. Options with wetland percentages as high as 70% could not efficiently and cost-effectively handle the placement of dredged material. Providing upland placement cells throughout wetland placement years prevents inflated operating costs in later years.

4.4.5.c Location of Borrow Areas

Those alternatives requiring borrow areas for dike construction outside of the alignment's footprint were deemed undesirable for further consideration due to impacts to bottom fish habitat. Removal of a layer of sand, even if a layer of sand is conserved within the borrow area, deepens the area making the water column more susceptible to seasonal anoxia and potentially changes local circulation patterns. This change in bottom circulation could result in the accumulation of fines and affect sediment drift and depositional patterns. This in turn will affect the character of the re-colonizing benthic community, potentially leading to the loss of important benthic forage species. Those alternatives that would also require building wetland cells over borrow areas within the footprint were considered infeasible to construct due to compaction necessary to fill deep borrow areas, which would not be a suitable foundation for wetland cells. See Appendix C, Attachments B and C, for more details on the technical analysis to determine the feasibility of wetland cells being built over borrowed areas. Additional design analysis will be conducted during the PED phase.

4.4.5.d Agency Preference/Environmental Benefits

After further discussion on the proposed alternatives, several agencies expressed concerns about the habitat value of alternatives with less than 50% wetlands. Therefore, only those alternatives that contained wetland components of 50% or more were supported by many of the resource agencies. Based on field investigations showing the productivity of benthic and fishing habitat at Barren Island, an additional constraint was placed on Barren Island to minimize the footprint. All Barren Island alternatives greater than 1,000 ac were eliminated. A smaller footprint was also advocated by the watermen to avoid winter gillnetting and crabbing areas to the west of Barren. Benthic habitat was not as productive or diverse at James Island; therefore, a larger footprint, limited to approximately 2,000 ac, at James Island would be acceptable.

4.4.5.e Cost per Habitat Output

A preliminary calculation of habitat output versus the cost for the alternative was developed. The habitat outputs were based on initial discussions with the PDT and analysis of the original Poplar Island restoration project. Those alternatives in which the cost was large compared to the habitat benefits were not carried forward for further consideration. The habitat units for this screening were refined and eventually changed to Island Community Units (ICUs), as described in Section 4.2, for detailed benefit analysis of alternatives remaining after this screening step.

4.4.6 *Results of Screening

After applying the screening criteria described in Section 4.4.5, only four out of 145 alternatives in Table 4-6 were proposed to be carried forward to the next step in the plan formulation process (see Tables 4-7 through 4-9 for screening results):

- James alignment 3, 50% upland/ 50% wetlands (3UW50);
- James alignment 5, 50% upland/ 50% wetlands (5UW50);
- A combined James alignment 3/ Barren alignment D 50% uplands/ 50% wetlands (D3UW50); and
- A combined James alignment 5/ Barren alignment D, 50% uplands/ 50% wetlands (D5UW50).

4.4.6.a Refining of Screening Results

Following presentation to the PDT and the consideration of newly available data, the four remaining alternatives were refined into the final 11 alternatives based on the professional opinions of the PDT and the following criteria:

(1) PDT consensus;
(2) Refined upland to wetland ratio to include a finer scale of options;
(3) The completion of a detailed dredged material placement analysis; and
(4) Additional geotechnical investigations.

4.4.6.b Results of Refinement

4.4.6.b.1 PDT Consensus

The screening process removed all stand alone Barren Island alternatives, primarily due to agency concern regarding excess environmental impacts. However, the PDT agreed that at least one independent Barren Island should remain for detailed evaluation and comparison with James Island and joint James and Barren Island alternatives. Therefore, the PDT agreed to reinsert Barren A (1354 ac) 50% upland/50% wetland into the list of alternatives. Of the stand alone Barren alternatives, Barren alignment A 50% upland/50% wetland was chosen for reconsideration because it was the smallest alignment that met all other screening criteria discussed in Section 4.4.5.

4.4.6.b.2 Refined Upland to Wetland Ratio

Ratios of 45% uplands/55% wetlands and 40% uplands/60% wetlands were added to each of the four alternatives listed above and to Barren alignment A at 50% uplands/50% wetlands.

4.4.6.b.3 Dredged Material Placement Analysis

Table 4-10 provides a matrix displaying the results of the dredged material placement analysis (All boxes containing an 'X' mark evaluated placement schemes). A shaded box indicates an efficient placement scheme, whereas an unshaded box denotes a placement scheme that is not efficient. See Appendix C, Attachment C- Dredged Material Placement Analysis for additional information and a detailed table). The goal of this analysis was to determine efficient placement schemes as defined by a specific upland to wetland proportion and a dike height. Dredged material placement analyses were conducted for a range of alignment sizes to determine if additional alignments could possibly provide more efficient placement. Alignment sizes included in the dredged placement analysis are: 600, 700, 1000, 1200, 1354, 1400, 1500, 1586, 1600, 1800, 2072, 2500, 2700, and 2756 ac. These sizes represented all potential alternatives, several Barren and James Island combinations, and several generic sites. The analysis has shown that alternatives under consideration could provide placement capacity ranging from approximately 27 to 102 mcy depending on the project acreage and upland to wetland ratio. If the project shifts toward a higher percentage of wetlands and a corresponding lower percentage of uplands, the total site capacity would decrease accordingly. As can be seen in Table 4-10, in order to create a site with more than 50% wetlands, the size of the site must be rather large or the upland cell needs to be built to a higher elevation than +20 ft MLLW. Of the screened alternatives under consideration, this placement analysis identified that only the 40% upland/60% wetland alternative at Barren A would not be a feasible plan for dredged material placement.

4.4.6.b.4 Additional Geotechnical Investigations

Additional investigation of potential borrow areas showed that a James 3/Barren D alignment would require borrowing outside the alignment sites at both locations, thereby increasing the impacts to existing fisheries. Further discussions with the PDT, also determined that the differences between a combination James 5/Barren D and a combination James 3/Barren D were not that significant in terms of placement capacity and potential benefits. For these reasons, James alignment 3/Barren alignment D was eliminated and James alignment 5/Barren alignment D was the only dual island option carried forward. If a two island plan was selected, multiple ratios and combinations would be considered and analyzed to meet all the objectives.

The screening process and its refinement produced the following 11 alternatives for evaluation and a more detailed benefits and cost analysis:

Remaining original alternatives:

- James alignment 3, 50% upland/50% wetland
- James alignment 5, 50% upland/50% wetland
- James alignment 5/Barren alignment D, 50% upland/50% wetland

Alternatives added during refinement:

- Barren alignment A, 50% upland/50% wetland

- Barren alignment A, 45% upland/55% wetland
- James alignment 3, 45% upland/55% wetland
- James alignment 3, 40% upland/60% wetland
- James alignment 5, 45% upland/55% wetland
- James alignment 5, 40% upland/60% wetland
- James alignment 5/Barren alignment D, 45% upland/55% wetland
- James alignment 5/Barren alignment D, 40% upland/60% wetland

4.5 COMPARE AND EVALUATE PLANS

The next step in the plan formulation process was to compare and evaluate the screened and refined alternatives identified in Section 4.4.6.b. As ecosystem restoration is a primary mission of the USACE Civil Works program, the objective in ecosystem restoration planning is to contribute to national ecosystem restoration (NER) by increasing the net quantity and/or quality of desired ecosystem resources. The benefits of ecosystem restoration projects can be quantified using a variety of measures, such as acres of habitat produced or miles of shoreline restored. Indices that combine separate measurements can also be used, and offer the advantage of lumping multiple types of benefits together into one unit. However, indices must be used carefully as they are subjective in nature and do not over rule best professional judgment.

As the primary goal of the project is to restore island ecosystems using dredged material, a critical component of this step was to determine the ecological components that could be used as or combined into an appropriate index, as well as the future NER benefits of restoring island ecosystems. The PDT developed an appropriate and relevant method for calculating benefits of each alternative. The method calculates ICUs to quantify the ecosystem benefits over the life of the restoration project. Due to construction sequencing and dredged material consolidation as stated in the project objectives (Section 2.0), the proposed upland and wetland acreage were broken down into manageable cells and subcells. ICUs measure the benefit to the ecological guilds/communities that will likely utilize the habitat types created in each cell and subcell. Ecosystem benefits of fully developed (graded and planted) cells and SAV resources protected by a restored island were included in the analysis.

The ICU method was developed to capture the value of island habitat diversity and the benefit to the communities that inhabit islands. ICUs are similar in concept to the Habitat Evaluation Procedure (HEP) and its associated Habitat Units and Habitat Suitability Index (HSI) developed by the USFWS. However, ICUs provide the advantage by allowing quantification of benefits to communities of wildlife rather than an individual species. The Plan Formulation Workgroup did not want to focus the benefits quantification on a single species as the remote islands provide benefits to a wide range of species. These benefits vary functionally and seasonally depending on the species or community. That is, some communities will use the islands for foraging habitat, some for mating/nesting habitat, and others for resting and refuge. Habitat use changes seasonally and is dependent upon the life cycles and migration patterns of species. Further, the ICU method was able to account for changes to benefits as the project developed and habitats matured. For the above reasons, it was concluded that the ICU method was the most suitable option for quantifying the many ecosystem benefits of restoring remote island habitat in the Chesapeake Bay.

4.5.1 Ecosystem Benefits

To provide discrete numbers to the ICU method for the ecological benefits provided by each alternative over the life of the project, additional information on island ecosystem habitat within the Chesapeake Bay was necessary. The Plan Formulation Workgroup focused on gathering the ecological data and determining the ecosystem benefits for each alternative.

The Workgroup had two primary goals. The first goal was to identify the limiting habitat requirements for guilds/communities based on the species that compose those communities. For the purposes of this study, 'community' and 'guild' were used interchangeably to describe a group of interacting plants and animals that utilize the resources of a given habitat in a similar way. The second goal was to determine the benefits (measured in ICUs) each guild will receive from each habitat type. Habitat types included in the development of the ICU were upland, low marsh, high marsh, and intertidal/mudflat.

4.5.2 Identification of Habitat Requirements of Island Communities

Based on recommendations from the Plan Formulation Workgroup, a panel of experts on Chesapeake Bay ecology was assembled (see Appendix B: Plan Formulation, Table B-1 for list of members). Persons were included on the panel based on their expertise of island ecosystems or of a specific guild/community. Using the Delphi Method[1], the panel of experts was polled on key habitat requirements, which would later be used to develop an Island Community Index (ICI).

The first step was to identify the species that use island habitat in Chesapeake Bay, and then identify the key habitat requirements for those groups. Based on the list of species identified, a total of nine guilds/communities were identified as primary users of island habitat in the Chesapeake Bay:

- Colonial nesting wading birds (herons, egrets, and ibises)
- Waterfowl
- Colonial nesting waterbirds (gulls, terns, and skimmers)
- Raptors
- Shorebirds
- Herpetofauna
- Benthic invertebrates
- Resident/forage fish
- Commercial/predatory/higher trophic level fish

The second step was to establish and identify limiting conditions for guilds/communities using measurable key habitat features (i.e., feeding and reproductive strategies), and the habitat types

[1] Source : USFWS, DOI. 1982. Biological Report 82 (10.134) . *Guidelines for Using the Delphi Technique to Develop Habitat Suitability Index Curves.*

that each guild would potentially use. For example, some species may utilize all of the habitat types, while other species may preferentially use a single habitat type. Other species may utilize multiple habitat types by using different habitat types for feeding and reproduction. A weighting factor was assigned to each guild/community based on the extent to which a guild depends on island habitat (Table 4-11). The Plan Formulation Workgroup decided upon these values.

4.5.3 Defining an Island Community Index

The Plan Formulation Workgroup's next task was to define an ICI for each guild for each habitat type based on the information gathered through the Delphi Method and additional literature search. The index is a value between 0 and 1. ICIs were used to classify the probability that a guild/community would utilize a specific habitat type, based on the characteristics (e.g., size, vegetation, soil type) of the habitat. The index is defined as follows:

- 1.0 = optimum/maximum use;
- 0.75 = use probable, but not optimum;
- 0.5 = use possible/some use;
- 0.25 = minimum use; and
- 0 = no use/habitat value.

For example, an intertidal/mudflat habitat with an area greater than 25 ac and a sandy beach/shoreline would be assigned a 1.0 (optimum/maximum use) for colonial nesting birds, while an intertidal/mudflat habitat with an area less than 12.5 ac and a sandy beach/shoreline would be assigned a 0.5 (use possible/some use) for colonial nesting birds. The complete list of ICIs for each guild used in the analysis is located in Tables 4-12 to 4-20. An example of the ICU calculation for wetland, intertidal and upland habitats for alternative Barren Island A with a 50/50 upland to wetland ratio and dike heights at +20 feet is in Tables B-24 to B-26 in Attachment B of Appendix B.

4.5.4 Island Community Unit Incremental Calculation

The ICU calculation made for each alternative included a value for the protection of existing island resources including SAV acreage and constructed habitat value that would be created. The annual placement schedule and cell development plan was used to determine the size of each cell and subcell (in ac), whether the cell was designated wetland or upland, and to identify the years in which a cell or subcell will be filled, graded, and planted. Wetland cells were further broken down into three habitat types: high marsh, low marsh, and intertidal/unvegetated mudflat. Of the total wetland cell acreage, the high marsh consists of 20% and the low marsh 80%. Intertidal coverage is 10% of the low marsh acreage. Benefits were calculated for 50 years, although benefits are expected to extend well beyond the period of analysis. Additional details on the dredged material placement analysis are provided in Appendix C: Engineering Design Analysis, Attachment B.

Once planted, cells start to accrue habitat benefits. ICIs were assigned for year 1, year 5, year 10, and year 25 after planting for each of the nine guilds/communities for each of the four habitat types. As use will change based on the maturity of the habitat, a maturity date (the time until a habitat develops full benefits) was defined for each habitat type. The maturity time assigned to each habitat type is located in Table 4-21. Only partial value was assigned prior to a habitat reaching maturity.

Based on the ICI analysis, ICUs were calculated for year 1, year 5, year 10, and year 25 using the following formula:

$$\sum_{g} \left[\left[\sum_{H} (I_{gH} * A_{H}) \right] * w_{g} \right]_{g}$$

where g = guild/community
H = habitat type
I = Island Community Index (ICI) Value
A = acreage of habitat type
W = weighting factor for the guild/community

See Tables B-5 to B-18 (Appendix B) for ICU calculation results for all 11 alternatives carried forward.

ICUs for years between those specifically calculated using the formula above were evaluated according to the following assumptions:

a) For upland cells, ecosystem benefits increase equal amounts per year between years 1 and 5, and 5 and 10. ICUs are constant between years 10 and 25. At year 25, benefits increase when upland trees are considered mature, and remain constant for the remainder of the specified 50 year period of analysis.
b) The majority of the function for a wetland cell will be reached by year 5 with a small amount of increased benefits through year 10. Of the function existing by year 5, it was assumed that 75% was achieved by year 3. Wetland benefits are constant after year 10 until interior dikes can be removed. Values increased by an equal proportion between years 5 and 10.

Due to significant benefits provided by SAV currently at Barren and historically at James, the PDT decided to include SAV as part of the ICU calculation. To accomplish this task, VIMS SAV maps for Barren and James Island vicinities were obtained for the period of record available, 1995 to 2003. SAV beds were then identified as polygons and each polygon was assigned a bed density and area. An average SAV ICU was calculated for Barren and James, respectively. Similar to the other habitat components within the ICI, the associated bed density was correlated to an index value:

- 1=70-100 % SAV density class
- 0.75 = 40-70 % SAV density class
- 0.5 = 10-40 %
- 0.25 = 0-10 %
- 0 = 0 % (no SAV/unmapped)

These index values were applied to the mapped areas (polygons) and the sum of the total ICU per year was calculated using the following formula:

$$\sum_{\substack{\text{All SAV polygons} \\ \text{mapped in year i}}} (\text{Area x Index}) = \text{Total ICU}_{\text{year i}}$$

year i

The ICU yearly totals were then averaged to account for natural yearly variability in order to compute the final ICU for SAV habitat for each island. The SAV ICU is 2.8 for James Island and 234.4 for Barren Island.

Once the ICUs for each subcell were calculated, the ICUs for all cells for an individual year plus the SAV ICU were summed to obtain Total ICU/year. The Total ICU/year versus time was plotted to determine how the habitat benefits would develop and come on-line with construction of the island alternative (Figures B-10 to B-23 in Attachment B of Appendix B for plots). This procedure was done for the existing conditions as well as proposed alternatives. A summary of the ICU calculation process is provided in Figure 4.7.

4.6 COST EFFECTIVENESS & INCREMENTAL ANALYSIS

After the PDT compared and evaluated all the proposed plans, the formulation process identified 11 island ecosystem restoration alternatives to be carried forward to determine which plan was cost effective and resulted in the most ecosystem benefits (as listed in Section 4.4.6). These 11 alternatives were compared to the no action alternative or without project condition. The set of 11 alternatives include 6 James Island alternatives, 2 Barren Island alternatives, and 3 James Island/Barren Island combined alternatives.

A cost effectiveness/incremental analysis (CE/ICA) was used to evaluate and compare the expected NER outputs and the expected costs associated with construction and development of the 11 island ecosystem restoration alternatives. CE/ICA is a useful tool to determine whether additional ecosystem outputs gained by increasing levels of restoration are worth the additional monetary cost. Although CE/ICA analyses do not necessarily result in the identification of a single “best” alternative, they contribute to informed decision making for ecosystem restoration.

According to USACE Guidance for Conducting Civil Works Planning Studies (ER 1105-2-100), CE/ICA are two distinct analyses that must be conducted to evaluate the effects of alternative plans. First, it must be shown through cost effectiveness analysis that an alternative restoration plan’s output cannot be produced more cost effectively by another alternative. “Cost-effective” means that, for a given level of non-monetary output, no other plan costs less and no other plan yields more output for less money. Subsequently, through incremental cost analysis, a variety of implementable alternatives and various-sized alternatives are evaluated to arrive at a “best” level of output within the limits of both the sponsor’s and USACE’s capabilities. The subset of cost effective plans are examined sequentially (by increasing scale and increment of output) to ascertain which plans are most efficient in the production of ecosystem benefits. Those most efficient plans are called “Best Buys” since they provide the greatest increase in output for the least increases in cost and have the lowest incremental costs per unit of output.

4.6.1 Project Output Analysis

The PDT defined and measured project outputs in terms of habitat units or ICUs, as defined in Section 4.4. The ICUs produced by each alternative included a value for protection of existing ICU’s at the island and for expected constructed ICUs or restored ICUs at the island. The ICUs were evaluated on an annual basis over time based on the expected island construction and development pattern. Project outputs are expected to begin to accrue as the perimeter dikes are constructed at the islands and continue to grow and accrue during the development of island upland and wetland cells. See Appendix B, Tables B-12 to B-25 for results of the ICUs output analysis. Each table includes ICU calculations for wetland (high and low marsh), intertidal and upland habitat types for each guild.

4.6.2 No-Action Alternative

The no-action alternative was included to provide a basis for output and cost comparisons. The no action alternative is defined as the projected future without project remaining acreage at both James Island and Barren Island. Rates of erosion were computed for each island based on long term historical loss rates at the islands. On average, the estimated long term rate of erosion at Barren Island is 4.1 ac per year (Wray, 1995). The estimated long term rate of erosion at James Island is 4.9 ac per year (Wray, 1995). These rates may vary from year to year based on extreme weather events. Based on the acreage remaining, Barren Island will be submerged by 2076 if the no action plan is chosen and current erosion rates continue. The 2004 remaining acreage at James Island is 79 ac. If the no action alternative is selected and the current erosion rate continues, James Island will be submerged by 2033.

The remaining ecosystem outputs or ICUs for the existing and without project conditions were evaluated for both Barren Island and James Island. These remaining ICUs were reduced over time based on the current rates of erosion at the two islands. In addition to the ICUs associated with island habitat, the ICUs associated with SAV beds protected by the islands were included in the remaining output evaluation. The period of analysis used was 50 years with a project base year of 2010. The no action alternative annual ICUs for Barren Island is 126.7 ICUs, and the no action annual ICUs for James Island is 1.8 ICUs. The combined no action annual ICUs for both islands is 128.5 ICUs. Tables 4-22 thru 4-24 display the no action alternative evaluation results for Barren Island, James Island, and the combined Barren and James Islands.

4.6.3 Island Restoration Alternatives Analyzed

Each alternative analyzed in this process is a distinct alternative that remained after screening and refinement. As previously described in section 4.3, alternative island sizes and configurations were defined by physical constraints, engineering considerations, ecological criteria and project delivery team objectives. A description of each alternative's acreage, dike height and upland/wetland ratio is provided in Table 4-25. These alternatives and the breakdown of their respective habitat types are presented in Table 4-26.

Two primary James Island restoration alignments with varying upland/wetland acreage ratios and upland dike heights were considered. The James Island alignment 3 suite of alternatives consists of a 1,586 ac restored island with upland to wetland ratios of 50% to 50%, 45% to 55% and 40% to 60%. The 50/50 alternative has an upland dike height of 20 feet, the 45/55 alternative has and upland dike height of 25 feet and the 40/60 alternative has an upland dike height of 30 feet. This additional dike height is necessary to meet the dredged placement need of 3.2 mcy. The James Island alignment 5 suites of alternatives consists of a 2,072 ac restored island with upland to wetland ratios of 50/50, 45/55, and 40/60. The 50/50 and 45/55 alternatives have an upland dike height of 20 feet, and the 40/60 alternative has an upland dike height of 25 feet.

There is one Barren Island restoration alignment within which there are varying upland/wetland acreage ratios and upland dike heights. The Barren Island A alignment suite of alternatives consists of a 1,354 ac restored island with upland to wetland ratios of 50/50 and 45/55. The 50/50 alternative has an upland dike height of 20 feet; the 45/55 alternative has an upland dike height of 25 feet.

One suite of joint James plus Barren Island alignments with varying upland/wetland acreage ratios and upland dike heights was analyzed during the CE/ICA process. The James Alignment 5/ Barren Alignment D suite of alternatives consists of 2,756 ac of restored island habitat with upland to wetland ratios at James Island of 50/50, 45/55 and 40/60. The 50/50 alternative has an upland dike height of 20 feet, the 45/55 alternative has an upland dike height of 20 feet and the 40/60 alternative has an upland dike height of 25 feet.

4.6.4 Alternatives Cost Analysis

Due to the extensive construction period, completing a detailed cost estimate for each alternative was not feasible at this point in the plan formulation process. Instead, conceptual level cost estimates were developed for each of the alternatives based on the actual, historical costs of the existing Poplar Island project. These conceptual level costs were then used to estimate projected costs over the lifetime of the alternative, which was dependent on the number of years required to develop and achieve the ICUs.

Table 4-27 displays the cost estimates for each alternative that were used in the CE/ICA analysis. The project costs are broken into 3 components in the following table: (1) dike construction, (2) all remaining construction costs excluding dike construction, and (3) an incremental cost for increasing the dike height above 20’. All remaining project costs excluding dike construction consist of site development, habitat development and dredged material transportation and placement costs. Site development and habitat development were dependent on the size and wetland/upland ratio of the alternative and include all site operation costs. These costs include: 1) environmental monitoring by various natural resource agencies (USFWS, NOAA, USGS); 2) habitat development, specifically site grading, developing channels and inlets for tidal flow and plantings; and 3) monitoring and management of inflow of dredged material, site operations, including crust management, dike maintenance, installing perimeter trenches, cutting interior drainage trenches, and maintaining trenches, sumps and bleeder channels. The incremental dike cost accounts for the cost to construct upland dikes higher than 20 feet and are only associated with alternatives proposed to have 25' or 30' dike heights. Increased dike heights are a result of the dredged material placement analysis (Table 4-10 and Appendix C) and are related to efficient dredged material placement given an alignment acreage and upland to wetland ratio.

The CE/ICA analysis is based only on the amortized construction costs described previously, with no consideration of OMRR&R cost or interest during construction (IDC) at this point in the cost estimating process. Although these costs would not be constant among the alternatives, they would likely be proportional and, therefore, not a factor in the final plan selection. Recreational costs were also not included at this point on the plan formulation process, as any recreational features included would be passive and consistently applied to all the alternatives equally. While important for the final cost estimate to determine appropriate cost-sharing levels, the results of this analysis are not sensitive to the inclusion of these costs, as they are essentially constant for all the large beneficial use alternatives analyzed.

4.6.5 Alternatives ICU Evaluation

Each of the 11 island restoration alternatives was evaluated for a 50 year period of analysis to evaluate the expected output in ICUs associated with construction and development of the alternative. Since this analysis was being conducted concurrently with the DMMP and PIERP GRR analysis, the project base year had not yet been firmly established and all alternatives assumed to begin accruing benefits in the same base year. The assumption was made that the base year for this comparison is 2010, two years after construction begins. Construction was estimated to begin in the year 2008 for this analysis. The year 2008 is significant, as this is the year that an additional dredged placement capacity needs to be underway to meet dredged material placement needs, as outlined in the draft Federal DMMP. The final recommendations of the DMMP were not available at the time this analysis was conducted. The ICUs were evaluated based on the site development plan and cell development plan generated for each alternative. For each alternative an average yearly ICU amount was computed. Table 4-28 displays the expected ICUs for each alternative.

4.6.6 Cost Effectiveness Analysis

The tables in Appendix B, Attachment C, provide detailed information on the ICU and cost analysis for each of the 11 island restoration alternatives. These tables show the expected output in ICUs by project year and the expected project cost by project year for each alternative. The project costs for each alternative were annualized using the FY 2005 interest rate of 5.375% that was applicable at the time of the analysis. The annualized cost is the amount that was used to compare the yearly average ICUs in the cost effectiveness analysis.

Table 4-29 displays the cost effectiveness analysis for the 11 island restoration alternatives. The table is arranged in ascending order from least to greatest output in ICUs. The No Action alternative, listed first in the table, produces 129 expected yearly ICUs (Column 6). The first 6 alternatives of Table 4-29 (shaded in gray) were eliminated because the Barren Island Alternative A (50/50) produces more output for less cost than each of those 6 alternatives. By the same cost per ICU comparison method, the James 5/Barren D (50/50) alternative was eliminated (shaded in gray). Four alternatives remained after the cost effectiveness analysis.

From a cost effectiveness perspective, selection of any of these four alternatives would be acceptable.

The four cost-effective alternatives remaining are highlighted in Table 4-29 with no shading. See Appendix B, Attachment C for additional information on this analysis.

4.6.7 Incremental Analysis of Cost Effective Alternatives

The next step is to examine the efficiency of each of the cost effective plans through an incremental cost analysis. In incremental analysis those cost effective plans that are most efficient in production are identified. These plans, known as "Best Buy" plans, provide the greatest increase in output for the least increase in cost. They have the lowest incremental costs per unit of output. The concept of incremental changes in costs and outputs is analogous to the concept of marginal changes, i.e., the differences in cost or output between one plan or alternative and the next one in succession. The decision rule in incremental analysis is to select the plan with the lowest cost per unit (i.e., the first "Best Buy" from a production perspective, producing output at the lowest unit cost) and then remove from consideration any plans that provide a smaller output level than the selected plan. These plans are deemed less efficient in production, producing a lower level of output at a higher unit cost.

Tables 4-30 to 4-32 display the incremental analysis of the remaining 4 cost effective alternatives identified in Table 4-29. Table 4-30 shows the incremental cost per unit of implementing each remaining alternative instead of the no action plan. Alternative Barren A, 45/55 produces 539 incremental ICUs at an additional cost of $55,800 per ICU. The cost per incremental ICU of Barren A, 45/55 is the lowest in relation to the No Action plan of the remaining alternatives. Alternative Barren A, 50/50 was eliminated from further consideration.

In Table 4-31, Barren A, 45/55 is the basis for the next iteration of incremental analysis. This table shows the incremental cost per unit of implementing each remaining alternative instead of Barren A, 45/55. Alternative James 5/Barren D, 40/60 produces 269 ICUs at an additional cost of $96,200 per ICU. The cost per incremental ICU of James 5/Barren D, 40/60 is the lowest in relation to Barren A, 45/55 of the remaining alternatives. Alternative James 5/Barren D, 45/55 was eliminated from the analysis.

4.6.8 Results of Incremental Cost/Cost Effective Analysis

Table 4-32 displays the summary data for the Mid-Bay Island incremental cost analysis. The table lists the alternatives that were selected from the iterations of the analysis. The column on the far right of the table shows the cost per ICU of selecting the succeeding alternative in the list. For example, the cost per ICU for an incremental output of 539 ICUs with implementation of Barren A, 45/55 compared to the No Action alternative is $55,800. Neither cost effectiveness analysis nor incremental cost analysis includes a plan selection rule. However, the information provided by these analyses can be used as a valuable tool in the plan selection process. The IC/CE analysis identified two 'best buy' plans, when compared to the no-action alternative: a single island restoration project at Barren, alignment A, totaling 1,354 acres with an upland/wetland ratio of 45/55 and dike heights of 25 feet; and a combined island restoration plan at James, alignment 5 and Barren, alignment D, totaling 2,756 acres, with an upland/wetland ratio of 40/60 and dike heights of 25 feet. The best buy plans are highlighted in Figure 4-8, which includes all 11 alternatives in the CE/ICA.

4.6.9 Re-iteration of Two Island Alternative

While James 5/Barren D option would provide the greatest ecosystem benefit, it was determined by the PDT that the Barren Island portion of the plan could be scaled down to reduce costs, to avoid negative impacts to fisheries in the area surrounding Barren Island, without sacrificing benefits. An alternative combining large scale island restoration at James Island with scaled down efforts at Barren Island focusing on shoreline protection with minor habitat restoration could provide the same benefits at much lower costs as the present James 5/Barren D alternative. The James Island portion of the combined plan could account for the placement capacity of the proposed Barren D option. As a result, the James 5/Barren D option was transformed into a James 5/Barren E alignment. Barren Alignment E was evaluated in combination with James Alignment 5 and carried forth as a third plan for the remainder of the plan formulation process. The cost savings of this plan iteration is clearly represented in Figure 4-9.

This alignment would provide protection of the existing island and SAV habitat at Barren Island and capture the dredged material placement opportunity at James Island. This alternative combines the James Island 5 restoration alignment with a modified Barren Island restoration centered on shoreline protection with minimal beneficial use opportunities. The James Island portion of these new alternatives has the same dimensions and construction features as the James Island 5 alignment. The Barren Island feature is designed primarily to protect the remnant Barren Island, currently 197 ac, and restore an additional 72 ac of wetlands through the beneficial use of dredged material, making it comparable to its size in the 1940s. Impacts to the diverse natural resources and fisheries use plus the loss of bottom fish habitat would be largely prevented by not constructing an offshore island at Barren Island. In addition, the significant SAV resources on the Eastern side of Barren Island would continue to be protected.

4.7 SELECTING THE RECOMMENDED PLAN

The final stage of the plan formulation process was to select the recommended plan from the list of cost effective plans described in Table 4-33, with the addition of the James 5/Barren E alignment (Barren protection). Although James 5/Barren E was not part of the incremental cost analysis, based on its average annual costs of $32,500,000 (total cost is $941,658,000) and annual ICUs of 813 (total ICUs of 40,650), it would have remained in the final array of Best Buy plans. Three methods were used to compare the 'best buy' plans and enable selection of a recommended plan: (1) an inventory of benefits and impacts to the four Principles and Guidelines evaluation accounts (2) evaluation of objectives and (3) a discussion NED/NER trade-offs.

4.7.1 *Inventory of Benefits and Impacts to the Principles and Guidelines Evaluation Accounts

The selected alternative must have, on balance, net beneficial effects after considering all plan effects, beneficial and adverse, in the four Principles and Guidelines evaluation accounts: National Economic Development, Environmental Quality, Regional Economic Development, and Other Social Effects. Table 4-33 summarizes the benefits and impacts of the four evaluation accounts for each of the four proposed alternatives. Impacts are discussed in further detail in Section 6.

The No Action alternative would have no benefits to any account. The main impacts would be tied to the eventual loss of James and Barren Islands and their associated resources. Local erosion would continue. Once the islands and the protection they provide are gone, the SAV beds would likely not exist. There may be increased erosion of the mainland shoreline after the islands disappear.

The Barren Island A with 45% upland/55% wetland plan would protect Barren Island and its associated resources such as SAV. Local erosion stemming from Barren Island would be reduced. 1354 ac of remote island habitat would be restored and local erosion would be reduced around Barren Island. However, 1,354 ac of 'healthy' benthic community and shallow water habitat would be permanently transformed into island habitat. The B-IBI (Benthic- Index of Biotic Integrity) performed during existing conditions surveys determined that the benthic community at James Island was 'stressed' and that at Barren Island was 'healthy' (Section 6.3.6c). Commercial fisheries would be displaced. Fisheries preferring hard bottom may be enhanced with dike construction. Protection/enhancement of SAV plus wetland restoration at Barren may improve some recreational species. Construction jobs would be created at Barren Island. There would be light and noise impacts during construction. The viewshed would permanently change. Travel time to fishing grounds and open water may be slightly increased. James Island and its associated resources would eventually be lost to erosion. With the loss of James Island, there may be heightened impacts to the shoreline properties on the mainland.

The James Island 5/Barren Island D at 40% upland/60% wetland alternative would protect existing James and Barren Islands, possibly the leeward mainland, and associated resources such as SAV beds. 2756 ac of remote island habitat would be restored. Local erosion would be reduced in the vicinity of both islands. Commercial fisheries at Barren and James Islands would be displaced. 2,072 ac of shallow water habitat would be transformed into remote island habitat at James Island plus 684 ac at Barren Island. Therefore, this alternative would impact a greater portion of 'stressed' habitat at James rather than 'healthy' habitat at Barren, but would still contribute the greatest loss of shallow water habitat than any other proposed alternative. Fisheries preferring hard bottom may be enhanced with dike construction. Protection/enhancement of SAV at Barren plus wetland restoration may improve some recreational species. Construction jobs would be created at James and Barren Island. There would be light and noise impacts during construction. The viewshed would permanently change at James and Barren Islands. Travel time to fishing grounds and open water may be slightly increased.

The James Island 5/Barren Island E at 45% upland/55% wetland alternative would protect existing James and Barren Islands, possibly the leeward mainland, and associated resources such as SAV beds. Approximately 2,144 acres of remote island habitat would be restored. Local erosion would be reduced in the vicinity of both islands. Commercial fisheries at James Islands would be displaced. There would be no significant negative impacts to commercial fisheries at

Barren Island. 2,072 ac of shallow water habitat and 'stressed' benthic community would be transformed into remote island habitat at James Island plus 72 ac of near shore habitat at Barren Island. This alternative would avoid impacts to the 'healthy' benthic habitat at Barren Island. Fisheries preferring hard bottom may be enhanced with dike construction. Protection/enhancement of SAV plus wetland restoration at Barren may improve some recreational species. Construction jobs would be created at James and Barren Island. There would be light and noise impacts during construction. The viewshed would permanently change at James Island. Travel time to fishing grounds and open water may be slightly increased.

4.7.2 *Evaluation of Objectives

As the plan formulation process is iterative, a final comparison to the objectives outlined at the beginning of the plan formulation process was conducted in February 2005, taking into consideration all available data collected at both James and Barren Islands over the course of 2 years, including additional survey results at Barren and James Islands, which had been delayed, as well as input from PDT members and resource agencies. The objectives of this study, as originally described in Section 4.1.4, are:

1. Restore and protect marsh, aquatic, and terrestrial island habitat for fish, reptiles, amphibians, birds, and mammals.
2. Protect existing island ecosystems, including sheltered embayments.
3. Optimize the capacity for placement of dredged material (3.2 mcy/y). (Federal DMMP identified a need to place 30 to 70 million cubic yards of material over a 20 year period.)
4. Increase wetlands acreage in the Chesapeake Bay watershed.
5. Decrease local erosion and turbidity.
6. Promote conditions to establish and protect submerged aquatic vegetation.
7. Promote conditions that support oyster recolonization.

The degree to which a plan meets an objective is indicated by one of three possibilities: 1) a minus indicating that the alternative did not meet the objective; 2) one plus sign indicating that the plan did meet the objective; and 3) two plus signs indicating that the plan met and exceeded the objective above and beyond the other plans. Once all plans were compared, a total score of each alternative could be calculated, providing the PDT with a range to assist in the selection of the final recommended plan.

4.7.2.a Objective 1

All alternatives except the "no-action alternative" met this habitat restoration objective, but did so by varying degrees. Barren A, James 5/Barren D, and James 5/Barren E all restore remote island ecosystem habitat, and therefore, at a minimum deserved a "+" ranking. However, based on results of existing conditions at Barren, and the cumulative loss of shallow water habitat to beneficial use projects in conjunction with the existing PIERP and authorized expansion, Barren A and James 5/Barren D would have greater impacts on existing shallow water habitat, a critical habitat for fisheries nurseries and feeding. James 5/Barren E does not have this additional concern, and therefore received a rank of "+ +".

4.7.2.b Objective 2

All alternatives except the "no-action alternative" met this objective, as they all protect critical existing habitat at Barren Island. James 5/Barren D and James 5/Barren E received a higher ranking of "+ +" as these two alternatives also protected James Island.

4.7.2.c Objective 3

All alternatives except the "no-action alternative" met this objective, as they all met the dredged placement shortfalls outlined in the Federal DMMP. However, two of the alternatives, James 5/Barren D and James 5/Barren E received a higher ranking of "+ +" as these two alternatives provided placement capacity beyond the 20 year planning horizon of the DMMP. Barren Island could accommodate the 3.2 mcy capacity requirement for 17 years, James 5/Barren D for 31 years, and James 5/Barren E for 24 years.

4.7.2.d Objective 4

All alternatives except the "no-action alternative" met this objective, as they all restore wetland habitat. Barren A would create 682 acres, James 5/Barren D would create 1512 acres, and James 5/Barren E would create 1108 acres. Since James 5/Barren D created the most wetland habitat, that alternative received "+ +" ranking, while the other two received a "+".

4.7.2.e Objective 5

All alternatives except the "no-action alternative" met this objective, as they all protect existing islands from further erosion, as well as provide protection of the mainland. However, based on modeling result, James 5/Barren E received a higher ranking of "+ +" as the extended breakwater would afford additional protection of both Barren Island remnants and Hoopers Island, while the other two received a "+".

4.7.2.f Objective 6

All alternatives except the "no-action alternative" met this objective, as they all would afford protection of existing SAV habitat at Barren and James Island. James 5/Barren E received a higher ranking of "+ +", as the extended breakwater would provide additional reduction in waves, thereby having the potential to reduce turbidity and provide quiescent conditions conducive to SAV growth.

4.7.2.g Objective 7

All alternatives except the "no-action alternative" met this objective, as they all avoid and protect existing natural oysters bars in the vicinity of James and Barren. Two critical factors necessary to encouraging the recolonization of oysters are providing the necessary hard substrate and ensuring salinity levels are correct. None of the alternatives would affect the current conditions negatively, and would possibly improve substrate conditions by reducing local turbidity and sedimentation of current NOBs by local erosion.

4.7.2.h Results of Objective Summary

Table 4-34 summarizes the results of the objective comparisons and degree to which each alternative met the objectives. The total score for each alternative was determined by giving zero credit for each minus and one credit for each plus. By summing the potential credits, the no-action alternative received zero; Barren A received 7 credits, James 5/Barren D received 11 credits, and James 5/Barren E received 13 credits.

4.7.3 NED/NER Trade-off Analysis

The purpose of an NED/NER tradeoff analysis is to compare the NER outputs (ICUs), the NED (dredged material placement) outputs and the costs for the alternatives. The alternatives were formulated to maximize ecosystem outputs (NER). The tradeoff analysis would show if selecting the alternative that maximizes NER outputs has NED costs. In other words, if a non-selected alternative provides greater placement capacity than the selected alternative it would not be necessary to invest in another dredged material placement project until the non-selected alternative capacity is reached. The greater placement capacity is an NED benefit. But if there is a loss of NER outputs with the non-selected alternative compared to the selected alternative, there is a tradeoff between an increase in placement capacity and a decrease in NER outputs with the non-selected alternative.

The formulation and plan selection for the Mid-Bay Islands project did not involve any NED/NER tradeoffs of navigation benefits and costs, since the navigation channels will continue to be maintained at their current depths and frequencies. There would be no impact on NED navigation benefits for the channels involved and the NED navigation costs are established using the base plans for disposal at each project. However, the formulation of island restoration through beneficial use of dredged material inherently requires some consideration of tradeoffs between the NED objective of providing beneficial use capacity at a reasonable incremental cost above the base disposal plan and the NER objective to efficiently produce ecosystem outputs through protection and restoration.

The Mid-Bay Islands formulation directly addressed some NER/NED objective tradeoffs in its analyses of island restoration. First, alternatives were specifically evaluated for varied wetland to upland ratios. The resulting comparison of their average annual ecosystem outputs to the average annual costs was used to determine the optimum ratio of wetlands to uplands for island restoration, building on knowledge gained from operations at PIERP.

Another consideration involved the timing of the investment in island development. Since dike construction involves a high initial investment, the timing of dike construction was evaluated based on a comparison of the average annual ecosystem outputs resulting from early investment to protect the existing island remnants and adjacent habitats with those that would result if the dike investment was delayed until the capacity is needed for disposal purposes and existing habitat was lost through continued erosion.

Lastly, once dikes are constructed the islands are filled by beneficially using dredged material at a rate that provides for efficient dewatering and consolidation. This is common practice at most dredged material placement facilities because it avoids overfilling and maximizes the site's dredged material capacity and useful life, resulting in a lower cost per cubic yard of material being placed. However, at a beneficial use project such site management practices to maximize capacity delay to some extent the ultimate development of the ecosystem habitat when the site is filled, and result in a higher cost per habitat unit created. Efficient filling of the site is a prudent economic consideration, which generally delays the next significant investment in a beneficial use project to provide dredged material capacity for maintenance of the channel system. However, as a site nears its capacity, the volume of dredged material that can efficiently be placed annually decreases, resulting in either inefficient overfilling of the remaining capacity or investing in replacement capacity to allow concurrent use of both sites to avoid overfilling. These NED cost considerations affect not only the NER outputs for the particular island being restored, but the NER outputs for future beneficial use projects from a system standpoint. The need and planning for future beneficial use projects would be addressed by subsequent DMMP efforts.

4.7.4 Recommended Plan

The final recommended plan selected by the PDT is James 5/Barren E that includes a 55/45 wetland/upland ratio of James Island Alignment 5 with dike heights of 20 feet and protection/restoration at Barren Island, alignment E. As was laid out in the objective evaluation this alternative was the only proposed plan that not only met all 7 objectives, but also exceeded five of these objectives when compared to the other plans. Further, this alternative provided protection to James and Barren Island and their associated SAV resources without negatively impacting the highly used Barren Island commercial fishing grounds, as described in the comparison of the four account tables. It was determined that after considering all plan effects, James 5/Barren E provided net beneficial effects with the minimal impacts. Refined estimates made during the timing analysis identified that the recommended plan could accommodate 90 to 95 mcy of dredged material over a 32 year period if placed efficiently. Further details of the recommended plan are provided in Section 5.

Restoring and protecting James and Barren Islands will provide needed remote island habitat within the Chesapeake Bay and benefit a diverse number of birds, diamondback terrapins, a recently delisted Federally threatened species (Bald eagle), and SAV. There is a limited amount of island habitat and only one chain of islands within the Chesapeake Bay region available to the species that rely on island habitat. Without restoration, these islands and the chain of islands would be lost to erosion. The existence of these islands is critical to many bird species including songbirds, colonial nesting wading and waterbirds, shorebirds, and waterfowl. Further, the addition of a restored James and Barren Island will contribute needed connectivity to the existing chain of restored islands that includes Hart-Miller Island and Poplar Island. Restoration of James Island will contribute 1,108 acres (1,043 ac at James Island plus 65 ac at Barren Island) of wetlands to the CBP goal of restoring 25,000 ac of tidal and non-tidal wetlands at a rate of 2,500 ac per year per basin. Restoration at James Island is expected to reduce erosion from the existing island remnants and thereby contribute to the C2K goal to improve water quality. Bald eagles nest at both James and Barren Island. Protection and restoration of these existing islands by the recommended plan will protect the nesting habitat of this Federally threatened species. The recommended plan is expected to provide diamondback terrapin nesting. Dr. Willem Roosenburg of the Ohio University is the international expert on diamondback terrapin nesting.

It is his view that the current nesting at the existing island remnants suggests the proposed project will support further nesting for this critical species. Finally, restored islands will provide protection to SAV beds which have extended over 1,347 ac at their maximum in recent years and contribute to the 185,000 ac CBP restoration goal.

4.7.4.a Relationship to DMMP

As this study was conducted concurrently with the Federal DMMP and PIERP GRR studies, the implementation of the recommended plan in context of these studies needed to be determined. This review was to ensure that the necessary quantities of dredged placement material would be available to achieve the proposed benefits within the period of economic analysis and to determine start dates for construction.

The Federal DMMP was finalized in December 2005 and included a recommended implementation schedule to meet the projected dredged placement shortfalls projected from 2005 to 2025 (Table 4-35). For the C&D canal approach and Chesapeake Bay Maryland approach channels, the DMMP evaluated both existing placement sites and proposed three new placement sites. It included: existing Poole's Island open water site; the existing PIERP; PIERP expansion; large island restoration at Mid-Bay; and wetland restoration in Dorchester County.

Some analysis on sequencing of the proposed dredged material management sites was completed as part of the Federal DMMP. However, these recommendations were based on the preliminary estimates of the amount of dredged material that could be handled at each site- 600 acres for Poplar Island Expansion and 1000 acres for a large island restoration project in Mid-Chesapeake Bay. The recommended plan of James 5/Barren E would provide 2,072 acres of capacity, and therefore would provide capacity beyond the planning period of the DMMP. The current start date for construction for James Island assumed during the plan formulation process and shown in Table 4-35 is 2012, which would move the base year for benefits to start accruing at James from 2010 used in the CE/ICA analysis to 2015. The subsequent timing analysis that was conducted considering the authorization of the PIERP expansion (Section 4.7.5) showed that James Island must be on line in 2018. Given the length of time required for the next phase and for development of the dikes the project was determined to meet the needs within the time frame outlined in the DMMP.

In terms of the Barren Island component of the recommended plan, implementation is not tied to the dredged placement needs. As the existing island ecosystem habitat is a significant portion of the benefits calculated, protection of these resources as soon as possible is critical to achieving the calculated benefits, particularly the SAV habitat. The proposed start date for the PED phase of Barren Island is 2009, with construction starting in late 2010.

4.7.4.b Recreational Considerations

Recreational and educational components are considered for inclusion on the James Island portion of the recommended plan to the extent that the components do not adversely impact the created habitats and the goal of the ecosystem restoration process. No recreation plans are considered for the Barren Island portion of the recommended plan, as Barren Island is USFWS property. According to USACE Regulations (Policy Guidance Letter No. 59), the Federal cost for recreational and educational features must be less than 10% of the project total cost. Costs for recreational components will be cost shared 50% Federal and 50% non-Federal. Recreation development at an ecosystem restoration project should be totally ancillary to the primary purpose, appropriate in scope and scale, and shall not diminish the ecosystem restoration benefits used to justify the project (ER 1105-2-100). Additionally, any recreational components incorporated at ecosystem restoration projects must be compatible with the objectives of the project and enhancement of the public's experience by taking advantage of natural values (ER 1105-2-100).

A detailed analysis of recreational features is provided in Appendix L. This analysis determines the net benefits for the recreation features proposed. Recreation features are being included in the Mid-Bay project as an additional project benefit, and are not part of the overall project benefit cost analysis. Therefore, recreation benefits will not be used in the justification of the recommended plan. Due to the incidental effect of these recreation elements, a determination of acceptable design to meet Corps standards has not been completed at this study phase. Based on a conceptual design for an existing tidal marsh cell, recreation costs are estimated at $204,000. Since recreational features must comply with the project purpose of remote island habitat, the actual location of the recreational features upon completion of the project will be restricted to the tidal gut area at James Island. This allows for passive recreation from the water (with possible time of year restrictions for nesting seasons, based on recommendations of local biologists). If deemed necessary, there is also the possibility of using of the dike areas for recreation, as no project benefits were claimed for habitat on the dikes themselves. In addition, if recreation were to expand to other restored areas outside of the dikes, the plan formulation section of the report would have to be updated and recalculated. This would lead to delaying finalization of the report.

Passive recreational and educational components considered in the plan formulation were very minimal. This was due to the fact that the project creates unique remote island ecosystem habitat, which is fragile and very susceptible to human interference. It was determined that even passive recreation could negatively impact nesting habitats. And so, the intention of the project is to develop minimal low-impact recreational/educational spaces in a way that benefits the local jurisdictions and the State of Maryland, while still meeting the objectives of the restoration project. The majority of the passive recreational components are interpretive guidance and media, including: a self-guided/interpretive water trail in the tidal gut at James Island, informative signage, and avian observation from the water. Other components such as public tours of the islands, research opportunities for universities, and volunteer opportunities will be available during the construction of the project (estimated 30 years).

Recreation and education components suggested for inclusion in the future development of the Mid-Bay Islands Restoration are as follows:

4.7.4.b.1 During Construction (Est. James Island can receive dredged material for 30 years)

- Research opportunities for educational institutions – Educational institutions would be provided opportunities and permitted to conduct scientific studies at James Island

and at the proposed lateral expansions during site construction. Barren Island is owned by Fish and Wildlife Service (USFWS); research opportunities at Barren Island would be coordinated through them.

- Volunteer opportunities – Volunteers would be invited to participate in both wetland and upland plantings, and various other activities that would aid in project creation / construction.
- Dock for visiting boats – A dock for visitors to tie-up boats will be located in the dike area. The main reasons for visitors during the construction phase would be construction, volunteer, or research. Upon completion of construction, the boat dock may remain in place if deemed necessary for additional project purposes such as O&M.
- Resting/viewing areas – Locations for resting on benches in the proposed dike areas would be in place during construction.

4.7.4.b.2 Upon Completion of Construction

- A self-guided/interpretive, low-impact water trial will be created through the main tidal gut area at James Island.
- Informative signage – Signs would be located at set areas along the water trail and other areas viewable by passive observance from the water. These signs would be intended to point out elements of viewable wildlife nearby and educate the public on the Mid-Bay Islands restoration. Other signage would be in place to indicate navigational warnings, land restrictions, tidal gut water trail directional signs, and time of year restrictions to tidal gut access if necessary.

4.7.4.b.3 Recreation Benefits

The national economic development (NED) benefit evaluation procedures contained in ER 1105-2-100 (22 Apr 00), Appendix E, Section VII, include three methods of evaluating the beneficial and adverse NED effects of project recreation: travel cost method (TCM), contingent valuation method (CVM), and unit day value (UDV) method.

The UDV method was selected for estimating recreation benefits associated with the expansion of the Mid-Bay Islands. UDV was chosen because both TCM and CVM require extensive recreation surveys that were not feasible or justifiable. UDV relies on informed judgment, and is an acceptable method to approximate average willingness to pay for federally funded projects. The UDV approach consists of two parts: determining value per visit and estimating visitation user days. The details of this analysis are provided in Appendix L.

4.7.5 Optimization of NER Plan

During the plan formulation phase, the analysis for both the Mid-Bay study and the Poplar Island Expansion study were done concurrently and independently to maximize placement efficiency and habitat benefits at both sites. Therefore, the placement and benefit analysis of the James Island project of the recommended plan as outlined thus far did not consider any influence of the Poplar Island expansion project on placement or development of habitat at James nor James Island's affect on the Poplar Island projects.

With the selection of a recommended plan in this study and an approved project to expand Poplar Island (Chief's report was signed on 31 March 2007), the implementation and timing of the Mid-bay recommended plan was reviewed to optimize the economic and ecological benefits. A timing analysis on placement and the accrual of benefits in light of these other projects was conducted on the James portion of the recommended plan. The Barren Island project was not included in this analysis, as the proposed project would not affect on-going operations or the authorized project at Poplar Island. Specifically, this analysis was done to:

1) Determine the effects on the schedule for implementation of the Poplar Island Expansion Study (PIES) project and realization of the benefits outlined in the approved Poplar Island Chief's Report (USACE, 2007), and

2) Determine if James Island, Poplar Island Expansion, and existing Poplar Island are authorized and constructed concurrently, the benefits/impacts to the existing Poplar projects and the proposed James Island project as formulated.

4.7.5.a Scenarios Evaluated

To answer these questions, the Baltimore District re-analyzed the dredged placement, costs, and benefits for both James and Poplar Island Expansion for three scenarios. The 2014 scenario is the earliest possible start date for filling at James due to the funding scenarios, completion of PED phase, and the period required for dike construction. The 2018 scenario is based on the recommendations of the DMMP to avoid overfilling of Poplar Island and Poplar Island Expansion. The 2023 scenario is included to reflect the recommended plan in the current PIERP GRR, which shows 2023 being the first year that dredged material placement needs of 3.2 mcy cannot be met. For reference, the Baltimore Harbor and Channels DMMP Implementation Schedule of dredged material quantities (cy) by placement site is provided in Table 4-35, even with overfilling.

4.7.5.b Dredged Material Placement Analysis

The scenarios evaluated have James Island accepting dredged material in 2014, 2018, or 2023, with dike construction 4 years in advance of those years (see Attachment 1 for placement scenarios). These scenarios result in overlapping operations at both Poplar and Mid-bay for four years for the 2014 and 2023 scenario, and only one year for the 2018 scenario. Overfilling is reduced by 17% at Poplar Island for the 2014 and 2023 scenario, but is reduced by 34% for the 2018 scenario. The different start dates at James also affect the operational life of the Poplar Island projects. The 2014 scenario extends the operational life of Poplar Island by 4 years, to 2029, while the 2018 scenario extends the operational life by one year to 2027. The 2023 scenario does not change the operational life at Poplar Island as presented in the Poplar Island Expansion GRR. The detailed placement analysis has been incorporated into Appendix C, Attachment C of the Mid-Bay Feasibility Report.

4.7.5.c Benefit Calculations

While the island community unit method was developed during the plan formulation process in the Mid-Bay study, it was modified when applied to Poplar Island, as the PDT for Poplar Island recognized that interim benefits during construction have been observed. Therefore, the ICUs for James Island portion of the recommended plan only (Barren Island was not included in this analysis) were recalculated to measure the interim benefits from sheltered open water habitat and mudflat habitat of the upland cells prior to planting. This allowed for both dredged material placement projects to be compared evenly, and to account for all benefits at the various start dates at both Poplar Island and James Island. The detailed analyses of these benefits are included in Appendix B, Plan Formulation.

4.7.5.d Cost/Benefit Analysis

For Poplar Island Expansion project, the costs presented in the final PIERP GRR report were used without any changes (USACE, 2006). However, in order to answer the question on timing at James Island, more detailed costs were calculated. To account for the delay in benefits during construction, interest during construction was calculated for all three scenarios for all costs accrued prior to first year of placement, respectively 2014, 2018, and 2023. All costs were then brought to a 2008 present value cost for each scenario and a total present value cost determined. A final comparison was made of the average annual cost per average annual ICUs for all three timing scenarios at James Island.

In order to ensure that the cost/benefit analysis was not artificially skewed towards the later start date, the period of analysis for calculating the average annual benefits was defined as the earliest and latest dates costs were accrued for all three scenarios. This resulted in a period of analysis of 52 years from 2008-2060. Since benefits for ecosystem restoration projects are not discounted, it was critical that this period of analysis truly reflect the effects on the benefits of starting at different times. Details on the cost analysis are included in Appendix B (Plan Formulation) of the feasibility report.

4.7.5.e Results

For the 2014 scenario, the primary benefits are preservation of the existing island remnants and additional NED benefits which increase operational effectiveness by reducing overfilling of upland cells by 17% at Poplar Island, and extending the placement life of the overall Poplar Island/Expansion projects from 2026 to 2029. Also, overall annual ICUs are increased for the proposed Poplar Island Expansion project from 557 to 569, due to delay of upland development and extended life of mudflat habitat. In order to minimize overfilling and accommodate the 3.2 mcy of dredged material, placement operations occurred at both James and Poplar Islands four times during the construction phase in the years 2014, 2016, 2024, and 2029. The average annual cost per average annual ICU for this scenario at James Island is $55,152.

The 2018 scenario is based on the recommendations of the DMMP to avoid overfilling of Poplar Island and Poplar Island Expansion. Benefits of this scenario include the preservation of some benefits of the existing James Island, reducing overfilling of the Poplar Island/Expansion projects by 34%, and extending the placement life at Poplar Island by one year to 2027. Also, the overall annual ICUs at Poplar Island/Expansion projects increased from 557 to 572 due to delay of upland development and extended life of mudflat habitat (see Appendix B, Attachment D for ICU calculations for each scenario). Placement at both sites for this scenario occurred only once, in 2027. In terms of timing at James Island, the average annual cost per average annual ICU is $50,936, which is significantly better than the 2014 scenario.

For the 2023 scenario, it is predicted that the existing island remnants at James Island would be gone by 2021. The benefits of this scenario are that by having James Island on line, overfilling at Poplar Island is reduced by 17%. The annual ICUs of the Poplar Island/Expansion projects did not change from what was reported in the Chief's Report, and remained at 557. Placement occurred at both sites four times for this scenario in years 2023 through 2026, and no change was made to the operational life of Poplar Island. The average annual cost per average annual ICU for this scenario is $49,487, which is slightly lower than the 2018 scenario.

As discussed, by placing dredged material concurrently at Poplar, Poplar Island Expansion and James Island (Mid-Bay), a net increase in both NED and NER benefits is expected at both sites for all three scenarios. Timing at James Island on its own is not significantly impacted by the change in placement start dates, with a slightly better cost per ICU ratio for the 2023 scenario versus the 2014 and 2018 scenarios (Table 4-36). However, all three scenarios are cost-effective and have increasing incremental costs/ICU.

4.7.5.f Conclusions of Timing Analysis of Recommended Plan

Based on the results outlined in the previous section, the 2018 placement scenario is recommended for implementation at James Island, thereby increasing the overall NED benefits at all three project sites, and increasing the overall net NER benefits at Poplar Island and Poplar Island Expansion project sites. Barren Island does not change as a result of this analysis, and is still recommended to begin construction in late 2010.

Even though there is an insignificant increase in NER benefits achieved at James in the 2023 scenario, the 34% reduction of overfilling at James, positive NED benefits achieved, net increase in NER benefits, and the risk and uncertainty that overfilling at existing sites would not occur sooner negate choosing the 2023 scenario over the 2018 scenario at James Island.

Finally, it is recommended that this type of analysis be conducted as part of the next update to the Dredged Material Management Plan to better reflect the recommended plan acreages outlined in the final PIERP GRR and Mid-Bay reports, and any projects that may have been authorized at the time of the update.

4.7.6 Evaluation of Net Ecosystem Outputs

In response to an EPR comment, an additional analysis was performed with the ICUs to incorporate the loss of open water habitat from island construction. An open water index was developed for the guilds that benefit from this habitat: waterfowl, benthic invertebrates, resident/forage fish, and commercial/predatory/higher trophic fish. The open water indices were utilized to quantify the impact of filling the open water during construction. The value derived for the open water habitat (defined as the Open Water ICUs) was subtracted from the Total Benefit quantified for constructing the islands as well as protecting the existing islands and SAV that is provided in Table 4-28. Representatives from NOAA NMFS, EA Engineering, Science, and Technology, Inc., NOAA, USGS, and MDNR were involved in developing the indices. The open water indices are provided in Table 4-37. The full evaluation tables for James and Barren open water ICUs are contained in Appendix B. The results of the net ICU analyses are presented in Table 4-38.

The open water ICU value at James Island is 0.18 ICU/ac while the value is 0.37 ICU/ac at Barren Island. The Barren Island open water ICU value is nearly double that of James Island due to a diverse benthic community that increases the potential impact to both benthic invertebrates and fisheries resources. At James Island, open water impacts are largest to the waterfowl community. The gem clam and dwarf surf clam densities identified in seasonal monitoring at James Island suggest that there are abundant foraging resources for wintering waterfowl in the area that would be filled by construction of any of the James Island alternatives. There is minimal impact to fisheries resources at James Island because there are not diverse benthic or planktonic communities, nor cover and structure. The recommended plan provides a total of 22, 045 net ICUs. The only alternative that provides a greater number of total net ICUs is the James 5/Barren protection alternative at 40%/60% upland/wetland ratio which provides a net of 23,275 ICU. This alternative, however, was not a ‘Best Buy’ Plan.

In conclusion, the net benefits analysis identified impacts to waterfowl foraging habitat, fisheries habitat, and benthic communities as a result of filling open water to restore remote islands, but did not result in a change in the selection of the recommended plan.

SECTION 4

FIGURES

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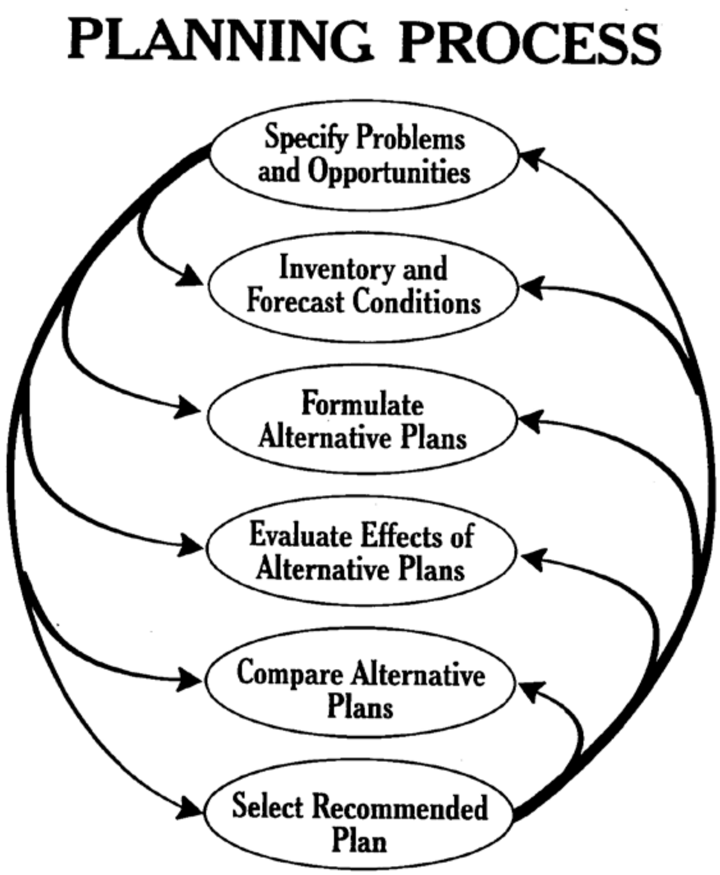

Figure 4-1: Plan Formulation Process

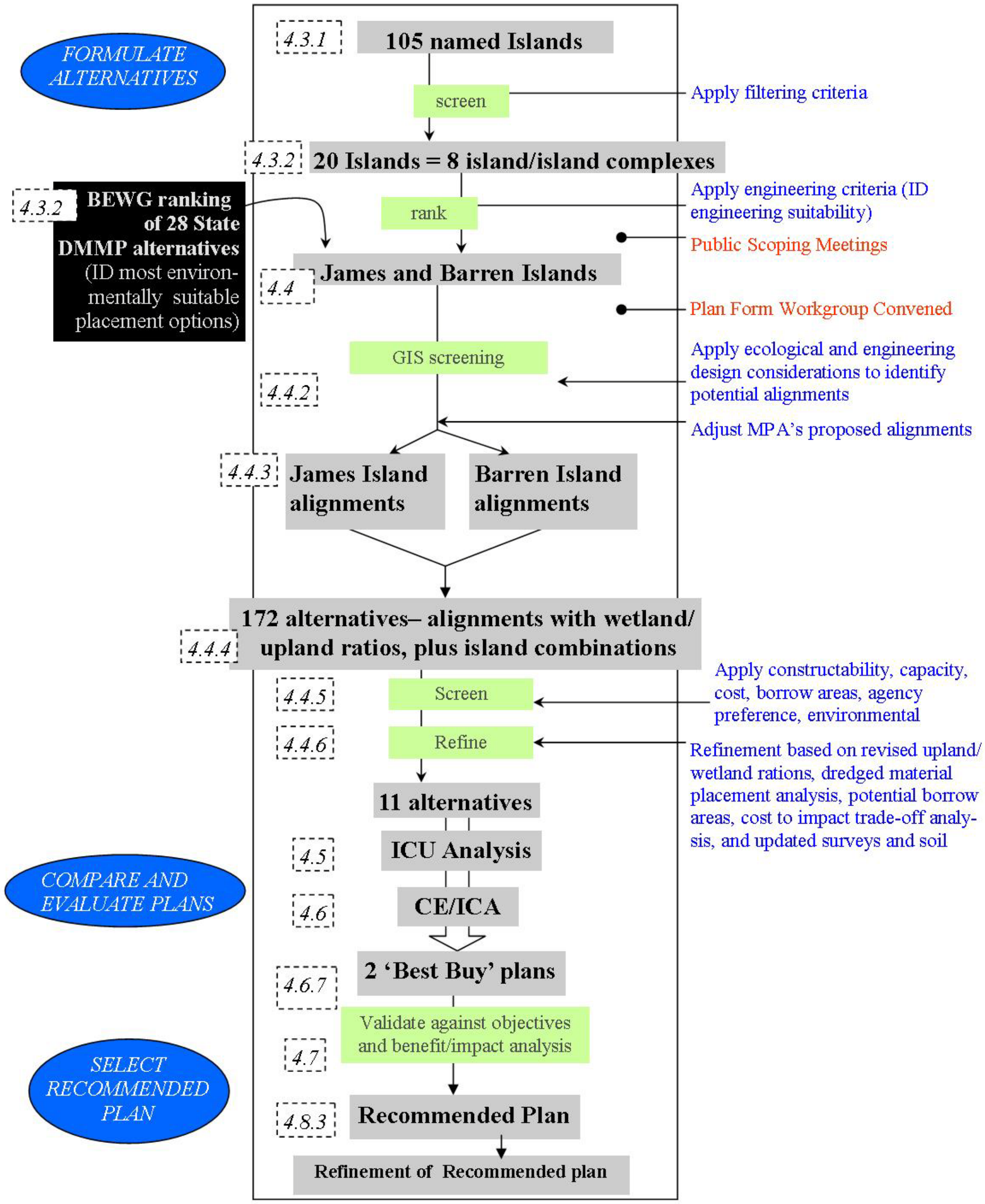

Figure 4-2: Mid-Chesapeake Bay Plan Formulation Process

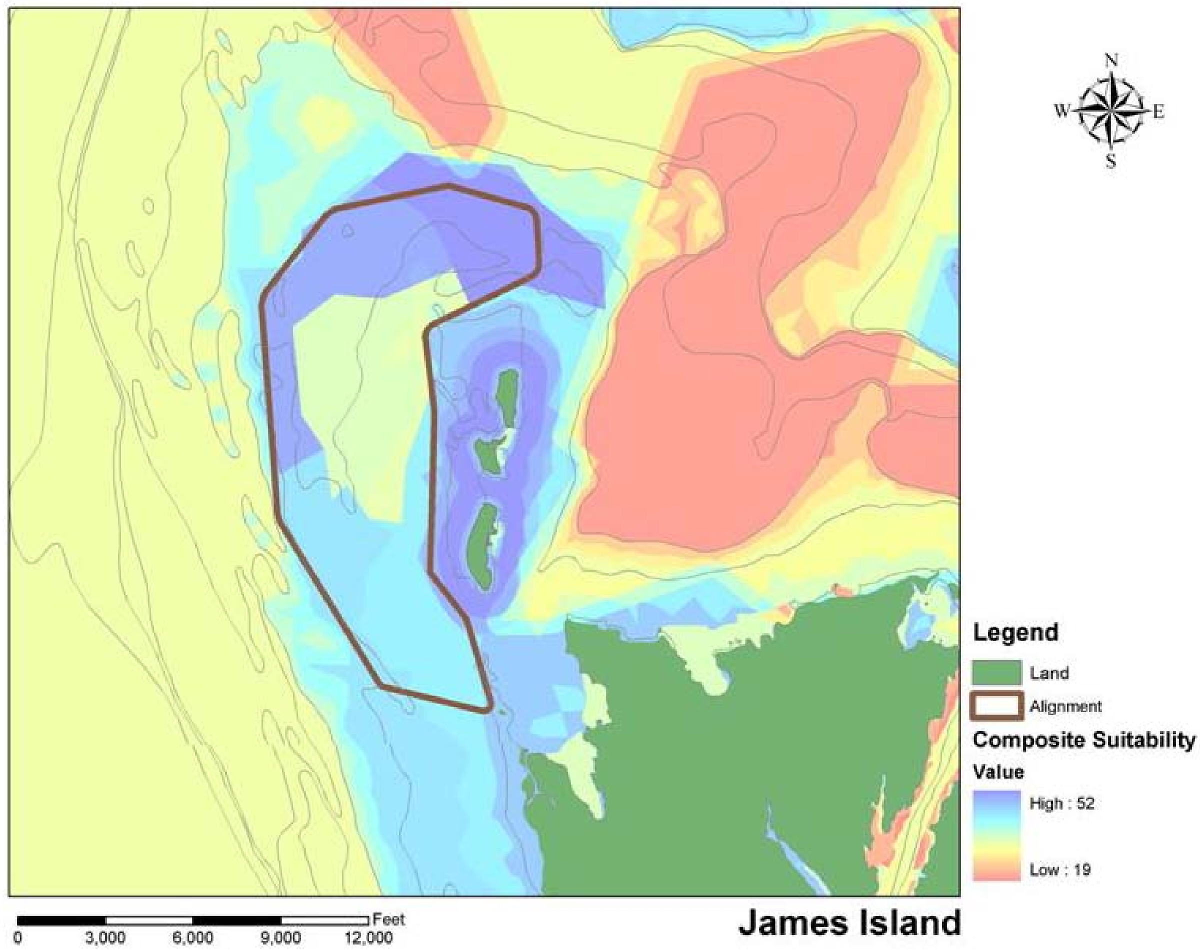

Figure 4-3: Composite Suitability for Potential James Island Restoration Alignments

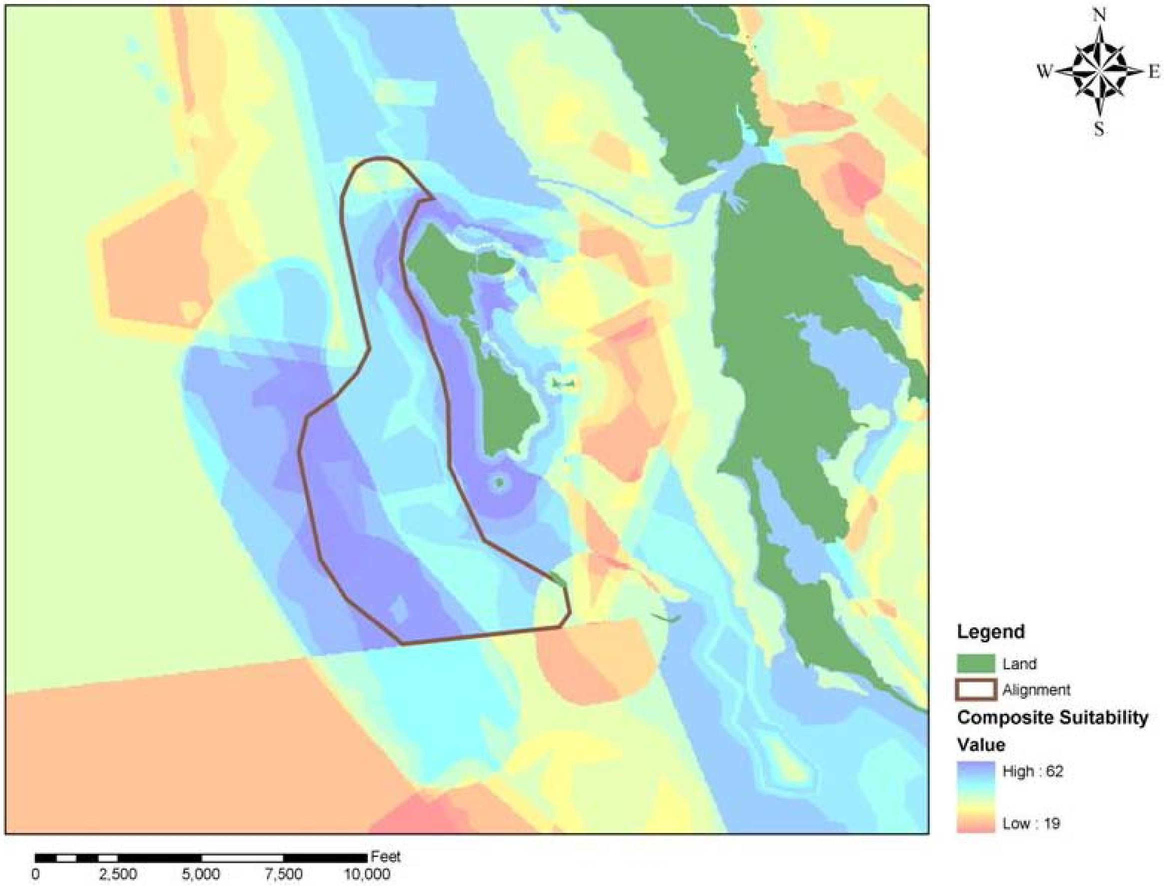

Figure 4-4: Composite Suitability for Potential Barren Island Restoration Alignments

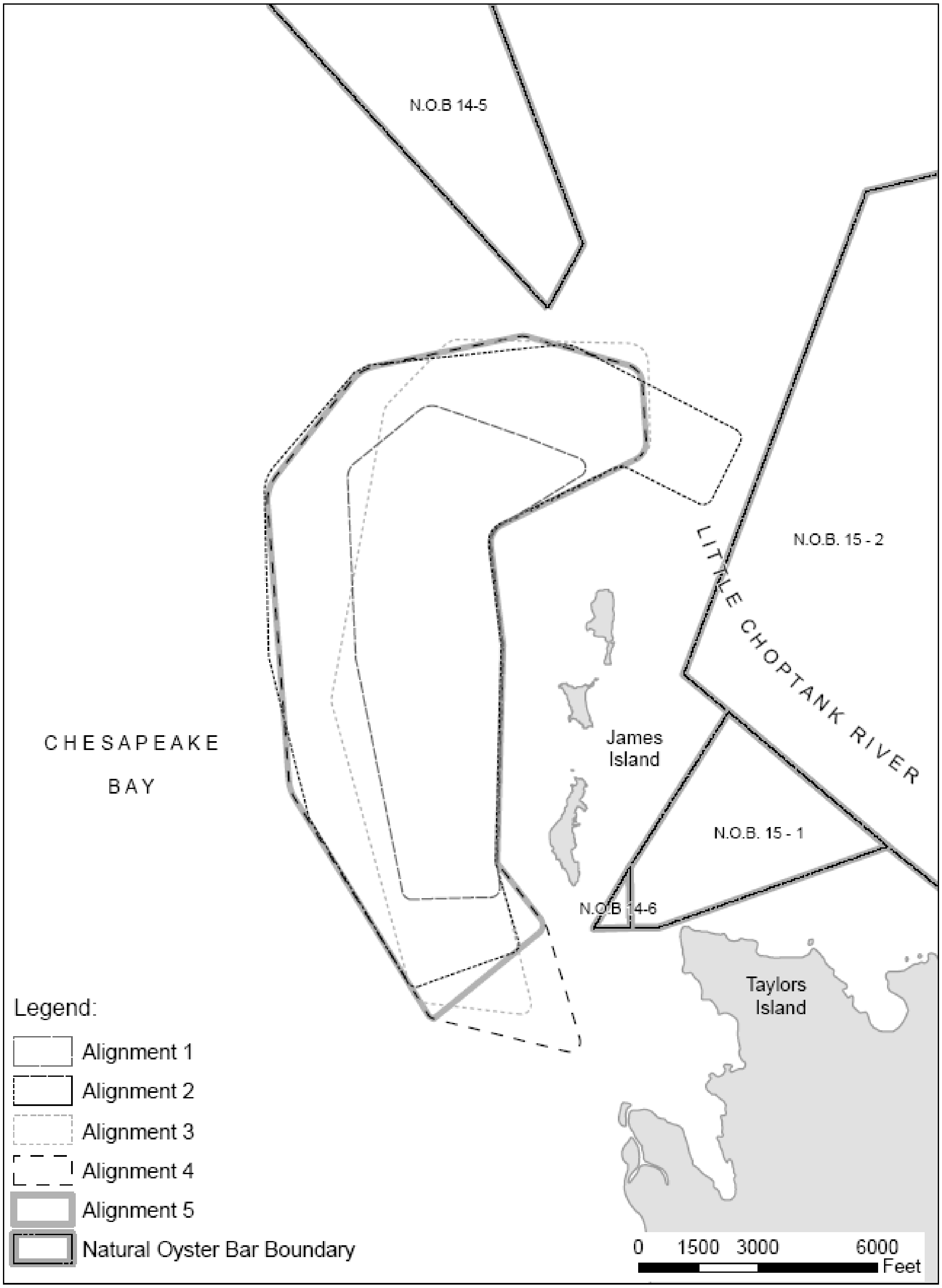

Figure 4-5: James Island Proposed Alignments

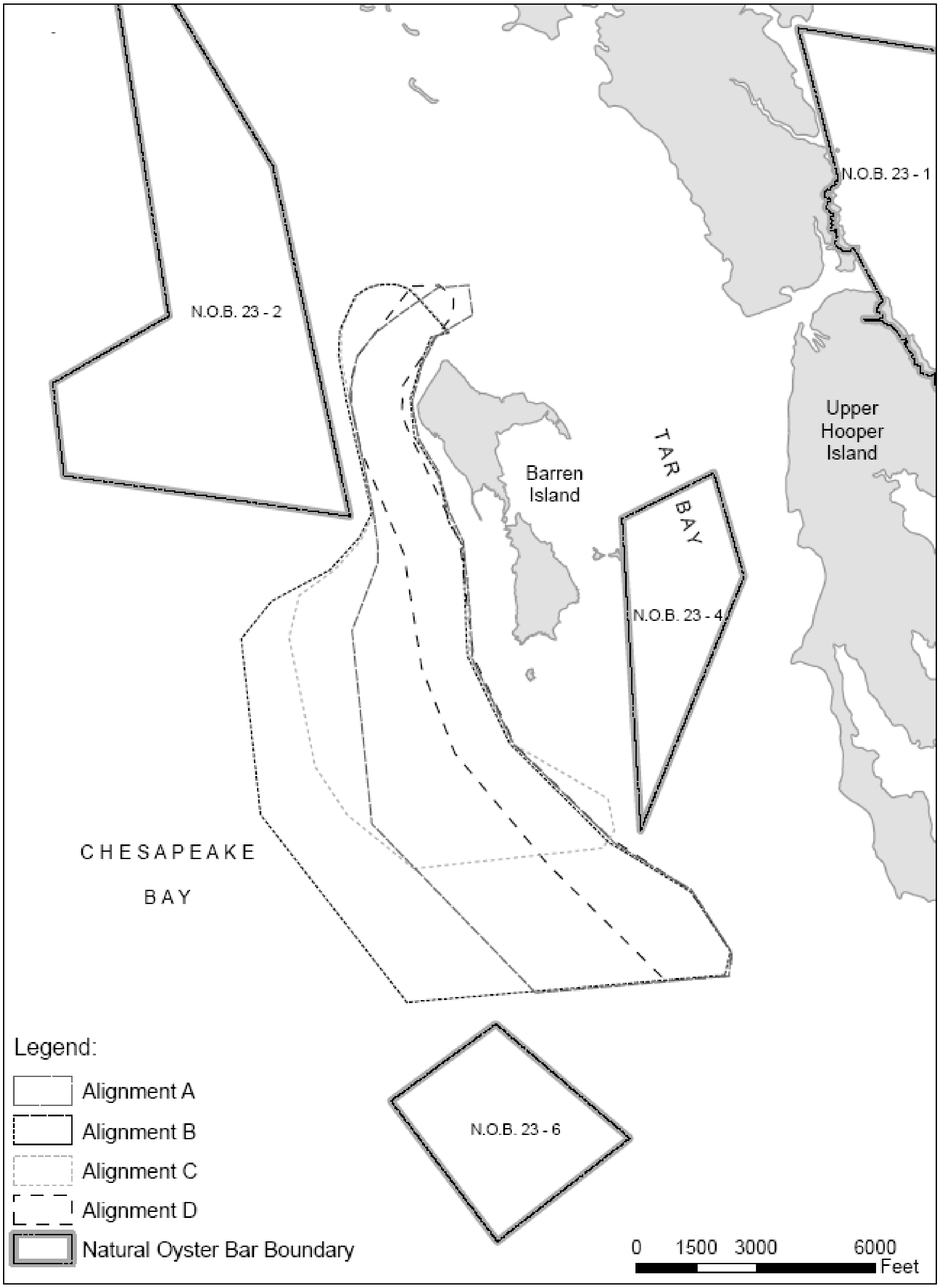

Figure 4-6: Barren Island Proposed Alignments

Summary of subcell acreage

Multiply Units by weight and then sum to calculate wetland weighted sum by

50% wetlands/50%uplands		Total (ac) = 1354										
		upland = 619		Island Community Index				Community Units				
YEAR 5		wetland subcell= 34.4		upland	high marsh	low marsh	intertidal	upland	high marsh	low marsh	intertidal	
	guild/community	WEIGHT	Sum of Weights	619	6.9	24.8	2.8					Wetland weighted sum by guild
BIRDS	colonial nesting wading birds	12	50		0.75	0.25	0.5		5.16	6.19	1.38	**1.53**
"	waterfowl	10			0	1	0.5		0	24.77	1.38	**2.61**
"	colonial nesting waterbirds	12			0.75	1	0		5.16	24.77	0.00	**3.59**
"	raptors	2			1	0.5	0		6.88	12.38	0.00	**0.39**
"	shorebirds	14			0.25	0.25	0		1.72	6.19	0.00	**1.11**
	rept/herps	2	2		1	1	1		6.88	24.77	2.75	**0.69**
	benthic invert.	20	20		0.5	0.5	0.5		3.44	12.38	1.38	**3.44**
FISH	resident/forage fish	23	28		0	0.75	0.75		0	18.58	2.06	**4.75**
"	commercial/predatory/higher	5			0	0.75	0.5		0	18.58	1.38	**1.00**
	TOTAL	**100**	**100**					Constructed Island Community Units				19.10

Wetland acreage

For each habitat, multiply ICI by acreage to get Units

Sum 'weighted sum by guild' totals to calculate Total Constructed Island

Figure 4-7: ICU Calculation Example- 50% wetlands/50% uplands alignment; wetland cell in Year 5.

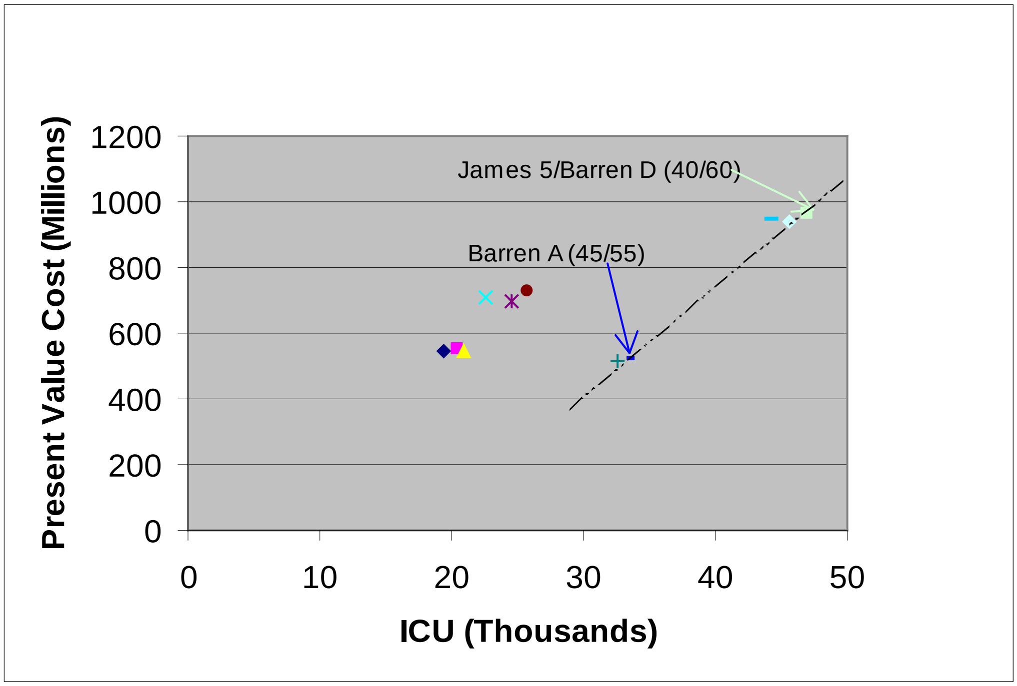

Figure 4-8: Comparison of Plans After CE/ICA

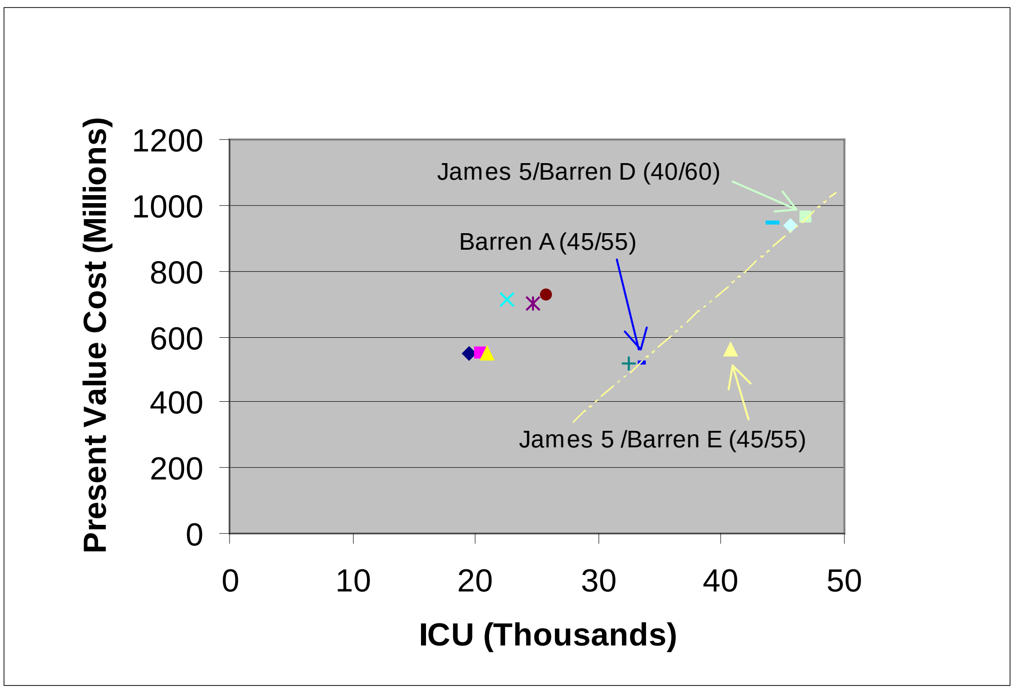

Figure 4-9: Comparison of Final Plans

SECTION 4

TABLES

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Table 4-1: Initial Screening of Island Complexes

No.	Island/Location (County)	Limited Restoration Potential < 200 ac	Access	Navigation Impacts	Hydraulics Impacts	Shoreline	Shallow Water	MECs	Other USACE /MPA Initiatives	Population Center	Managed Area/No interest stated	Out of Study Area	No Current Location
	DORCHESTER COUNTY												
1	Adam Island, Holland Straits - Bloodsworth Complex							X					
2	Asquith Island, Honga River	X								X			
3	Axis Island, Nanticoke River	X			X								
4	Barren Island, Chesapeake Bay												
5	Bettys Island, Blackwater River		X										
6	Billys Island, Honga River							X					
7	Bloodsworth Island, Chesapeake Bay							X					
8	Bull Point Island, Meekins Creek		X										
9	Cattail Island, Chesapeake Bay	X											
10	Chance Island, Transquaking River		X										
11	Cherry Island, Little Choptank River	X	X										
12	Clay Island, Fishing Bay												
13	Dunnock Island, Dunnock Slough	X	X										
14	Elliott Island, Fishing Bay	X				X							
15	Grays Island, Fishing Bay	X											
16	Gunners Island, Chesapeake Bay		X										
17	Hog Island, Hoopers Straits					X							
18	Holland Island, Chesapeake Bay												
19	Hoopers Island, Chesapeake Bay												
20	James Island, Chesapeake Bay												
21	Jenny Island, Chesapeake Bay	X											
22	Langrells Island, Nanticoke River		X										
23	Long Island, Chesapeake Bay Holland Complex												
24	Lower Hoopers Island, Chesapeake Bay -Hoopers Complex												
25	Middle Hoopers Island, Chesapeake Bay -Hoopers Complex												
26	Northeast Island, Chesapeake Bay							X					
27	Opossum Island, Tar Bay - Barren Island Complex												
28	Pone Island, Chesapeake Bay -Bloodsworth Complex							X					

Table 4-1. Continued.

No.	Island/Location (County)	Limited Restoration Potential < 200 ac	Access	Navigation Impacts	Hydraulics Impacts	Shoreline	Shallow Water	MECs	Other USACE/ MPA Initiatives	Population Center	Managed Area/No interest stated	Out of Study Area	No Current Location
29	Poplar Island, Fishing Bay	X											
30	Pot Island, Honga River	X	X										
31	Punch Island, Chesapeake Bay	X	X							X			
32	Ragged Island, Little Choptank River												
33	Rowland Island, Blackwater River		X										
34	Sandy Island, Nanticoke River												
35	Sharpes Island, Chesapeake Bay											X	
36	Snake Island, Fishing Bay		X				X						
37	Spriggs Island, Blackwater River		X										
38	Spring Island, Holland Straits - Holland Complex												
39	Stingaree Island, Blackwater River		X										
40	Swan Island, Chesapeake Bay - Holland Complex												
41	Taylors Island, Chesapeake Bay					X							
42	Upper Hoopers Island, Chesapeake Bay - Hoopers Island Complex												
43	Woods Island, Blackwater River		X										
44	Woolford Island, Parsons Creek	X			X								
45	Wroten Island, Honga River	X	X										
	KENT COUNTY												
46	Cacaway Island, Langford Bay	X	X										
47	Chase Island, Chester River	X	X				X						
48	Cockey Island, Chester River - Eastern Neck Complex	X				X							
49	Eastern Neck Island, Chesapeake Bay					X			X				
50	Little Neck Island, Chesapeake Bay	X			X								
51	Millers Island, Chester River	X											
52	Pooles Island, Chesapeake Bay											X	
53	Rush Island, Chesapeake Bay - Eastern Neck Complex	X		X	X								
	QUEEN ANNE'S COUNTY												
54	Bodkin Island, Eastern Bay	X											

Table 4-1. Continued.

No.	Island/Location (County)	Limited Restoration Potential < 200 ac	Access	Navigation Impacts	Hydraulics Impacts	Shoreline	Shallow Water	MECs	Other USACE/ MPA Initiatives	Population Center	Managed Area/No interest stated	Out of Study Area	No Current Location
55	Carpenter Island, Chester River	X			X								
56	DeCoursey Island, Wye River	X	X										
57	Herring Island, Eastern Bay												X
58	Hog Island, Prospect Bay	X											
59	Johnson Island, Crab Alley Bay	X			X								
60	Kent Island, Chesapeake Bay									X			
61	Little Island, Crab Alley Bay	X											
62	Long Marsh Island, Eastern Bay	X											
63	Parson Island, Eastern Bay	X							X				
64	Philpots Island, Eastern Bay	X			X					X			
65	Wye Island, Wye River	X											
	SOMERSET COUNTY												
66	Ballards Island	X											
67	Big Island, Tangier Sound	X	X		X		X						
68	Boat Island, Chesapeake Bay	X	X		X								
69	Deal Island, Tangier Sound									X			
70	Deep Banks Island, Holland Straits - South Marsh Complex												
71	Fishing Island, Manokin River	X	X		X								
72	Gab Island, Chesapeake Bay												X
73	Hog Neck Island, Chesapeake Bay												X
74	Horse Hammock, Tangier Sound - Smith Island Complex												
75	House Island, Tangier Sound												X
76	Janes Island, Chesapeake Bay										X		
77	Jersey Island, Little Annemessex River	X			X					X			
78	Little Deal Island, Tangier Sound												
79	Little Troy Island, Chesapeake Bay												X
80	Maddox Island, Manokin River	X	X		X								
81	Monie Island	X											
82	Otter Island, Tangier Sound - Smith Island Complex												
83	Piney Island, Manokin River - Smith Island Complex												
84	Pry Island - South Marsh Complex												

Table 4-1. Continued.

No.	Island/Location (County)	Limited Restoration Potential < 200 ac	Access	Navigation Impacts	Hydraulics Impacts	Shoreline	Shallow Water	MECs	Other USACE/ MPA Initiatives	Population Center	Managed Area/No interest stated	Out of Study Area	No Current Location
85	St. Pierre Island, Manokin River	X											
86	Smith Island, Chesapeake Bay								X				
87	Solomons Lump, Kedges Straits - Smith Island Complex												
88	South Marsh Island, Chesapeake Bay												
89	Swan Island, Chesapeake Bay		X										
90	Troy Island, Chesapeake Bay		X										
91	Turtle Egg Island, Holland Straits												X
92	Western Islands, Kedges Straits - South Marsh Complex												
	TALBOT COUNTY												
93	Avalon Island, Harris Creek	X											
94	Bruffs Island, Wye River	X		X			X						
95	Coaches Neck Island, Chesapeake Bay - Poplar Island Complex								X				
96	Goat Island, Chesapeake Bay	X				X							
97	Hambleton Island, Broad Creek	X			X								
98	Herring Island, Miles River												X
99	Jefferson Island, Chesapeake Bay - Poplar Island Complex								X				
100	Nelson Island, Choptank River	X											
101	Poplar Island, Chesapeake Bay								X				
102	Royston Island, Choptank River	X											
103	Sharps Island, Chesapeake Bay												
104	Tilghman Island, Chesapeake Bay					X				X			
	WICOMICO COUNTY												
105	Round Island, Nanticoke River	X	X		X								

Key

(yellow)	Selected main island
(green)	Selected island as part of main island complex

Table 4-2: Island Screening Criteria			
Criteria	**Description**	**Ranking**	**Weighted Factor**
Possible restoration size (ac)	<300	0	2
	300-700	2	
	700-1000	4	
	1000-2000	5	
Possible capacity (mcy)	< 10	0	4
	11-20	1	
	21-30	2	
	31-40	3	
	41-50	4	
	>50	5	
Foundation material	Soft silt/clay	0	2
	Medium silt/sand	3	
	Stiff lay or silty sand	4	
	Sand	5	
Borrow material found on site (should be sand)	Clay or silt	0	2
	Covered sand	3	
	Sand	5	
Depth of site range (should be 8-10 ft)	<5	0	2
	5-8	2	
	8-10	5	
	10-12	2	
	>12	0	
Length of access channel (mi)	< 0.5	5	2
	0.5-1	3	
	1-2	1	
	>2	0	
Mean Tidal Range (ft)	<1	0	1
	1-1.5	3	
	>1.5	5	
Stone size (lbs)	<1500	5	1
	1500-3000	3	
	>3000	1	
Hauling Distance (mi)	<30	5	3
	31-40	4	
	41-60	3	
	61-70	2	
	>70	0	
Possibility of finding MEC's	Yes	0	1
	Potential	3	
	No	5	

Table 4-3: Engineering Screening Criteria *(completed 3/6/2003)*

CRITERIA	SMITH	LITTLE DEAL	JAMES	BARREN	HOLLAND	SOUTH MARSH	HOOPERS	RAGGED
				FWS prefer <1000 & wetland		3000 ac WMA entirely marsh	*SW side*	
Possible Restoration Size (ac)	*800-1000* 4	*400-500* 2	*978-2200* 5	*700-1000* 4	*930-1639* 4	*300-900* 3	*700-1000* 4	*400-500* 2
Possible Capacity (mcy)	*22-28* 2	*7.5-9* 0	*36-79* 4	*30-40* 3	*26-46* 3	*assume Holland* 2	*prob 20-30* 2	*8-9* 0
Foundation Material	*silty sand-good* 4	*Assume holland* 3	*silty sand-good* 4	*silty sand-excl* 5	*silty sand-fair* 3	*assume Holland* 3	*assume Barren* 4	*assume James* 4
Borrow Material on Site	*good* 4	*Assume holland* 3	*good* 4	*excellent* 5	*fair/mixed* 3	*assume Holland* 3	*assume Barren* 4	*assume James* 4
Depth of site range (avg) in feet	*0-5 (3)* 0	*0-6 (3)* 0	*3-12 (6)* 3	*0-10 (6)* 3	*0-11 (4)* 2	*1-6 (3) East* 0	*3-5 (4)* 0	*1-4 (2)* 0
Length of access channel (mi)	*3* 0	*1-2* 1	*<.5* 4	*<.5* 4	*3* 0	*>3* 0	*>2* 0	*.5-1* 3
Water Levels *Mean Tide Range (ft)* *Storm Surge (ft) - 35yr/100yr*	 *1.6* *5.8* 5	*Assume holland* *1-1.2* *5.7/7.4* 3	 *1.2 - 1.6 (1.4)* *4.5/5.6* 3	 *1.4* *4.1/5.4* 3	 *1.9* *6.0/6.8* 5	*assume Holland* 5	*assume Barren* 3	assume James 3
Design Storm *Ave Fetch Depth* *Fetch Length* *Wave (ft)* *Crest Height (ft mllw)*	*assume Holland*	*Assume Holland*	35-yr 43 ft 30 mi *S & N 10'* 7-11.5	35-yr 37 ft 10 mi *SW 8.6 ft* 8-10	35-yr 30 ft 17 mi *SW 7 ft* 8-11.25	*assume* *Holland*	*assume* *Barren*	assume James
Stone Size (lbs)	*assume Holland* 3	*Assume Holland* 3	700-5000 1	2600-3000 3	300-3000 3	*assume Holland* 3	*assume Barren* 3	*assume James* 3
Distance to haul (mi)	>75 0	>75 0	40 4	55 3	70 0	73 0	68 2	40 4
Possible UXO's	no 5	no 5	no 5	no 5	no 3	no 5	No 5	no 5

Table 4-4: Ranking of Mid-Chesapeake Bay Islands for Large Island Restoration

Option	Rank based on environmental factors.		Rank based on engineering factors	
	BEWG score	BEWG overall rank*	Mid-Bay Score	Mid-Bay rank*
James Island	2.2684	7	77	1
Barren Island	2.5500	4	74	2
Hoopers Island	NA	NA	49	3
Ragged Island	NA	NA	49	3
Lower Eastern Neck Island	2.2077	9		
Holland Island	1.9270	10	47	4
Smith Island	NA	NA	45	5
South Marsh	NA	NA	39	6
Little Deal Island	NA	NA	29	7
Parsons Island	1.7158	12	NA	NA
Sharps Island	0.7710	25	NA	NA

*Full ranking process and results are available in Appendix B.
NA = Not assessed. State DMMP considered only six island alternatives.

Table 4-5: GIS Analysis Ranking Criteria.

Criteria	Description	Ranking (0-10, with 10 being optimal)
Proximity to existing island remnants	<100’	0
	100-250’	2
	250-500’	10
	500-1,000’	7
	1,000-1,500’	2
	>1,500’	0
Proximity to Natural Oyster Bars	within boundary	0
	within 500’ of boundary	5
	beyond 500’ of boundary	10
Presence of submerged aquatic vegetation	within bed	0
	outside of bed	10
Foundation material	Suitable	10
	unsuitable	0
Borrow material quality	unsuitable borrow	0
	suitable borrow of lower quality	5
	suitable borrow of higher quality	10
Constructability of a perimeter dike with a toe dike (based on water depth)	<2’ deep	2
	2-5’ deep	4
	5-8’ deep	10
	8-10’ deep	7
	10-12’ deep	4
	>12’ deep	0
Constructability of a perimeter dike without a toe dike (based on water depth)	<2’ deep	10
	2-5’ deep	5
	>5’ deep	0
Navigation restrictions	within a restricted area	0
	within a dredge spoil area	4
	in an unrestricted area	10

Table 4-6: Mid-Chesapeake Bay Island Restoration Alternatives (n = 145)

	Alignment (ac)	100% Uplands	100% Wetlands	70% Uplands/ 30% Wetlands	50% Uplands/ 50% Wetlands	30% Uplands/ 70% Wetlands
Barren						
1	Alignment A (1,354)	AU	AW	AUW30	AUW50	AUW70
2	Alignment B (2,059)	BU	BW	BUW30	BUW50	BUW70
3	Alignment C (1,125)	CU	CW	CUW30	CUW50	CUW70
4	Alignment D (690)	DU	DW	DUW30	DUW50	DUW70
James						
5	Alignment 1 (978)	1U	1W	1UW30	1UW50	1UW70
6	Alignment 2 (2,126)	2U	2W	2UW30	2UW50	2UW70
7	Alignment 3 (1,586)	3U	3W	3UW30	3UW50	3UW70
8	Alignment 4 (2,200)	4U	4W	4UW30	4UW50	4UW70
9	Alignment 5 (2,072)	5U	5W	5UW30	5UW50	5UW70
Barren & James						
10	Alignment A1 (2,308)	A1U	A1W	A1UW30	A1UW50	A1UW70
11	Alignment A2 (3,456)	A2U	A2W	A2UW30	A2UW50	A2UW70
12	Alignment A3 (2,916)	A3U	A3W	A3UW30	A3UW50	A3UW70
13	Alignment A4 (3,530)	A4U	A4W	A4UW30	A4UW50	A4UW70
14	Alignment A5 (3,402)	A5U	A5W	A5UW30	A5UW50	A5UW70
15	Alignment B1 (3,037)	B1U	B1W	B1UW30	B1UW50	B1UW70
16	Alignment B2 (4,185)	B2U	B2W	B2UW30	B2UW50	B2UW70
17	Alignment B3 (3,645)	B3U	B3W	B3UW30	B3UW50	B3UW70
18	Alignment B4 (4,259)	B4U	B4W	B4UW30	B4UW50	B4UW70
19	Alignment B5 (4,134)	B5U	B5W	B5UW30	B5UW50	B5UW70
20	Alignment C1 (2,103)	C1U	C1W	C1UW30	C1UW50	C1UW70
21	Alignment C2 (3,251)	C2U	C2W	C2UW30	C2UW50	C2UW70
22	Alignment C3 (2,711)	C3U	C3W	C3UW30	C3UW50	C3UW70
23	Alignment C4 (3,325)	C4U	C4W	C4UW30	C4UW50	C4UW70
24	Alignment C5 (3,197)	C5U	C5W	C5UW30	C5UW50	C5UW70
25	Alignment D1 (1,668)	D1U	D1W	D1UW30	D1UW50	D1UW70
26	Alignment D2 (2,816)	D2U	D2W	D2UW30	D2UW50	D2UW70
27	Alignment D3 (2,276)	D3U	D3W	D3UW30	D3UW50	D3UW70
28	Alignment D4 (2,890)	D4U	D4W	D4UW30	D4UW50	D4UW70
29	Alignment D5 (2,762)	D5U	D5W	D5UW30	D5UW50	D5UW70

**Alternative alignments are summarized according to the following example: D4UW70 = Barren Alignment D plus James Alignment 4, with a habitat ratio of 70% upland / 30% wetland*

Table 4-7: Screening Criteria Applied to Island Restoration Alternatives for James Island.

An ‘X’ denotes that an alternative did not meet the specified criteria. Only those alternatives that are shaded were carried further into formulation. (This applies to Tables 4-8 through 4-10).

Alternatives	**Preliminary Calculations**								**Screening criteria**					
	Upland (ac)	**Wetland (ac)**	**HU**	**Capacity (M yd^3)**	**cost (millions)**	**$/HU**	**HU/ ac**	**$/percent wetland**	**Construct-ability**	**Capacity/ Dredge Placement**	**Borrow areas**	**$/HU high**	**Agency Preference**	**Environ-mental Benefits**
Alignment 1 Total acres=978 Total acres minus dike=878														
1W	0	878	725.2	13.2	210.7	0.2906	0.7415	2.11	X	X	X			
1UW70	263.4	614.6	539.3	19.8	316.1	0.5861	0.5514	4.52		X				
1UW50	439	439	412.0	24.1	386.3	0.9378	0.4212	7.73		X				
1UW30	614.6	263.4	277.0	28.5	456.6	1.6483	0.2832	15.22		X			X	
1U	878	0	105.4	35.1	561.9	5.3333	0.1077	0				X	X	X
Alignment 2 Total acres=2126 Total acres minus dike=2026														
2W	0	2026	1684.0	30.4	486.2	0.2887	0.7921	4.86	X		X		X	
2UW70	607.8	1418.2	1251.7	45.6	729.4	0.5827	0.5888	10.42		X			X	
2UW50	1013	1013	958.3	55.7	891.4	0.9302	0.4508	17.83					X	
2UW30	1418.2	607.8	672.2	65.8	1053.5	1.5672	0.3162	35.12					X	
2U	2026	0	243.1	81.0	1296.6	5.3333	0.1144	0		X		X	X	X
Alignment 3 Total acres=1586 Total acres minus dike=1486														
3W	0	1486	1235.2	22.3	356.6	0.2887	0.7788	3.57	X	X	X			
3UW70	445.8	1040.2	912.7	33.4	535.0	0.5861	0.5755	7.64		X				
3UW50	743	743	702.9	40.9	653.8	0.9302	0.4432	13.08						
3UW30	1040.2	445.8	489.7	48.3	772.7	1.5781	0.3087	25.76					X	X
3U	1486	0	178.3	59.4	951.0	5.3333	0.1124	0				X		X
Alignment 4 Total acres=2200 Total acres minus dike=2100														
4W	0	2100	1745.5	31.5	504.0	0.2887	0.7934	5.04	X		X		X	

Table 4-7: Continued.

Alternatives	Preliminary Calculations								Screening criteria					
	Upland (ac)	**Wetland (ac)**	**HU**	**Capacity (M yd^3)**	**cost (millions)**	**$/HU**	**HU/ ac**	**$/percent wetland**	**Construct-ability**	**Capacity/ Dredge Placement**	**Borrow areas**	**$/HU high**	**Agency Preference**	**Environmental Benefits**
4UW70	630	1470	1297.5	47.3	756.0	0.5827	0.5898	10.80					X	
4UW50	1050	1050	993.3	57.8	924.0	0.9302	0.4515	18.48					X	
4UW30	1470	630	696.8	68.3	1092.0	1.5672	0.3167	36.40					X	
4U	2100	0	252.0	84.0	1344.0	5.3333	0.1145	0		X		X	X	X
Alignment 5 Total acres=2072 Total acres minus dike=1972														
5W	0	1972	1639.1	29.6	473.3	0.2887	0.7911	4.73	X		X			
5UW70	591.6	1380.4	1218.4	44.4	709.9	0.5827	0.5880	10.14		X				
5UW50	986	986	932.8	54.2	867.7	0.9302	0.4502	17.35						
5UW30	1380.4	591.6	654.3	64.1	1025.4	1.5672	0.3158	34.18					X	
5U	1972	0	236.6	78.9	1262.1	5.3333	0.1142	0				X	X	X

Table 4-8: Screening Criteria Applied to Island Restoration Alternatives for Barren

Alternatives	**Preliminary Calculations**								**Screening criteria**					
	Upland (ac)	**wetland (ac)**	**HU**	**Capacity (M yd^3)**	**cost (millions)**	**$/HU**	**HU/ ac**	**$/percent wetland**	**Construct-ability**	**Capacity/ Dredge Placement**	**Borrow areas**	**$/HU high**	**Agency Preference**	**Environmental Benefits**
Alignment A Total acres=1354 Total acres minus dike=1253														
AW	0	1253	1041.5	18.8	319.5	0.3068	0.7692	3.20	X	X				
AUW70	375.9	877.1	769.6	28.2	479.3	0.6228	0.5684	6.85		X				
AUW50	626.5	626.5	613.3	34.5	585.8	0.9551	0.4530	11.72					X	
AUW30	877.1	375.9	412.9	40.7	692.3	1.6767	0.3049	23.08					X	
AU	1253	0	150.4	50.1	852.0	5.6667	0.1110	0				X	X	X
Alignment B Total acres=2059 Total acres minus dike=1942														
BW	0	1942	1614.2	29.1	495.2	0.3068	0.7840	4.95	X	X			X	
BUW70	582.6	1359.4	1199.8	43.7	742.8	0.6191	0.5827	10.61					X	
BUW50	971	971	918.6	53.4	907.9	0.9884	0.4461	18.16					X	
BUW30	1359.4	582.6	644.4	63.1	1073.0	1.6652	0.3129	35.77					X	
BU	1942	0	233.0	77.7	1320.6	5.6667	0.1132	0				X	X	X
Alignment C **Total acres=1172** **Total acres minus dike=1084**														
CW	0	1084	895.4	16.3	276.4	0.3087	0.7640	2.76	X	X			X	
CUW70	325.2	758.8	665.8	24.4	414.6	0.6228	0.5681	5.92		X			X	
CUW50	542	542	512.7	29.8	506.8	0.9884	0.4375	10.14					X	
CUW30	758.8	325.2	357.2	35.2	598.9	1.6767	0.3048	19.96					X	
CU	1084	0	130.1	43.4	737.1	5.6667	0.1110	0				X	X	X
Alignment D **Total acres=684** **Total acres minus dike=584**														
DW	0	584	482.4	8.8	148.9	0.3087	0.7052	1.49	X	X				
DUW70	175.2	408.8	366.1	13.1	223.4	0.6102	0.5352	3.19		X				
DUW50	292	292	274.0	16.1	273.0	0.9964	0.4006	5.46		X				
DUW30	408.8	175.2	183.4	19.0	322.7	1.7593	0.2681	10.76		X			X	
DU	584	0	70.1	23.4	397.1	5.6667	0.1025	0		X		X	X	X

Table 4-9: Screening Criteria Applied to Combined Island Restoration Alternatives for James and Barren										
Alternatives	**Preliminary Calculations**				**Screening criteria**					
	upland (ac)	**wetland (ac)**	**capacity (M yd^3)**	**cost (M)**	**Construct-ability**	**Capacity/ Dredge Placement**	**Borrow areas**	**$/HU high**	**Agency Preference**	**Environ-mental Benefits**
Alignment A1 **Total acres=2308** **Total acres minus dike=2208**										
A1W	0	2208	33.1	529.9	X		X		X	
A1UW70	662.4	1545.6	49.7	794.9					X	
A1UW50	1104	1104	60.7	971.5					X	
A1UW30	1545.6	662.4	71.8	1148.2		X		X	X	
A1U	2208	0	88.3	1413.1		X		X	X	X
Alignment A2 Total acres=3456 Total acres minus dike=3356										
A2W	0	3356	50.3	805.4	X		X		X	
A2UW70	1006.8	2349.2	75.5	1208.2		X			X	
A2UW50	1678	1678	92.3	1476.6		X			X	
A2UW30	2349.2	1006.8	109.1	1745.1		X		X	X	
A2U	3356	0	134.2	2147.8		X		X	X	X
Alignment A3 Total acres=2916 Total acres minus dike=2816										
A3W	0	2816	42.2	675.8	X		X			
A3UW70	844.8	1971.2	63.4	1013.8		X				
A3UW50	1408	1408	77.4	1239.0		X				
A3UW30	1971.2	844.8	91.5	1464.3		X		X	X	
A3U	2816	0	112.6	1802.2		X		X	X	X
Alignment A4 Total acres=3530 Total acres minus dike=3430										
A4W	0	3430	51.5	823.2	X		X		X	

Table 4-9: Continued.										
Alternatives	**Preliminary Calculations**				**Screening criteria**					
	upland (ac)	**wetland (ac)**	**capacity (M yd^3)**	**cost (M)**	**Construct-ability**	**Capacity/ Dredge Placement**	**Borrow areas**	**$/HU high**	**Agency Preference**	**Environ-mental Benefits**
A4UW70	1029	2401	77.2	1234.8		X			X	
A4UW50	1715	1715	94.3	1509.2		X			X	
A4UW30	2401	1029	111.5	1783.6		X		X	X	
A4U	3430	0	137.2	2195.2		X		X	X	X
Alignment A5 Total acres=3402 Total acres minus dike=3302										
A5W	0	3302	49.5	792.5	X		X		X	
A5UW70	990.6	2311.4	74.3	1188.7		X			X	
A5UW50	1651	1651	90.8	1452.9		X			X	
A5UW30	2311.4	990.6	107.3	1717.0		X		X	X	
A5U	3302	0	132.1	2113.3		X		X	X	X
Alignment B1 Total acres=2103 Total acres minus dike=2003										
B1W	0	2003	30.0	480.7	X		X		X	
B1UW70	600.9	1402.1	45.1	721.1					X	
B1UW50	1001.5	1001.5	55.1	881.3					X	
B1UW30	1402.1	600.9	65.1	1041.6				X		
B1U	2003	0	80.1	1281.9		X		X	X	X
Alignment B2 Total acres=3251 Total acres minus dike=3151										
B2W	0	3151	47.3	756.2	X		X		X	
B2UW70	945.3	2205.7	70.9	1134.4					X	
B2UW50	1575.5	1575.5	86.7	1386.4		X			X	
B2UW30	2205.7	945.3	102.4	1638.5		X		X	X	
B2U	3151	0	126.0	2016.6		X		X	X	X

Table 4-9: Continued.										
Alternatives	**Preliminary Calculations**				**Screening criteria**					
	upland (ac)	**wetland (ac)**	**capacity (M yd^3)**	**cost (M)**	**Construct-ability**	**Capacity/ Dredge Placement**	**Borrow areas**	**$/HU high**	**Agency Preference**	**Environ-mental Benefits**
B3W	0	2611	39.2	626.6	X		X		X	
B3UW70	783.3	1827.7	58.7	940.0		X			X	
B3UW50	1305.5	1305.5	71.8	1148.8		X			X	
B3UW30	1827.7	783.3	84.9	1357.7		X		X	X	
B3U	2611	0	104.4	1671.0		X		X	X	X
Alignment B4 Total acres=3325 Total acres minus dike=3225										
B4W	0	3225	48.4	774.0	X		X		X	
B4UW70	967.5	2257.5	72.6	1161.0		X			X	
B4UW50	1612.5	1612.5	88.7	1419.0		X			X	
B4UW30	2257.5	967.5	104.8	1677.0		X		X	X	
B4U	3225	0	129.0	2064.0		X		X	X	X
Alignment B5 Total acres=3197 Total acres minus dike=3097										
B5W	0	3097	46.5	743.3	X		X		X	
B5UW70	929.1	2167.9	69.7	1114.9		X			X	
B5UW50	1548.5	1548.5	85.2	1362.7		X			X	
B5UW30	2167.9	929.1	100.7	1610.4		X		X	X	
B5U	3097	0	123.9	1982.1		X		X	X	X
Alignment C1 Total acres=1588 Total acres minus dike=1488										
C1W	0	1488	22.3	357.1	X	X	X		X	
C1UW70	446.4	1041.6	33.5	535.7					X	
C1UW50	744	744	40.9	654.7					X	
C1UW30	1041.6	446.4	48.4	773.8				X		
C1U	1488	0	59.5	952.3				X	X	X

Table 4-9: Continued.										
Alternatives	**Preliminary Calculations**				**Screening criteria**					
	upland (ac)	**wetland (ac)**	**capacity (M yd^3)**	**cost (M)**	**Construct-ability**	**Capacity/ Dredge Placement**	**Borrow areas**	**$/HU high**	**Agency Preference**	**Environ-mental Benefits**
Alignment C2 Total acres=2736 Total acres minus dike=2636										
C2W	0	2636	39.5	632.6	X		X		X	
C2UW70	790.8	1845.2	59.3	949.0		X			X	
C2UW50	1318	1318	72.5	1159.8		X			X	
C2UW30	1845.2	790.8	85.7	1370.7		X		X	X	
C2U	2636	0	105.4	1687.0		X		X	X	X
Alignment C3 Total acres=2196 Total acres minus dike=2096										
C3W	0	2096	31.4	503.0	X		X		X	
C3UW70	628.8	1467.2	47.2	754.6					X	
C3UW50	1048	1048	57.6	922.2					X	
C3UW30	1467.2	628.8	68.1	1089.9				X	X	
C3U	2096	0	83.8	1341.4		X		X	X	X
Alignment C4 Total acres=2810 Total acres minus dike=2710										
C4W	0	2710	40.7	650.4	X		X		X	
C4UW70	813	1897	61.0	975.6		X			X	
C4UW50	1355	1355	74.5	1192.4		X			X	
C4UW30	1897	813	88.1	1409.2		X		X	X	
C4U	2710	0	108.4	1734.4		X		X	X	X
Alignment C5 Total acres=2682 Total acres minus dike=2582										
C5W	0	2582	38.7	619.7	X		X		X	
C5UW70	774.6	1807.4	58.1	929.5		X			X	
C5UW50	1291	1291	71.0	1136.1		X			X	

Table 4-9: Continued.										
Alternatives	**Preliminary Calculations**				**Screening criteria**					
	upland (ac)	**wetland (ac)**	**capacity (M yd^3)**	**cost (M)**	**Construct-ability**	**Capacity/ Dredge Placement**	**Borrow areas**	**$/HU high**	**Agency Preference**	**Environ-mental Benefits**
C5UW30	1807.4	774.6	83.9	1342.6		X		X	X	
C5U	2582	0	103.3	1652.5		X		X	X	X
Alignment D1 Total acres=1668 Total acres minus dike=1558										
D1W	0	1558	23.4	373.9	X	X	X			
D1UW70	467.4	1090.6	35.1	560.9		X				
D1UW50	779	779	42.8	685.5			X			
D1UW30	1090.6	467.4	50.6	810.2				X		
D1U	1558	0	62.3	997.1				X	X	X
Alignment D2 Total acres=2816 Total acres minus dike=2716										
D2W	0	2716	40.7	651.8	X		X		X	
D2UW70	814.8	1901.2	61.1	977.8					X	
D2UW50	1358	1358	74.7	1195.0		X			X	
D2UW30	1901.2	814.8	88.3	1412.3		X		X	X	
D2U	2716	0	108.6	1738.2		X		X	X	X
Alignment D3 Total acres=2276 Total acres minus dike=2176										
D3W	0	2176	32.6	522.2	X	X	X			
D3UW70	652.8	1523.2	49.0	783.4		X				
D3UW50	1088	1088	59.8	957.4						
D3UW30	1523.2	652.8	70.7	1131.5		X		X		
D3U	2176	0	87.0	1392.6		X		X	X	X
Alignment D4 Total acres=2890 Total acres minus dike=2790										

Table 4-9: Continued.

Alternatives	Preliminary Calculations				Screening criteria					
	upland (ac)	wetland (ac)	capacity (M yd^3)	cost (M)	Construct-ability	Capacity/ Dredge Placement	Borrow areas	$/HU high	Agency Preference	Environ-mental Benefits
D4W	0	2790	41.9	669.6	X		X		X	
D4UW70	837	1953	62.8	1004.4		X			X	
D4UW50	1395	1395	76.7	1227.6					X	
D4UW30	1953	837	90.7	1450.8				X	X	
D4U	2790	0	111.6	1785.6				X	X	X
Alignment D5 Total acres=2756 Total acres minus dike=2656										
D5W	0	2656	39.9	638.9	X		X			
D5UW70	796.8	1859.2	59.9	958.3		X				
D5UW50	1328	1328	73.2	1171.3						
D5UW30	1859.2	796.8	86.5	1384.2				X		
D5U	2656	0	106.5	1703.7				X	X	X

Table 4-10: Dredged Material Placement Efficiency Analysis

X' identifies a placement scheme that was evaluated at the designated acreage. A shaded box denotes that the placement scheme at the designated acreage is feasible.

Placement scheme	Size of placement scheme evaluated (acres)													
	600	**700**	**1000**	**1200**	**1354**	**1400**	**1500**	**1586**	**1600**	**1800**	**2700**	**2500**	**2072**	**2756**
70% Upland-30% Wetland	X	X	X				X			X		X		
30% Upland-70% Wetland w/ +47 MLLW Upland										X				
30% Upland-70% Wetland w/ Accelerated Wet Dev.												X		
50% Upland-50% Wetland				X	X	X	X	X					X	X
45% Upland-55% Wetland					X			X			X		X	X
45% Upland-55% Wetland +25 MLLW Upland					X			X						
45% Upland-55% Wetland w/ Borrow Excavation													X	
40% Upland-60% Wetland							X	X	X	X	X		X	X
40% Upland-60% Wetland +25 MLLW Upland					X	X	X	X	X				X	X
40% Upland-60% Wetland +30 MLLW Upland					X	X	X	X	X	X			X	
40%Upland-60%Wetland w/ Borrow Excavation													X	
40% Upland-60% Wetland w/ Accelerated Wet Dev.							X							

Table 4-11: Weights Assigned to Guilds	
Guild	**Weight**
Colonial nesting wading birds (herons, egrets, ibises)	12%
Waterfowl	10%
Colonial nesting waterbirds (gulls, terns, skimmers)	12%
Raptors	2%
Shorebirds	14%
Birds Total:	**50%**
Herpetofauna	**2%**
Benthic invertebrate	**20%**
Resident/forage fish	23%
Commercial/predatory/higher trophic level fish	5%
Fish Total:	**28%**

Table 4-12 Island Community Index (ICI) for Colonial Nesting Wading Birds (herons, egrets & ibises)

Habitat Type	*Index*	*Description*
Upland	1	2-10 ha (5-25 ac) including woody vegetation, availability of >250 (820 ft)m buffer for heronries, and freshwater ponds
(as nesting habitat)	0.75	2-10 ha (5-25 ac) including woody vegetation, <250 (820 ft)m buffer, and freshwater ponds
	0.50	<2 ha or 10-100 ha (25-250 ac) with woody vegetation, may or may not include ponds
	0.25	N/A
	0	>100 ha (250 ac); no vegetation or grass (non-woody vegetation)
High Marsh	1	N/A
(as foraging habitat)	0.75	includes intertidal pools
	0.50	N/A
	0.25	> 2 ha, marsh acreage not split 80/20, NO tidal gut or intertidal pools
	0	Year 1 followng construction
Low Marsh	1	>80 ha (200 ac) 80/20 split, upgrade from sand beach, includes tidal gut, plus tidal and intertidal pools
(as foraging habitat)	0.75	>40 ha (100 ac) 80/20 split, includes tidal gut, plus tidal and intertidal pools
	0.50	>20 ha (50 ac) 80/20 split, includes tidal gut, plus tidal and intertidal pools
	0.25	any size, marsh acreage not split 80/20, no tidal guts, no pools, and no sand beach
	0	Year 1 following construction
Intertidal	1	> 10 ha (25 ac) mudflats and sandy beach/shoreline
(as foraging habitat)	0.75	> 5 ha (12.5 ac) mudflats or sandy beach
	0.50	< 5 ha (12.5 ac) mudflats and/or sandy beach
	0.25	N/A
	0	N/A

Table 4-13: Island Community Index (ICI) for Colonial Nesting Waterbirds (gulls, terns & skimmers)

Habitat Type	*Index*	*Description*
Upland	1	1-2 ha (2.5-5 ac) open sand, soil, or shell; sparsely vegetated (< 25%)
(as nesting habitat)	0.75	2- 7 ha (5-17 ac) open sand, soil, or shell; sparsely vegetated (< 25%)
	0.50	7-20 ha (17-49.5 ac); sparsely vegetated (< 25%)
	0.25	< 1 ha, > 20 ha; sparsely vegetated (< 25%)
	0	< 1 ha, > 20 ha; thicker vegetation (> 25%)
High Marsh	1	N/A
(as foraging habitat)	0.75	includes intertidal pools
	0.50	N/A
	0.25	> 2 ha, marsh acreage not split 80/20, NO tidal gut or intertidal pools
	0	Year 1 following construction
Low Marsh	1	any size, 80/20 split, upgrade from sand beach, includes tidal gut, plus tidal and intertidal pools
(as foraging habitat)	0.75	any size, 80/20 split, no tidal guts/pools or sand beach
	0.50	any size, marsh acreage not split 80/20, no tidal guts, no pools, and no sand beach
	0.25	N/A
	0	Year 1 following construction
Intertidal	1	>40 ha (100 ac) mudflats and sandy beach/shoreline
(as foraging habitat)	0.75	>20 ha (50 ac) mudflats and sandy beach/shoreline
	0.50	>10 ha (25 ac) mudflats and sandy beach/shoreline
	0.25	>5 ha (12.5 ac) mudflats and sandy beach/shoreline
	0	< 5 ha (12.5 ac)

Table 4-14: Island Community Index (ICI) for Shorebirds (sandpipers & plovers)

Habitat Type	*Index*	*Description*
Upland	1	N/A
	0.75	N/A
	0.50	N/A
	0.25	N/A
	0	no benefit to shorebirds
High Marsh	1	N/A
	0.75	N/A
	0.50	contains >20 ha (50 ac) intertidal pools
	0.25	contains <20 ha (50 ac) intertidal pools
	0	No intertidal pools; year 1 following construction
Low Marsh	1	>80 ha (200 ac) 80/20 split, upgrade from sand beach, includes tidal gut, plus tidal and intertidal pools
	0.75	>40 ha (100 ac) 80/20 split, includes tidal gut, plus tidal and intertidal pools
	0.50	>20 ha (50 ac) 80/20 split, includes tidal gut, plus tidal and intertidal pools
	0.25	any size, marsh acreage not split 80/20, no tidal guts, no pools, and no sand beach
	0	Year 1 followingn construction
Intertidal	1	>80 ha (200 ac) mudflats and sandy beach/shoreline
	0.75	>40 ha (100 ac) mudflats and sandy beach/shoreline
	0.50	>20 ha (50 ac) mudflats and sandy beach/shoreline
	0.25	>10 ha (25 ac) mudflats and sandy beach/shoreline
	0	< 10 ha (25 ac)

Table 4-15: Island Community Index (ICI) for Waterfowl

Habitat Type	*Index*	*Description*
Upland	1	1-2 ha (2.5-5 ac), forested edge adjacent to high marsh, ponds
	0.75	> 2 ha, forested edge adjacent to high marsh, ponds
	0.50	forested, but not adjacent to high marsh; and ponds
	0.25	forested, but not adjacent to high marsh; no ponds
	0	grassed expanses, no vegetative cover; may or may not include ponds
High Marsh	1	> 2 ha, adjacent to uplands; incorporates hummocks, woody vegetation; includes intertidal ponds, channels
	0.75	> 2 ha, most not adjacent to uplands; no hummocks; woody vegetation; includes intertidal ponds, channels
	0.50	any size, most not adjacent to uplands; woody vegetation; no ponds or channels
	0.25	N/A
	0	any aize; most not adjacent to uplands; no woody vegetation; no ponds or channels; year 1 following construction
Low Marsh	1	any size, 80/20 split, upgrade from sand beach, includes tidal gut, plus tidal and intertidal pools
	0.75	any size, 80/20 split, no tidal guts/pools or sand beach
	0.50	any size, marsh acreage not split 80/20, no tidal guts, no pools, and no sand beach
	0.25	N/A
	0	Year 1 following construction
Intertidal	1	> 3 ha (7.4 ac), 9-305 m (30-1000 ft) wide; gently sloping; on southeast side (maximize sunlight, minimize wind)
	0.75	> 3 ha (7.4 ac), 9-305 m (30-1000 ft) wide; gently sloping; NOT on southeast side (maximize sunlight, minimize wind)
	0.50	any size and width; located anywhere
	0.25	N/A
	0	N/A

Table 4-16: Island Community Index (ICI) for Raptors

Habitat Type	*Index*	*Description*
Upland	1	forested with 1.5 km strip of land adjacent to water;
	0.75	forested without 1.5 km strip of land adjacent to water
	0.50	N/A
	0.25	not forested, but grass (provide some hunting area for hawks)
	0	Year 1 following construction
High Marsh	1	any size or features (high marsh provides hunting for hawks, and nesting for some hawks)
	0.75	N/A
	0.50	N/A
	0.25	N/A
	0	Year 1 following construction
Low Marsh	1	N/A
	0.75	N/A
	0.50	any size or features (will provide some use for foraging for fish in shallow water)
	0.25	N/A
	0	Year 1 following construction
Intertidal	1	N/A
	0.75	N/A
	0.50	N/A
	0.25	N/A
	0	No use to raptors regardless of features

Table 4-17: Island Community Index (ICI) for Resident/Forage Fish

Habitat Type	*Index*	*Description*
Upland	1	N/A
	0.75	N/A
	0.50	N/A
	0.25	N/A
	0	no benefit to resident/forage fish
High Marsh	1	any size, cut with channels
	0.75	N/A
	0.50	N/A
	0.25	N/A
	0	any size, NO channels; year 1 following construction
Low Marsh	1	any size; upgrade from sandy beach; cut with channels; adjacent to possible SAV bed sites
	0.75	any size; cut with channels; NOT upgrade from sandy beach and/or possible SAV bed sites
	0.50	any size, NO channels
	0.25	N/A
	0	year 1 following construction
Intertidal	1	any size; sand beaches cut with channels; adjacent to possible SAV bed sites
	0.75	any size; sand beaches cut with channels; NOT upgrade from sandy beach and/or possible SAV bed sites
	0.50	any size, NO channels
	0.25	N/A
	0	year 1 following construction

Table 4-18: Island Community Index (ICI) for Commercial/Predatory/Higher Trophic Fish

Habitat Type	*Index*	*Description*
Upland	1	N/A
	0.75	N/A
	0.50	N/A
	0.25	N/A
	0	no benefit to resident/forage fish
High Marsh	1	N/A
	0.75	N/A
	0.50	N/A
	0.25	N/A
	0	any size or features
Low Marsh	1	any size; upgrade from sandy beach; cut with channels; adjacent to possible SAV bed sites
	0.75	any size; cut with channels; NOT upgrade from sandy beach and/or possible SAV bed sites
	0.50	any size, NO channels
	0.25	N/A
	0	Year 1 following construction
Intertidal	1	N/A
	0.75	any size; sand beaches cut with channels; adjacent to possible SAV bed sites
	0.50	any size; sand beaches cut with channels; NOT upgrade from sandy beach and/or possible SAV bed sites
	0.25	any size, NO channels
	0	Year 1 following construction

Table 4-19: Island Community Index (ICI) for Invertebrates

Habitat Type	*Index*	*Description*
Upland	1	N/A
	0.75	N/A
	0.50	N/A
	0.25	N/A
	0	N/A
High Marsh	1	Mature community (10 years old)
	0.75	N/A
	0.50	Immature community characterized by pioneer and pollution tolerant species; exposed to erosional forces.
	0.25	newly established colony
	0	N/A
Low Marsh	1	Mature community (10 years old)
	0.75	N/A
	0.50	Immature community characterized by pioneer and pollution tolerant species; exposed to erosional forces
	0.25	newly established colony
	0	N/A
Intertidal	1	Mature community (10 years old)
	0.75	N/A
	0.50	Immature community characterized by pioneer and pollution tolerant species; exposed to erosional forces
	0.25	newly established colony
	0	N/A

Table 4-20: Island Community Index (ICI) for Reptiles and Herpetofauna

Habitat Type	*Index*	*Description*
Upland	1	N/A
	0.75	N/A
	0.50	any size, vegetative cover- will get use by some herpetofaunal use, but most in guild don't require upland
	0.25	N/A
	0	any size; barren, no vegetative cover
High Marsh	1	any size; with channels and permanent pools (fishless)
	0.75	any size; with channels; no pools
	0.50	any size, no channels or pools
	0.25	N/A
	0	Year 1 following construction
Low Marsh	1	any size; with channels on Eastern side; maximize edge habitat, <20% (sparse) vegetation
	0.75	N/A
	0.50	any size; no channels; < 20% vegetated
	0.25	N/A
	0	any size; dense vegetation (>20% vegetated); year 1 following construction
Intertidal	1	sand beaches (above high water) and intertidal mudflats adjacent to channel
	0.75	sand beaches or intertidal mudflats adjacent to channel
	0.50	mudflats of any size, not adjacent to channel
	0.25	N/A
	0	N/A

Table 4-21: Maturity Dates used to perform Island Community Unit Incremental Calculation	
Habitat Type	**Time for habitats to develop full benefits (yrs)**
Wooded upland for colonial nesting wading birds (herons, egrets, and ibises)	25+ years
Upland habitat for colonial nesting waterbirds (gulls, terns, and skimmers)	1
Upland for waterfowl use (including woody/shrubby cover surrounding pools for nesting)	10
High marsh (no woody vegetation)	5
High marsh with woody/shrubby vegetation	10
Low marsh	10
Intertidal (mudflats)	10
Invertebrate communities	10

Table 4-22: No action alternative analysis for Barren Island					
Project Year	**Year**	**Remaining Acreage**	**Remaining Island ICUs**	**SAV ICUs**	**Total ICUs**
0	2010	172.7	88.6	205.2	293.8
1	2011	168.6	86.5	200.3	286.8
2	2012	164.5	84.4	195.5	279.9
3	2013	160.4	82.3	190.6	272.9
4	2014	156.3	80.2	185.7	265.9
5	2015	152.2	78.1	180.8	258.9
6	2016	148.1	76.0	176.0	252.0
7	2017	144.0	73.9	171.1	245.0
8	2018	139.9	71.8	166.2	238.0
9	2019	135.8	69.7	161.4	231.0
10	2020	131.7	67.6	156.5	224.1
11	2021	127.6	65.5	151.6	217.1
12	2022	123.5	63.4	146.7	210.1
13	2023	119.4	61.3	141.9	203.1
14	2024	115.3	59.2	137.0	196.2
15	2025	111.2	57.0	132.1	189.2
16	2026	107.1	54.9	127.3	182.2
17	2027	103.0	52.8	122.4	175.2
18	2028	98.9	50.7	117.5	168.3
19	2029	94.8	48.6	112.6	161.3
20	2030	90.7	46.5	107.8	154.3
21	2031	86.6	44.4	102.9	147.3
22	2032	82.5	42.3	98.0	140.4
23	2033	78.4	40.2	93.2	133.4
24	2034	74.3	38.1	88.3	126.4
25	2035	70.2	36.0	83.4	119.4
26	2036	66.1	33.9	78.5	112.5
27	2037	62.0	31.8	73.7	105.5
28	2038	57.9	29.7	68.8	98.5
29	2039	53.8	27.6	63.9	91.5
30	2040	49.7	25.5	59.1	84.6
31	2041	45.6	23.4	54.2	77.6
32	2042	41.5	21.3	49.3	70.6
33	2043	37.4	19.2	44.4	63.6
34	2044	33.3	17.1	39.6	56.7
35	2045	29.2	15.0	34.7	49.7
36	2046	25.1	12.9	29.8	42.7
37	2047	21.0	10.8	25.0	35.7
38	2048	16.9	8.7	20.1	28.8
39	2049	12.8	6.6	15.2	21.8
40	2050	8.7	4.5	10.3	14.8
41	2051	4.6	2.4	5.5	7.8

Table 4-22: Continued.					
Project Year	**Year**	**Remaining Acreage**	**Remaining Island ICUs**	**SAV ICUs**	**Total ICUs**
42	2052	0.5	0.3	0.6	0.9
43	2053	0	0	0	0
44	2054	0	0	0	0
45	2055	0	0	0	0
46	2056	0	0	0	0
47	2057	0	0	0	0
48	2058	0	0	0	0
49	2059	0	0	0	0
			1,910.4	**4,424.6**	**6,335.0**
		Annual ICUs	**126.7**		
Assumptions/Constants: 2004 Acreage=197.3 ac; Annual Erosion Rate=4.1 ac; Base Year=2010; Period of Analysis=50 years					

Table 4-23: No action alternative analysis for James Island					
Project Year	**Year**	**Remaining Acreage**	**Remaining Island ICUs**	**SAV ICUs**	**Total ICUs**
0	2010	49.9	14.6	1.8	16.4
1	2011	45	13.2	1.6	14.8
2	2012	40.1	11.7	1.4	13.2
3	2013	35.2	10.3	1.3	11.6
4	2014	30.3	8.9	1.1	10.0
5	2015	25.4	7.4	0.9	8.3
6	2016	20.5	6.0	0.7	6.7
7	2017	15.6	4.6	0.6	5.1
8	2018	10.7	3.1	0.4	3.5
9	2019	5.8	1.7	0.2	1.9
10	2020	0.9	0.3	0.0	0.3
11	2021	0	0.0	0.0	0.0
12	2022	0	0.0	0.0	0.0
13	2023	0	0.0	0.0	0.0
14	2024	0	0.0	0.0	0.0
15	2025	0	0.0	0.0	0.0
16	2026	0	0.0	0.0	0.0
17	2027	0	0.0	0.0	0.0
18	2028	0	0.0	0.0	0.0
19	2029	0	0.0	0.0	0.0
20	2030	0	0.0	0.0	0.0
21	2031	0	0.0	0.0	0.0
22	2032	0	0.0	0.0	0.0
23	2033	0	0.0	0.0	0.0
24	2034	0	0.0	0.0	0.0
25	2035	0	0.0	0.0	0.0
26	2036	0	0.0	0.0	0.0
27	2037	0	0.0	0.0	0.0
28	2038	0	0.0	0.0	0.0

Table 4-23: Continued.					
Project Year	**Year**	**Remaining Acreage**	**Remaining Island ICUs**	**SAV ICUs**	**Total ICUs**
29	2039	0	0.0	0.0	0.0
30	2040	0	0.0	0.0	0.0
31	2041	0	0.0	0.0	0.0
32	2042	0	0.0	0.0	0.0
33	2043	0	0.0	0.0	0.0
34	2044	0	0.0	0.0	0.0
35	2045	0	0.0	0.0	0.0
36	2046	0	0.0	0.0	0.0
37	2047	0	0.0	0.0	0.0
38	2048	0	0.0	0.0	0.0
39	2049	0	0.0	0.0	0.0
40	2050	0	0.0	0.0	0.0
41	2051	0	0.0	0.0	0.0
42	2052	0	0.0	0.0	0.0
43	2053	0	0.0	0.0	0.0
44	2054	0	0.0	0.0	0.0
45	2055	0	0.0	0.0	0.0
46	2056	0	0.0	0.0	0.0
47	2057	0	0.0	0.0	0.0
48	2058	0	0.0	0.0	0.0
49	2059	0	0.0	0.0	0.0
			81.7	**10.1**	**91.8**
Annual ICUs			**1.8**		
Assumptions/Constants: 2004 Acreage=79.3 ac; Annual Erosion Rate=4.9 ac; Base Year=2010; Period of Analysis=50 years					

Table 4-24: No action alternative analysis for combined James and Barren Islands					
Project Year	**Year**	**Remaining Acreage**	**Remaining Island ICUs**	**SAV ICUs**	**Total ICUs**
0	2010	222.6	103.2	207.0	310.2
1	2011	213.6	99.7	202.0	301.6
2	2012	204.6	96.1	196.9	293.0
3	2013	195.6	92.6	191.9	284.4
4	2014	186.6	89.1	186.8	275.9
5	2015	177.6	85.5	181.8	267.3
6	2016	168.6	82.0	176.7	258.7
7	2017	159.6	78.4	171.7	250.1
8	2018	150.6	74.9	166.6	241.5
9	2019	141.6	71.4	161.6	232.9
10	2020	132.6	67.8	156.5	224.3
11	2021	127.6	65.5	151.6	217.1
12	2022	123.5	63.4	146.7	210.1

Table 4-24: Continued.					
Project Year	**Year**	**Remaining Acreage**	**Remaining Island ICUs**	**SAV ICUs**	**Total ICUs**
13	2023	119.4	61.3	141.9	203.1
14	2024	115.3	59.2	137.0	196.2
15	2025	111.2	57.0	132.1	189.2
16	2026	107.1	54.9	127.3	182.2
17	2027	103.0	52.8	122.4	175.2
18	2028	98.9	50.7	117.5	168.3
19	2029	94.8	48.6	112.6	161.3
20	2030	90.7	46.5	107.8	154.3
21	2031	86.6	44.4	102.9	147.3
22	2032	82.5	42.3	98.0	140.4
23	2033	78.4	40.2	93.2	133.4
24	2034	74.3	38.1	88.3	126.4
25	2035	70.2	36.0	83.4	119.4
26	2036	66.1	33.9	78.5	112.5
27	2037	62.0	31.8	73.7	105.5
28	2038	57.9	29.7	68.8	98.5
29	2039	53.8	27.6	63.9	91.5
30	2040	49.7	25.5	59.1	84.6
31	2041	45.6	23.4	54.2	77.6
32	2042	41.5	21.3	49.3	70.6
33	2043	37.4	19.2	44.4	63.6
34	2044	33.3	17.1	39.6	56.7
35	2045	29.2	15.0	34.7	49.7
36	2046	25.1	12.9	29.8	42.7
37	2047	21.0	10.8	25.0	35.7
38	2048	16.9	8.7	20.1	28.8
39	2049	12.8	6.6	15.2	21.8
40	2050	8.7	4.5	10.3	14.8
41	2051	4.6	2.4	5.5	7.8
42	2052	0.5	0.3	0.6	0.9
43	2053	0	0	0	0
44	2054	0	0	0	0
45	2055	0	0	0	0
46	2056	0	0	0	0
47	2057	0	0	0	0
48	2058	0	0	0	0
49	2059	0	0	0	0
			1,992.2	**4,434.7**	**6,426.8**
		Annual ICUs	**128.5**		
Assumptions/Constants: 2004 Acreage=276.6 ac; Base Year=2010; Period of Analysis=50 years					

Table 4-25: Island Restoration Alternatives By Acreage, Dike Height and Upland/Wetland Ratio			
Alternative	**Total Acreage (ac)**	**Upland Dike Height (ft)**	**Upland/Wetland Ratio**
Barren Island A	1,354	20	50%/50%
Barren Island A	1,354	25	45%/55%
James Island 5/ Barren Island D	2,756	20	50%/50%
James Island 5/ Barren Island D	2,756	20	45%/55%
James Island 5/ Barren Island D	2,756	25	40%/60%
James Island 3	1,586	20	50%/50%
James Island 3	1,586	25	45%/55%
James Island 3	1,586	30	40%/60%
James Island 5	2,072	20	50%/50%
James Island 5	2,072	20	45%/55%
James Island 5	2,072	25	40%/60%

Table 4-26: Habitat Type Distribution of Remaining Alternatives Used to Calculate ICUs								
Alternative	**Cell Acreage**		**Placement Acreage**		**Habitat Type**			
	upland	**wetland**	**upland**	**wetland**		**high marsh**	**low marsh**	**mudflat/ intertidal**
Barren Island A, 50/50	677	677	619	619	--->	117	421	81
Barren Island A, 45/55	609.3	744.7	577	682	--->	130	466	86
Barren D/James 5, 50/50	1378	1378	1261	1261	--->	239	861	161
Barren D/James 5, 45/55	1240.2	1515.8	1136.1	1386	--->	264	951	171
Barren D/James 5, 40/60	1102.4	1653.6	1008.8	1512	--->	289	1041	182
James Island 3, 50/50	793	793	726	726	--->	139	499	88
James Island 3, 45/55	713.7	872.3	653	798	--->	153	550	95
James Island 3, 40/60	634.4	951.6	580	871	--->	167	603	101
James Island 5, 50/50	1036	1036	948	948	--->	183	658	107
James Island 5, 45/55	932.4	1139.6	853	1043	--->	202	728	113
James Island 5, 40/60	828.8	1243.2	758	1138	--->	221	797	120

Table 4-27: Mid-Bay Island Restoration Alternative Project Dimensions and Cost Estimates

*The project costs are broken into 3 components in the following table: (1) dike construction, (2) all remaining constructions costs excluding dike construction, and (3) an incremental cost for increasing the dike height above 20'. The first two costs are included in all projects. The incremental cost for increasing dike height above 20' is only associated with those alternatives that have dike heights of 25' or 30'.

Alternative	Total Acres	Upland Dike Height	Upland/ Wetland Ratio	Project Costs Excluding Dike Construction	20' Dike Construction Cost	Incremental Dike Height Cost	Total Project Cost
Barren A	1354	20	50/50	$519,699,000	$167,247,000	$0	$686,946,000
Barren A	1354	25	45/55	$512,089,000	$167,247,000	$18,279,000	$697,615,000
James 3	1586	20	50/50	$549,614,000	$174,460,000	$0	$724,074,000
James 3	1586	25	45/55	$532,034,000	$174,460,000	$21,411,000	$727,905,000
James 3	1586	30	40/60	$514,454,000	$174,460,000	$38,064,000	$726,977,000
James 5	2072	20	50/50	$713,922,000	$227,920,000	$0	$941,842,000
James 5	2072	20	45/55	$699,177,000	$227,920,000	$0	$927,097,000,
James 5	2072	25	40/60	$684,431,000	$227,920,000	$49,747,000	$962,098,000
James 5/ Barren D	2756	20	50/50	$949,599,000	$303,160,000	$0	$1,252,759,000
James 5/ Barren D	2756	20	45/55	$941,130,000	$303,160,000	$0	$1,244,000
James 5/ Barren D	2756	25	40/60	$910,373,000	$303,160,000	$66,144,000	$1,279,677.000

Table 4-28: Mid-Bay Island Restoration Expected ICUs By Alternative for 50-year Period of Analysis		
Alternative	**Tot. ICUs (50 yr period)**	**Yearly Average ICUs**
Barren A, 50/50	32,467	649
Barren A, 45/55	33,385	668
James 5/Barren D, 50/50	44,234	885
James 5/Barren D, 45/55	45,641	913
James 5/Barren D, 40/60	46,861	937
James 3, 50/50	19,396	388
James 3, 45/55	20,492	410
James 3, 40/60	20,931	419
James 5, 50/50	22,626	453
James 5, 45/55	24,598	492
James 5, 40/60	25,797	516

Table 4-29: Results of Alternatives Cost Effective Analysis (interest rate=5.375%)					
Alternative (Upland/Wetland Ratio)	**Total Cost ($000s)**	**Present Value Cost ($000s)**	**Total ICUs**	**Average Annual Cost ($000s)**	**Average Annual ICUs**
No Action	$0	$0	6,427	$0	129
James 3, 50/50	$724,074	$546,122	19,396	$31,664	388
James 3, 45/55	$727,904	$549,011	20,492	$31,832	410
James 3, 40/60	$726,977	$548,312	20,931	$31,791	419
James 5, 50/50	$941,842	$710,371	22,626	$41,188	453
James 5, 45/55	$927,097	$699,249	24,598	$40,543	492
James 5, 40/60	$962,098	$725,647	25,797	$42,073	516
Barren A, 50/50	$686,946	$516,775	32,467	$29,963	649
Barren A, 45/55	$697,615	$518,692	33,385	$30,074	668
James 5/Barren D, 50/50	$1,252,759	$944,875	44,234	$54,748	885
James 5/Barren D, 45/55	$1,244,290	$941,133	45,641	$54,567	913
James 5/Barren D, 40/60	$1,279,677	$965,177	46,861	$55,962	937

Table 4-30: Incremental Cost Analysis Compared to the No Action Alternative					
Alternative	**Average Annual Cost ($000s)**	**Annual ICUs**	**Incremental ICUs**	**Incremental Cost ($000s)**	**Incremental Cost/Incremental ICU**
No Action	$0	129	N/A	N/A	N/A
Barren A, 50/50	$29,963	649	520	$29,963	$57,620
Barren A, 45/55	$30,074	668	539	$30,074	$55,800
James 5/Barren D, 45/55	$54,567	913	784	$54,567	$69,600
James 5/Barren D, 40/60	$55,962	937	808	$55,962	$69,260

Table 4-31: Incremental Cost Analysis Compared to Barren A, 45/55					
Alternative	**Average Annual Cost ($000s)**	**Annual ICUs**	**Incremental ICUs**	**Incremental Cost ($000s)**	**Incremental Cost/Incremental ICU**
No Action	$0	129	N/A	N/A	N/A
Barren A, 45/55	$30,074	668	539	$30,074	$55,800
James 5/Barren D, 45/55	$54,567	913	245	$24,493	$99,970
James 5/Barren D, 40/60	$55,962	937	269	$25,888	$96,240

Table 4-32: Mid-Bay Island Alternatives Remaining After Incremental Analyses					
Alternative	**Average Annual Cost ($000s)**	**Annual ICUs**	**Incremental ICUs**	**Incremental Cost ($000s)**	**Incremental Cost/Incremental ICU**
No Action	$0	129	N/A	N/A	N/A
Barren A, 45/55	$30,074	668	539	$30,074	$55,800
James 5/Barren D, 40/60	$55,962	937	269	$25,888	$96,240

Table 4-33: Impacts and Benefits of 'Best Buy' Plans in the Four Evaluation Accounts

	Benefits	Impacts
NED		
No Action	NA	NA
Barren A, 45/55	NA	NA
James 5/ Barren D, 40/60	NA	NA
James 5, Barren E, 45/55	NA	NA
Environmental Quality		
No Action	None	Eventual loss of Barren and James Islands and associated resources; continued local erosion.
Barren A, 45/55	Protect existing Barren Island, leeward mainland, and SAV beds; restore 1354 ac; decreased local erosion.	Eventual loss of James Island and associated resources; continued local erosion. Transformation of 1354 ac of shallow water habitat/'healthy' benthic community*. Displacement of commercial fishery use at Barren and James.
James 5/ Barren D, 40/60	Protect existing Barren and James Island, leeward mainland (wave reduction provides the greatest shoreline benefit to areas in lee of Barren Island), and SAV beds; restore 2,756 ac of island habitat; decreased local erosion. Greatest benefit to shoreline to areas in lee of Barren Island.	Transformation of 2,756 ac of shallow water habitat (2,072 ac at James Island and 684 ac at Barren Island). Displacement of commercial fishery use at James Island and loss of potential waterfowl foraging in open water that would be filled. Deepening and disturbance of 101 acres of shallow water habitat to create access channel.
James 5, Barren E, 45/55	Protect existing Barren and James Island, leeward mainland, and SAV beds; restore 2144 ac; decreased local erosion.	Transformation of 2144 ac of shallow water habitat (2072 ac of 'stressed' and 72 ac of 'healthy' benthic community*.) Displacement of commercial fishery use at James Island and loss of potential waterfowl foraging in open water that would be filled. Deepening and disturbance of 101 acres of shallow water habitat to create access channel. Cumulative loss of 22 acres of shallow water habitat to sill and breakwater construction.
Regional Economics		
No Action	None	Eventual loss of Barren and James Islands and associated losses to property owners on mainland. Loss of recreation and commercial fisheries negatively impacted by loss of James and Barren Islands.
Barren A, 45/55	Creation of construction jobs. Hoopers Island shoreline provided protection. Enhanced fisheries from wetland and dike (reef) creation, and SAV protection.	Eventual loss of James Island and associated impacts to property owners on mainland. Loss of recreation and commercial fisheries negatively impacted by loss of James Island. Relocation/loss of fishing/crabbing grounds in restored island footprint.
James 5/ Barren D, 40/60	Creation of construction jobs. Hoopers Island shoreline provided protection (reduced wave height during storms). Enhanced fisheries from wetland and dike (reef) creation, and SAV protection.	Significant displacement of fishery resources within footprint of restored islands (2,072 ac at James Island, and 684 ac at Barren Island). Significant displacement of crabbing grounds at James and Barren Islands. Displacement of pound nets at Barren Island.
James 5, Barren E, 45/55	Creation of construction jobs. Hoopers Island shoreline provided protection. Enhanced fisheries from wetland and dike (reef) creation, and SAV protection.	Loss of recreation and commercial fisheries negatively impacted by loss of Barren Island (2144 ac, but only 72 ac at Barren Island). Significant displacement of crabbing grounds at James, but not to other fisheries.

Table 4-33 cont'd.

Other Social Effects		
No Action	None	Likely loss of SAV resources and associated fishery support that SAV provides following eventual loss of James and Barren Islands. This will lead to degradation of regional fisheries and recreational fishing. Loss of islands, primarily Barren, would lead to increased wave heights and erosion on shoreline in lee of islands. Likely large impacts to shoreline communities.
Barren A, 45/55	Potentially enhanced fishing of fish attracted to hard bottom. Protection/enhancement of SAV may improve some recreational species. Likely increase in waterfowl hunting and wildlife viewing in Barren area.	Minimal increase of travel time to fishing grounds and open water at Barren Island. Light, noise, and possibly disruption of tourism in near vicinity of Barren Island during construction. Viewshed impacts at Barren Island.
James 5/ Barren D, 40/60	Potentially enhanced fishing of species attracted to hard bottom. Protection/enhancement of SAV may improve some recreational species. Likely increase in waterfowl hunting and wildlife viewing in James and Barren area. Reduction of wave height on mainland shoreline in lee of Barren Island would be a significant benefit to those communities. Only minor benefit expected to mainland shoreline from James Island.	Minimal increase of travel time to fishing grounds and open water at Barren Island. Light, noise, and possibly disruption of tourism in near vicinity of Barren and James Islands during construction. Viewshed impacts at James Island.
James 5, Barren E, 45/55	Potentially enhanced fishing of fish attracted to hard bottom. Protection/enhancement of SAV may improve some recreational species. Likely increase in waterfowl hunting and wildlife viewing in James and Barren area. Reduction of wave height on mainland shoreline in lee of Barren Island would be a significant benefit to those communities. Only minor benefit expected to mainland shoreline from James Island.	Minimal increase of travel time to fishing grounds and open water at Barren Island. Light, noise, and possibly disruption of tourism in near vicinity of Barren and James Islands during construction. Viewshed impacts at James Island.
**As determined by the B-IBI (Benthic- Index of Biotic Integrity) performed during existing conditions surveys.*		

Table 4-34: Final Objective Comparison of Best Buy Plans

Alternatives		**Objectives**						
Upland/Wetland Ratio	**Upland Dike Heights**	1	2	3	4	5	6	7
No action	0	-	-	-	-	-	-	-
Barren A, 45/55	25	+	+	+	+	+	+	+
James 5/Barren D, 40/60	25	+	+ +	+ +	+ +	+	+	+
James 5/Barren E, 45/55	20	+ +	+ +	+ +	+	+ +	+ +	+

Table 4-35: Baltimore Harbor and Channels DMMP
Implementation Schedule- Dredged Material Quantities (cy) by Placement Site

Placement Sites and Alternatives	2005	2006 WRDA	2007	2008 WRDA	2009	2010 WRDA	2011	2012 WRDA	2013	2014 WRDA	2015	2016 WRDA	2017	2018 WRDA	2019	2020 WRDA	2021	2022 WRDA	2023	2024 WRDA	2025	REMAINING CAPACITY (cy)
Harbor Channels																						
Hart-Miller Island Containment Facility (EXISTING)					Cap	Cap																
OPERATING LIFE	2,751,100	2,750,000	2,750,000	1,748,900	2,500,000	2,500,000																0
Cox Creek Containment Facility (EXISTING)																						
OPERATING LIFE	0	642,400	634,700	536,900	330,000	600,000	363,000	600,000	600,000	821,880	716,960	154,160	Capacity	Exhausted								0
New Confined Disposal Facilities - Patapsco River																						
New CDF #1 and #2 (2x≈100 acres)																						
AUTHORIZATION		Authorization																				
PLANNING + DESIGN		Planning &	Design																			
CONSTRUCTION				Construction																		
OPERATING LIFE						743,100	0	632,990	557,970	1,300,000	1,200,000	630,770	332,750	616,495	833,085	341,220	181,500	707,850	181,500	616,495	609,840	0
New CDF #3 and #4 (2x≈100 acres)																						
AUTHORIZATION						Authorization																
PLANNING + DESIGN						Planning &	Design															
CONSTRUCTION								Construction														
OPERATING LIFE										1,300,000	1,200,000	630,770	332,750	616,495	833,085	341,220	181,500	707,850	181,500	616,495	609,840	0
C & D Canal Approach and Chesapeake Bay (MD) Approach Channels																						
Pooles Island Open Water Site (EXISTING)																						
OPERATING LIFE	1,320,000	1,320,000	1,320,000	740,000	Capacity	Exhausted																0
Poplar Island Restoration Project (EXISTING)																						
OPERATING LIFE	1,896,070	1,798,060	2,102,980	2,378,060	1,592,110	824,970	2,683,600	2,683,600	2,683,600	2,683,600	2,683,600	2,720,862	Capacity	Exhausted								0
Poplar Island Expansion																						
AUTHORIZATION	Authorization																					
PLANNING + DESIGN	Planning &	Design																				
CONSTRUCTION				Construction																		
OPERATING LIFE							532,470	434,460	739,380	434,460	532,470	335,220	1,989,776	1,452,000	1,452,000	1,452,000	1,452,000	1,452,000	1,452,000	1,452,000	1,452,000	7,385,764
Large Island Restoration - Mid Bay																						
AUTHORIZATION	Authorization																					
PLANNING + DESIGN	Planning &	Design																				
CONSTRUCTION								Construction														
OPERATING LIFE											0	168,888	1,833,446	1,397,172	1,702,092	1,397,172	1,495,182	1,604,082	1,495,182	1,397,172	2,578,132	19,531,480
Wetlands Restoration - Dorchester County																						
AUTHORIZATION								Authorization														
PLANNING + DESIGN								Planning &	Design													
CONSTRUCTION										Construction												
OPERATING LIFE											0	100,000	268,888	268,888	268,888	268,888	268,888	268,888	268,888	268,888	268,888	TBD
Chesapeake Bay Approach Channels (VA)																						
Rappahannock Deep Alternate Open Water-Site (EXISTING)																						
OPERATING LIFE	0	0	12,100	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	12,100	SUFFICIENT
Wolf Trap Alternate Open Water-Site (EXISTING)																						
OPERATING LIFE	792,550	0	0	0	792,550	0	0	0	792,550	0	0	0	792,550	0	0	0	792,550	0	0	0	792,550	SUFFICIENT
Dam Neck Ocean Open Water-Site (EXISTING)																						
OPERATING LIFE	1,877,920	0	0	0	1,877,920	0	0	0	1,877,920	0	0	0	1,877,920	0	0	0	1,877,920	0	0	0	1,877,920	SUFFICIENT
TOTAL	8,637,640	6,510,460	6,819,780	5,403,860	7,092,580	4,668,070	3,579,070	4,351,050	7,251,420	6,539,940	6,333,030	4,740,670	7,428,080	4,351,050	5,089,150	3,800,500	6,249,540	4,740,670	3,579,070	4,351,050	8,201,270	
		Authorization		Planning & Design		Construction		Operating Life												Total	119,717,950	

Table 4-36- James Island NER Plan- Optimization Analysis		
2014 Scenario	**PV Cost**	**ICUs**
Total	$514,393,000	26,055
AA	$27,634,000	501.1
	AAC/ICUs	$55,152
2018 Scenario	**PV Cost**	**ICUs**
Total	$434,983,000	23,856.3
AA	$23,368,000	458.8
	AAC/ICUs	$50,936
2023 Scenario	**PV Cost**	**ICUs**
Total	$ 382,676,000	21,566
AA	$ 20,558,000	501
	AAC/ICUs	$ 49,551

Table 4-37. Open Water Indices		
Wadingbirds		N/A
Waterbirds		N/A
Shorebirds		N/A
Waterfowl		Feeding (benthics- primarily mollusks)
	1	silty and sandy substrates; diverse benthic community; abundant foraging habitat (>100,000/m2 gem clam, >150 dwarf surf clam, etc.); hard substrate (oyster bars), SAV
	0.75	silty/sandy substrate OR hard substrate/SAV present; good foraging habitat (>50,000/m2 gem clam, >100 dwarf surf clam, etc)
	0.50	silty or sandy substrate; no structure or SAV; fair benthic foraging habitat (>10,000/m2 gem clams, >40 dwarf surf clams, etc.)
	0.25	mud/clay substrate, no structure or SAV, poor foraging habitat (<9,999/m2 gem clam; <40 dwarf surf clams, etc.)
	0	mud/clay substrate, no structure or SAV; no benthic food items
Raptors		N/A
Resident/Forage Fish		
Three habitat requirements were identified for fishery resources: 1. diversity of benthic food sources (A); 2. cover from predation (B); and 3. a productive planktonic community (C). (A) diversity of benthic food sources is specified as the most important and highly desired requirement. The requirements were defined as: A - diverse benthos = B-IBI>3, sand and mud substrate; DO>5. B - presence of cover/structure = presence of oyster reef; within 2 m of SAV bed. C- for mesohaline waters, a diverse community includes copepods, cladocerans, rotifers, larval stages of barnacles, decapod crustaceans, mysid shrimp, comb jellies.		
Open Water	1	Availability of A, B, and C.
	0.75	Availability of A and B, or A and C
	0.50	Availability of only A, or of B and C
	0.25	Availability of B or C
	0	Neither A, B, or C are available.
Commercial/predatory/higher trophic fish		
Open Water	1	Availability of A, B, and C.
	0.75	Availability of A and B, or A and C
	0.50	Availability of only A, or of B and C
	0.25	Availability of B or C
	0	Neither A, B, or C are available.
Benthic invertebrates		
	1	Mature community (10 years)
	0.75	N/A
	0.50	Immature community characterized by pioneer and pollution tolerant species; exposed to erosional forces
	0.25	Newly established colony
	0	N/A
Herptofauna		N/A

Table 4-38. Results of Net ICU Analysis

	Average Annual ICUs				Cumulative ICUs (over 50 year project life)		
Alternative	Benefit ICUs	Open Water ICUs (impact)	NET ICUs		Benefit ICUs	Open Water ICUs (impact)	NET ICUs
James 5, 50/50	469	363	106		23,452	18,130	5,322
James 3, 50/50	388	278	110		19,396	13,878	5,519
No Action	129	0	129		6,427	0	6,427
James 5, 45/55	492	363	129		24,598	18,130	6,468
James 3, 45/55	410	278	132		20,492	13,878	6,615
James 3, 40/60	419	278	141		20,931	13,878	7,054
James 5, 40/60	516	363	153		25,797	18,130	7,667
Barren A, 50,50	649	494	155		32,467	24,711	7,757
Barren A, 45,55	668	494	173		33,385	24,711	8,675
5D, 50/50	885	582	302		44,234	29,115	15,119
5D, 45/55	913	582	331		45,641	29,115	16,526
5D, 40/60	937	582	355		46,861	29,115	17,746
J5+Bp, 50/50	790	371	419		39,509	18,575	20,934
J5+Bp, 45/55	813	371	442		40,650	18,575	22,075
J5+Bp, 40/60	837	371	466		41,850	18,575	23,275

5 RECOMMENDED PLAN

5.1 *DESCRIPTION OF RECOMMENDED PLAN

The Mid-Chesapeake Bay Islands Restoration Project recommended plan consists of two parts: island restoration at James Island and island restoration/protection at Barren Island (See Figures 5.1, 5.2 and 5.3). During the plan formulation process, this plan met all the objectives set by the PDT, maximized the NER benefits, and had the least impacts on existing fisheries resources. Implementation of both James and Barren Island parts is critical to achieving the ecosystem benefits for the recommended plan. The James Island project component will provide the primary dredged material disposal capacity required as well as restore critical island habitat. The Barren Island project component will provide some dredged placement capacity, protect the existing island resources, reduce erosion of the existing shoreline at Barren, create wetlands, and protect areas of SAV from high wave energy.

Components of the recommended plan presented in Section 4.7.4 are further outlined in Table 5.1. Construction of Barren Island restoration measures are broken into two phases. Phase I involves construction of all sills along the Barren Island shoreline and monitoring to determine the extent of breakwaters necessary to protect SAV resources south and southeast of Barren Island. Phase II would encompass construction of breakwaters determined necessary for protection of these SAV resources.

The recommended plan will provide the capacity to place 90 to 95 mcy of clean dredged material over a 32 year period if placed efficiently. The capacity of the recommended plan exceeds the targeted range of 30-70 mcy (3.2 mcy/y) by approximately 20 to 25 mcy. Recommending a project with the ability to handle a greater capacity of dredged material than the objective provides the flexibility to accommodate risk and uncertainty surrounding annual dredging needs (3.2 mcy/y is an average) and incorporates a safety factor into the plans. Additionally, many existing channels are maintained below their authorized widths. Therefore, recommending a project that provides a larger capacity than anticipated enables the project to efficiently manage increased placement needs should these channels be enlarged to their authorized widths. The remainder of the project life once placement has been completed in year 32 would be focused on site management including habitat development and providing time for the habitats to mature.

5.1.1 Overview of James Island Project Site

The James Island portion of the project involves constructing armored dikes, breakwaters, and/or other structures approximating the island's historical footprint from 1877 (Cronin, 2005) and filling the enclosed area with clean dredged material from Federal navigation channels in the Chesapeake Bay. The 2,072-ac fill area will be subdivided to provide 932 ac of upland cell acreage (853 ac for placement and habitat development) and 1,140 ac for wetland cell development (1,043 ac for placement), for a breakdown of 45% uplands and 55% wetlands. The following habitat acreages are targeted in the wetland cells: 202 ac of high marsh, 728 ac of low marsh, and 113 ac of mudflat and intertidal, but are subject to update throughout the design phase with monitoring and data collection as part of the adaptive management plan. The James Island portion would protect up to 22.6 ac of SAV habitat that has been recorded east of the existing island since 1994. Additionally, 17.4 wetland ac, 53.5 upland ac, and 8.4 intertidal ac would be protected on the existing island. (The acreages will decrease each year until containment dikes are constructed.)

This alternative would provide between 90 and 95 million cubic yards of dredged material placement capacity, depending upon borrow excavation within the island footprint. It is projected that placement would occur over the first 32 years of the 50 year project life. Upland placement capacity would last at least two full years beyond anticipated wetland placement to ensure proper wetland development. This alternative includes the option to reconfigure the wetland and upland ratios.

Construction at James Island will necessitate dredging an access channel on the northwest end of the island. The access channel would be approximately 12,720 feet in length, 400 feet in width at base with 3:1 side slopes. Of the total length, 3,070 feet would lie within the island footprint with 9,650 feet extending outside the footprint. The total footprint of the access channel is roughly 153.5 ac, with 52.7 ac within and 100.8 ac outside the island footprint. Approximately 45,000 feet of perimeter dikes would be constructed. The sand for dike construction will be hydraulically dredged from within the island footprint or from the access channel (Figure 5.2). The sediment to construct the proposed wetland and upland habitat area at James Island will be dredged from the C&D Canal approach channel and the Chesapeake Bay approach channel to the Port of Baltimore in MD and potentially other Federal navigation channels in the James Island vicinity (see Table 2.2 for details). Additional details on the analysis and construction sequence of the James Island portion of the plan can be found in Section 5.2.

5.1.2 Overview of Barren Island Project Site

Plans for Barren Island incorporate the use of sills to protect the current acreage of the island and the SAV/shallow water habitat off the eastern shore of Barren Island, and create wetland habitat using dredged material. Approximately, 23 and 49 ac of island habitat (72 ac total, equates to 65 ac for placement) will be created by backfilling on the north and west shoreline of the island, respectively. The following habitat acreages are targeted: 13 ac of high marsh, 47 ac of low marsh, and 5 ac of mudflat/intertidal. Additionally, 84.2 wetland ac, 77.9 upland ac, 17.3 intertidal ac, and 8.6 ac of beach upland would be protected on the existing island. (The acreages will decrease each year until containment dikes are constructed.) The Barren Island portion would protect up to 1,325 ac of SAV habitat that has been recorded east and southeast of the existing island since 1994.

Depths greater than six feet off the western shore of Barren Island made it more costly to build dikes, requiring the proposed sill to be moved closer to the existing shoreline. The recommended plan for Barren Island is broken down into two phases. Phase I Barren restoration would involve the modification of 4,900 feet of existing rock sill and the construction of 9,760 feet of new rock sill (3,840 feet on the northern shore, 4,620 feet on the western shore, and 1,300 feet on the sourthern shore). Sills would be built to an elevation of 4 feet MLLW. Modification of the existing sill would slightly expand its footprint, consuming an additional 1.1 ac footprint. The near-shore sill would consume 5 ac of shallow water habitat. Approximately, 23 and 49 ac of island habitat (72 ac total) will be created by backfilling on the north and west, respectively. The material that would be used to backfill behind the breakwaters at Barren Island will be from authorized maintenance of Federal navigation channels in the Honga River channels and is characterized as silt and sand.

Also, as part of Phase I, further wave and hydrodynamic modeling will be completed to determine the optimum length, height, and configuration of breakwater required to reduce waves to tolerable levels for the SAV. The habitat requirements for SAV and the results of the modeling will be reviewed as part of the adaptive management process. Phase II would consist of constructing breakwaters off the southern tip of Barren Island following the historic shoreline in order to protect the SAV habitat to the south and southeast of Barren Island. If it is determined that the SAV habitat to the south and southeast require further protection, a maximum 8,200 ft of structure is proposed at a maximum height of 6 feet above MLLW. If built to maximum length, the southern breakwater would have a 9.5 ac footprint.

It has not been determined which SAV beds are protected by the existing island and which are protected by the submerged sandbar remaining from the eroded island that extends south from the existing island. A goal of Phase I modeling and monitoring will be to provide this information. At this time, the following estimates are made based on VIMS mapping since 1994: Phase I would protect up to 1,025 ac of potential SAV habitat; and, Phase II would protect up to 300 ac of potential SAV habitat.

In total, Barren Island restoration measures would directly impact a maximum of 100 ac of near-shore habitat. The project limit is identified in Figure 5-3. Additional details of the Barren Island portion of the plan can be found in Section 5.3.

Although the Barren Island National Wildlife Refuge is Federally owned land, it is noted that the primary objective of this study, and the majority of the benefits to be derived from the Barren Island portion of the recommended project, involves the protection and restoration of wetland and SAV habitat in State owned waters (defined as anything below mean high water). The constructed sills would be backfilled to mean high water to restore wetlands along the Barren Island coastline. The State of Maryland is a willing non-Federal sponsor. The proposed breakwater structures would be constructed in State waters to protect and promote SAV offshore of the Federal property. Finally, the Federal lands must be protected to realize the benefits in the State waters. That is, the protection and conditions provided to SAV beds by Barren Island would be lost without protecting and stabilizing the eroding island.

5.2 *DETAILS OF RECOMMENDED PLAN AT JAMES ISLAND

5.2.1 Dredged Placement Analysis

The results of the incremental analysis in Section 4 indicated that a 45% upland / 55% wetland ratio was a cost-effective alternative. However, additional analysis on dredged material placement was conducted to determine if a higher ratio of wetlands was potentially achievable at James Island for the alignment selected. Originally, the additional capacity provided by the excavation of the borrow material within the uplands was not accounted for in the evaluation. The analysis was reevaluated to account for this additional capacity.

The analyses show that 45%/55% upland to wetland ratio is achievable for the selected alignment with the uplands built to elevation +20 feet MLLW. They also show that if enough suitable borrow material is recovered from within the uplands footprint, that a 40%/60% ratio is potentially achievable. See Appendix C, Engineering and Design Analysis, Table 4-1 for more details on this analysis.

5.2.2 Proposed Dike Section

The total length of the perimeter dike is estimated at 45,235 feet as measured along the perimeter road. The length of the main separator dike between the uplands and wetlands is estimated to be 6,235 ft. The entire perimeter dike will be protected by a toe dike in two sections. The toe dike for the dike sections with southern, western, and northern exposure will consist of a core of quarry run stone, with two layers of 3,500 lb armor stone above the core. The toe dike for the dike sections with eastern exposure will consist of a core of quarry run stone, with two layers of 250 lb or 1,000 lb armor stone above the core. The top elevation of the toe dikes will be at +1 feet MLLW for all dike sections. The upland perimeter dike is currently estimated to run from station 0+00 to station 207+16. The wetland perimeter dike is estimated to run from station 207+16 to station 452+35 (Figure 5-1).

A 6,235 ft separator dike is located between the upland cells and the wetland cells. Additionally, it is estimated that the upland area will be divided into 4 cells. The cross-dikes required to divide these cells will be temporarily built to about elevation +25 feet MLLW to provide for consolidation then lowered to a permanent average elevation of +20 feet MLLW, with 2.5H:1V side slopes and a top width of 20 feet. The wetland area will initially be subdivided. An estimated 27 wetland cells will be created for ease of construction. The dividing cross-dikes will be built to approximately +6 feet MLLW with a top width of 15 feet. For additional details on materials used for the dike construction and proposed cross sections, Figures 11-14 in Appendix C, Engineering Design and Analysis, Attachment A.

5.2.3 Tidal Guts

The recommended plan for James Island also includes a tidal gut passing along all of the wetland cells with an opening at both the northeastern and southeastern end of the wetland area footprint. The tidal gut is currently assumed to be 150 feet wide and will not be connected to the Chesapeake Bay on the western side of the proposed island. The final dimensions and alignment of the tidal gut will be determined following detailed hydraulic modeling in the next design phase. Constructing unarmored containment dikes along both sides of the proposed alignment will create the tidal gut. These dikes will be composed primarily of sand with appropriate surface stabilization to minimize erosion and deposition that could affect the hydraulic efficiency of the gut during dredged material placement. The containment dikes can be removed after development and stabilization of the wetlands, or can be left in place as desired. Further hydrodynamic analysis will be conducted in the PED phase to determine if the entrances to the tidal gut from the Chesapeake Bay will require a limited reach of stone armor.

5.2.4 Dredged Material and Barge Offloading Facilities

Offloading of dredged materials and equipment and materials from barges will initially occur inside the upland at the south-central portion of the area. In order to site the access channel through a sand deposit to maximize borrow materials, the channel is located along the western side of upland cells. A sheetpile bulkhead will most likely be required along the crossdike adjacent to the turning basin. This will allow for barges to offload equipment and materials easily. This location is the most central location to the entire site within the upland area. Thus, the overall length of dredged material pumping to the wetland cells and the other upland cells will be minimized. Once the other upland cells are filled, the unloading cell will be closed. To accommodate for the closure of the unloading cell, an unloading facility/bulkhead/turning basin will be provided on the outside of the upland cell. Wave protection structures such as jetties, breakwaters, and/or sheetpile walls will be provided to allow for protection of the offloading facilities during periods of high wave conditions. A sheetpile bulkhead will be provided along the dike to allow for equipment offloading.

5.2.5 Island Facilities

To adequately operate and maintain the project site, various facilities are required for the project. Office space in the form of an operations building or trailer complex will be required and located on the separator dike between the uplands and wetlands, due to its central location. A personnel pier is proposed for construction on the east side of the project to provide access for work crews. It will most likely be located near the separator dike as well. The east side of the project will be more protected and, therefore, is the best location for the pier. A fuel farm will be required to supply the various vehicles and generators which will be operating on-site. Power and telephone service from the mainland will likely be required. Additionally, a land base will be required on the mainland, most likely at the marina along Slaughter Creek.

5.2.6 Recreational Components

Recreational components at ecosystem restoration projects should be compatible with the objectives of the project and enhance the public's experience by taking advantage of natural values (ER 1105-2-100). The social, cultural, scientific, and educational values of recreational components should be considered within the framework of the ecosystem restoration project purpose. Recreational components of the project may be implemented only to the extent that recreation does not adversely impact the ecosystem restoration process.

Several proposed project features would provide increased recreational opportunities around the project. The rock reefs, segmented breakwater structures, and armored perimeter dikes constructed for the lateral expansion will provide additional fish cover, increasing their potential as high-functioning fish habitat that could support a more productive recreational fishery in the vicinity of the project.

Passive recreational and educational components considered included developing low-impact recreational/educational spaces in a way that benefits the local jurisdictions, the State of Maryland, as well as the objectives of the restoration project. The majority of the passive recreational components are interpretive guidance and media, including: self-guided/interpretive nature trails and boardwalks, kiosks with informative signage, a demonstration garden, a stone sculpture/monument/memorial area, resting/viewing areas, and avian observation areas.

Recreational components will be evaluated and justified in accordance with existing regulations at such time when the sponsor and the appropriate locations to avoid impacts to the project purpose have been identified. Recreational and educational features implemented will be consistent with the goals of the restoration project, and implementation will be coordinated with interested parties and local jurisdictions. A full analysis would be accomplished through a Limited Reevaluation Report (LRR) or other appropriate decision document. In the future, stakeholders will be encouraged to participate and provide input on the specific types of recreational/educational uses, and to help shape the plan for the island. Recreational and educational features will not exceed 10% of the project total cost as per USACE guidelines (Policy Guidance Letter No. 59) and will be cost-shared as specified in ER 1105-2-100 (22 April 2000). A detailed analysis on the recreation components is included in Appendix L.

5.2.7 Habitat Enhancements

Design details will be investigated during the next project phase, PED, which would likely enhance the habitat value of the proposed island. For example, NMFS suggested diversification of proposed shorelines to provide more habitat benefits to finfish using adjacent waters. Specifically, small coves lined with smooth cordgrass marsh would be attractive foraging habitat for juvenile summer flounder. The east side of James Island could be diversified with a series of small coves and/or crenulations. The cove should tie into the 9 to 10 foot depth contour, to increase its value to recreational fishing. The southern tip of the proposed James Island may also be suitable to a cove. Maximizing the number of tidal ports is another design element that would enhance the export of detritus and other energy from the wetland cells.

5.3 *DETAILS OF RECOMMENDED PLAN AT BARREN ISLAND

5.3.1 Site Layout

As shown in Figure 5.3, the western alignment is approximately 13,550 feet in length. The northern protection option is approximately 3,840 feet in length. Each alignment is laterally located just offshore in relatively shallow water (est. 3-4 feet of depth at MLLW). The northern portion of the western protection consists of adding one layer of armor stone to the existing project. This will raise the top of the structure from the existing elevation +2 feet MLLW to +4 feet MLLW. The new breakwater/sill option along the western shoreline will be built to +4 feet MLLW.

As previously stated in Section 5.1.2, monitoring would be carried out to evaluate the need for constructing breakwaters off the southern tip of Barren Island following the historic shoreline in order to protect the SAV habitat to the south and southeast of Barren Island. If it is determined that the SAV habitat to the south and southeast require further protection, a breakwater section that continues south of the existing island is currently proposed. This breakwater would be 8,200 feet structure built up to +6 feet MLLW. This height is suggested based on preliminary consultation with the US Coast Guard with respect to navigation hazards, but may be modified in the adaptive management phase to include habitat features with vegetation, which might allow for a lower structure. Additional options will be investigated as part of the adaptive management process and as monitoring data on erosion rates and SAV habitat growth is collected and evaluated.

The northern alignment option will also consist of a stone breakwater/sill to elevation +4 feet MLLW. Wetland restoration behind the northern protection and much of the western protection is also recommended. Containment on the eastern side of the proposed wetland area will also be required just south of the existing Island. This containment will likely consist of a stone sill to approximately elevation +4 feet MLLW. The south breakwater will be constructed in order to provide a more favorable environment for the large SAV beds located to the east of Barren Island. The wave reduction provided by the breakwater will create and/or retain favorable conditions for SAV growth. Detailed hydraulic modeling will still need to be performed and could result in refinements of the structure lengths, heights, and locations. The additional modeling will also consider whether the breakwater structure to the south of the existing Island can be segmented. See Appendix C, Engineering and Design Analysis, Attachment F for more details on the proposed modeling.

5.3.2 Breakwater/Sill Section

Three different sections are proposed for use on the project. They are identified as (1) modification of existing sill; (2) near-shore sill, and (3) south breakwater (see Appendix C, Figures 20 to 22 for the typical sections). The section for the modification of existing sill consists of adding one layer of 1,300 lb armor stone to the sill section currently in place and adding two stones at the bayside toe of the structure. The top width will be 6 feet, and the top elevation will be +4 feet MLLW. The total length of the modified sill section is estimated at 4,900 feet.

The near-shore sill will have a top elevation of +4 feet MLLW, a top width of 6 feet, and consist of core stone layer covered by two layers of 130 lb underlayer stone and two layers of 1,300 lb armor stone. A geotextile/sand filter section will be required on the eastern side of the section in order to prevent the eventual backfill material from migrating through the stone section. The filter will be provided at the time of backfilling. The total length of the nearshore sill is 3,840 linear feet (LF) along the north side of the island, 4,620 LF along the west side of the island, and 1,300 feet on the south side of the island.

The south breakwater section has a top elevation of +6 feet MLLW, a top width of 6 feet, and consists of a core stone section covered by 2 layers of 130 lb intermediate stone, and 2 layers of 1,300 lb armor stone. The estimated length of the breakwater section is 8,200 feet.

5.3.3 Wetland Restoration

As described previously, portions of the recommended project will be backfilled between the created structure and the existing island in order to create wetlands along the shoreline of the island. Dredged material from the Federal navigation channels in the Honga River will supply the backfill for the wetland restoration. Since the primary source is from the small navigation channels in the Honga River, the wetlands will need to be created in several increments, as the quantity of maintenance dredged material will likely not be enough to create the wetlands all at once. Planting of the wetlands will commence after each backfilled portion or cell is filled and consolidated to the required elevations.

In addition to wetlands, some small island hummocks will be investigated for placement at the southern end of Barren Island. These islands would be one to five acres in size, similar to small upland islands located on the larger islands, which are predominantly wetlands, unlike Barren and James, which were historically primarily upland islands. The habitat requirements for these islands have been discussed in Section 4 and will be included in the AMP.

5.3.4 Habitat Enhancements

An addition of one or more islands isolated from the main Barren Island formation would provide high quality nesting habitat for birds. Once the nature and extent of the proposed breakwaters off the southern tip of Barren Island are determined, the possibility of using a portion of the structure to enhance bird nesting habitat will be considered. For example, a section of a segmented breakwater, if part of the final design, could be transformed into an isolated bird island.

5.4 CONSTRUCTION & SITE OPERATIONS

The construction of this project is not without its challenges. However, with the experience and knowledge gained from the Poplar Island Restoration Project, construction can be accomplished. The work done at Poplar Island has provided much information and provided the following details.

5.4.1 Habitat Design

Ecological design considerations for habitat development are outlined in Table 5.2, with features for upland, high marsh, low marsh, and intertidal/unvegetated mudflats. These design features were produced from the Island Community Unit analysis. They are a record of habitat features that were included in the quantification of environmental benefits. The inclusion of these features in the constructed habitats is critical to ensure that all quantified ecological benefits are fully realized.

5.4.2 James Island

The project has been developed with the assumption that funding will be provided to build the project in one phase. The project will be built most effectively, efficiently, and economically if construction is performed in a single phase. However, if funding does become a limitation, the project will have to be built in phases, thereby increasing costs. In addition, a number of environmental and engineering issues will need to be reconsidered. Keeping each phase at 45% upland/55% wetland will be more difficult than the Poplar Island construction, as the project site is not divided in half longitudinally for the upland/wetland delineation as it was at Poplar Island. Therefore, with the current configuration of upland cells at the northern end and wetland cells at the southern end, it will be a challenge to stage construction laterally and still maintain the final upland/wetland ratio throughout. In addition, partial construction of the wetlands may be very difficult due to the prominent tidal gut feature within the wetland cells. The most efficient placement to ensure the success of the wetlands cell will be consistently evaluated as part of the adaptive management process.

In general, construction procedures are assumed to be similar to those used on the Poplar Island project where the sand portion of the dikes will be built using mechanical methods. Hydraulic dike construction will most likely not be permitted due to the higher material losses associated with that method. Based on geotechnical surveys conducted during this phase, estimated surplus amounts of sand are not available to risk hydraulic placement. Instead, construction quality sand from the borrow areas and access channel will be hydraulically dredged and stockpiled. From the stockpile area, the material will be mechanically placed within the perimeter or cross dikes. The armor stone, underlayer stone, and bedding/core stone will be barged in from commercial sources. Initial construction of the stone toe dikes will be accomplished by barge, however, it is assumed that all subsequent stone placements will be from the sand dike surface. Construction of the stone toe dike will be required prior to the construction of the sand dikes in order to minimize the loss of sand. Settlement monitoring may be required in reaches having soft foundation conditions to allow for accurate quantity measurements.

As construction of the toe dike advances, the main dike section construction can begin. The construction of the main dike will be accomplished by conventional means from land. During the entire construction process, the toe dike section will need to stay ahead of the sand placement in order to provide the needed protection against large amounts of sand erosion.

Once a large enough area in the upland area has been constructed to provide adequate protection, dredging of the borrow material from within the upland cells can begin. This material will be hydraulically dredged and pumped into a large stockpile. The proposed stockpile area will be midway along the separator dike in the uplands area. This sand will then be mechanically moved from the stockpile to be placed as the dike construction progresses. Depending on time requirements for dredged material inflow into the site, an upland cell could be closed off initially while construction progressed over the remainder of the site.

5.4.2.a Wetland Cell Development

Wetland construction with dredged material will be undertaken after the appropriate wetland perimeter dikes and interior dikes are constructed for a given wetland section. At this point, wetland construction is expected to be performed in a similar manner to the construction of Cell 3D at Poplar Island. This would involve dividing the overall wetland area into smaller cells, approximately 40 ac in nominal area. See Appendix C, Figure 16 for an example of the Cell 3D layout at Poplar Island.

Each cell would then be developed by a combination of hydraulic dredged material inflows and surface dewatering/crust development. During the first inflows into a wetland cell, up to 70% of the total expected dredged material volume will be inflowed into the cells. Then, 70% of the remaining dredged material volume will be added in the next inflow, continuing on this cycle until the last inflow is less than 20,000 cy. The remaining volume required would be placed at this time.

After each inflow event, an aggressive dewatering/crust development process will need to be undertaken. Once a stable surface and an elevation was achieved which is close to the target elevation (+1.5 feet MLLW at Poplar Island), mechanical excavation of the channel features and grading of the site to provide the required topography for the different plant types would begin. This excavation and grading process will allow for channels of varying widths and alignments to be cut, as well as desired elevation variations in the marsh areas to be created. Once the final grades are met, an outlet structure will be installed at the site to connect the wetland channel to the tidal gut or the Chesapeake Bay as required.

Planting of the wetland cells will commence as each wetland cell is filled, primary channel systems are excavated, and surface grading is completed. Based on experience at PIERP, 30 to 40 ac wetland areas can be filled in one year and sculpted and planted the following year.

Planting schemes will be determined during the adaptive management process with input from the PDT and technical advisory team. These procedures will continue to be adjusted throughout the adaptive management process and included in the Cell Development Plans and AMP.

5.4.2.b Upland Cell Construction/Development

The upland area will be divided into four cells for dredged material placement and cell development. The cross-dikes required for cell division will be constructed initially to approximately elevation +25 feet MLLW. The cross-dikes will be constructed primarily of sand on 2.5H:1V side slopes. Further analyses will be performed to determine the best solutions for erosion control. Until the dredged material is filled above the Chesapeake Bay water level, the cells will contain open water. Based on lessons learned at Poplar Island, a high potential exists for erosion to occur due to wave action within the cells. Some geotextile tubes may be required as breakwaters within the cells. Additionally, surface treatments of erosion-resistant geosynthetics or clays may also be employed.

An access channel and a turning basin will be dredged in the northwestern and an offloading bulkhead will be constructed. This cell will serve as the primary dredged material and equipment offloading area throughout most of the life of the project. This area will be the most centrally located and protected area available for offloading on the site. The other three upland cells will be filled according to a general schedule that will keep each inflow lift thickness under 3 feet.

The final elevation of the upland cells will average +20 feet MLLW due to allowances for development of the habitat and drainage toward the wetlands. Once this elevation has been achieved, each cell will be taken off-line and upland development will commence. This will include providing drainage features to handle surface runoff from storm events, as well as preventing concentrated areas of open water or erosion from runoff. It will be difficult to keep any drainage features functioning as designed due to the likelihood of continued settlement for years after the final inflow into the cell. This settlement will be greatest at the center of each cell. Therefore, it may be desirable to overbuild the center portion of the cell to account for this. Lessons learned from upland grading at Poplar Island will be incorporated into the upland cell development for James Island.

5.4.2.c Site Operation and Maintenance

The construction and operation and maintenance of James Island will be a cooperative effort between USACE-Baltimore District and MPA similar to the arrangement for the restoration and maintenance of Poplar Island. As each functional element of the project is completed and determined to be functioning as intended, it will become the responsibility of the MPA to operate, maintain, repair, replace, and rehabilitate the project elements as needed. Such functional elements include: containment dikes including armor stone, internal dikes, service structures, access channels, and each of the wetland and habitat areas defined by permanent cell divisions. Ultimately, the entire site will become the responsibility of the MPA.

Site infrastructure will include those facilities required to support the project. Infrastructure at James Island will include dike roadways, personnel and equipment access, storage areas, piers and off-loading facilities, and on-site operations buildings and monitoring facilities. Proposed site facilities were previously discussed in Section 5.2.4 and 5.2.5.

An integral component to the site operations and maintenance at James Island is the AMP and monitoring framework agreed upon by the PDT. During the next phases of this project (PED and construction), an Ecosystem Restoration Project Coordination Team will be formed to steer habitat development and adaptive management. This group will include the following sub-teams: Site Development Team, Site Operations Team, and Adaptive Management Team. See Section 8 and Appendix F for more details on the adaptive management process.

5.4.3 Barren Island

The project has been developed with the assumption that the project will be built in two main phases, with the wetland restoration occurring over time during the various dredging cycles. The reasons for building in multiple phases include anticipated incremental project funding, and the desire to obtain more detailed information for the final design of the breakwater section, which may provide opportunities for other protection measures that increase habitat, and do not cause navigational hazards. The breakwater construction is separated into Phase II primarily to allow time to acquire the needed information design during Phase I to determine the length of breakwater needed to provide appropriate conditions for SAV growth and finalize breakwater.

This project will be phased by first building the near-shore sill sections on the north and west sides in addition to the modifications to the existing sill. The east side containment sill for the lower wetland cell could be built at this point or delayed until maintenance dredging of local Federal channels is required. However, before any dredged material backfill was placed south of the existing island, the containment sill would need to be in place.

Most of the construction at Barren Island will be performed from barges with cranes or excavators being used for stone placement. Due to the shallow depths along the selected alignment, it is anticipated that the larger stone barges will anchor offshore in deeper water, while a contractor uses smaller barges to access the work locations. This “light-loading” method has proven effective for similar USACE projects in the Chesapeake Bay. While efficiency is somewhat sacrificed by using this method, large environmental effects that would occur due to dredging to allow near-shore barge access will be avoided.

The second phase of the project would involve the construction of the south breakwater section. While the near-shore sills built in the first phase will provide erosion protection to the island and create wetland habitat, the south breakwater section’s main purpose is to protect the SAV area located to the east of Barren Island by attempting to decrease wave action and erosive forces that might impact the SAV. By holding off on construction of the breakwater section, more detailed engineering analyses will be performed to determine the optimum size and length of the breakwater project. Additionally, the decision on whether to make the breakwater continuous or segmented can be more accurately made with more analysis. The risk of waiting to build the breakwater is the additional time that the SAV area is exposed to a high energy environment. If the SAV area is degraded or lost, creation of the breakwater may not be beneficial, and many of the environmental benefits of the project will be lost. Therefore, a decision would be made early in the design phase on whether phased construction is appropriate, or if both the northern sills and south breakwater should be constructed at the same time.

5.4.3.a Wetland Construction

Wetland restoration can begin once the required stone sill containment sections are constructed. The size and timing of each wetland restoration event will depend upon the local maintenance channel dredging. During the backfilling operation, some containment such as sand dikes may be required on the southern extent of each pumping operation to keep the dredged material from spreading out too far and not allowing any wetland development to occur at that time. This additional design requirement will be determined in the PED phase. The inflow amount of each event should be approximated. Using that estimate, an appropriate acreage can be estimated for wetland restoration from that event. Once the event acreage is determined, the secondary containment structure can be put into place. If the dredged material is predominantly sand, the secondary containment structure will be less critical due to its tendency to settle out close to the inflow point. The containment of the inflow event will be much more critical if the dredged material contains a lot of fines (silts and clays).

5.5 REAL ESTATE REQUIREMENTS

The construction at both the James Island and Barren Island will be located primarily in open waters of the Chesapeake Bay in Dorchester County, Maryland. The USACE will exercise its right of navigational servitude for construction of the project on lands below the mean high water line. However, it is noted that the State of Maryland owns the Chesapeake Bay bottom in fee simple. James Island is currently privately owned, but since the project will not be attached to the existing island remnants, no action is required to acquire the islands. Barren Island is owned and managed by the USFWS as part of the Chesapeake Bay Island Wildlife Refuge Complex. Since there will be construction on the shoreline of Barren Island, possibly overlapping the mean high water line, a Special Use Permit will be obtained from the USFWS for project purposes for an area near the shore.

The navigation channels from which the dredged material will come to fill the sites will be from several navigation projects around the Chesapeake Bay. No additional real estate will have to be acquired in conjunction with the Project, other than possibly a yet-to–be-determined temporary leased staging and harbor area(s) on the mainland for the construction of the James Island component of the recommended plan. See Appendix D for additional details on the Real Estate Plan.

5.6 MONITORING AND ADAPTIVE MANAGEMENT

Environmental monitoring will be performed to ensure regulatory compliance, to document the restoration of beneficial habitat, to confirm the expected findings of the impact statement, and to provide operational input on the success of habitat restoration through the use of adaptive management principles. The monitoring components will be determined as part of the AMP outlined in Section 8 and Appendix F of this report, and will be designed to meet the specific objectives and criteria set out in the AMP and agreed upon by the PDT and regulators. The monitoring protocols are broken down into three different areas: habitat cell development, adaptive management, and environmental compliance. The following components are proposed to be included in the monitoring framework for the AMP, some of which will be a continuation of the existing conditions monitoring that have been on-going since 2002 (see Appendix I for additional information on monitoring results): (1) turbidity; (2) shellfish bed sedimentation; (3) sediment quality; (4) wetland vegetation; (5) water quality; (6) benthic and epibenthic community; (7) wetlands use by fish; (8) wetlands use by birds; (9) wetlands use by wildlife, other than birds and fish; (10) interior water quality/algae; (11) terrapin monitoring; and (12) SAV growth and cover.

The project management team structure for the AMP would be similar to that established for PIERP. There would be two groups broken out from the entire project partnership: (1) working group, and (2) Ecosystem Restoration Project Coordination Team. Two subgroups would be formed from the working group: a Habitat subgroup and a Monitoring subgroup. There would be three subgroups developed from the Coordination Team: (1) a Site Development team, (2) a Site Operations team, and (3) an Adaptive Management team. Locations of monitoring stations and frequency of monitoring for each component would be determined based on consultation with the appropriate agency representatives, and approved by members of the Monitoring subgroup (see Section 8 and Appendix F, AMP for additional details on this subgroup). In addition, geotechnical sampling and testing of dredged material for upland and wetland development will occur and adjustments made as necessary. Changes and updates to the monitoring framework will be evaluated as part of the adaptive management process.

Adaptive techniques can also be utilized to accommodate potential sea level rise. Potential impacts resulting from relative sea level rise will be examined during the PED phase. Using predictive models, hydraulic engineers will determine the required dike, sill, and breakwater heights and armor stone sizes. Consideration will be given to modifying the dimensions of the perimeter dike during the detailed design phase. By increasing the initial width of the perimeter dike, future dike raisings could occur with little to no effect on project operations. Increasing the initial height of the perimeter dike would accommodate rising sea levels during the life of the project. During the detailed design phase for each of the wetland cells, engineers and scientists will also develop grading and planting plans that will attempt to accommodate expected changes in sea level. One such method would be to grade the marsh plain so that final elevations are at the higher end of the low-marsh and high-marsh planting zones. This would allow for moderate increases in relative sea level with little to no change in the ratio of low-marsh to high-marsh. Another possible design strategy would be to initially develop the marsh with a significantly higher percentage of high-marsh, thereby allowing the marsh to naturally progress toward the desired low-marsh/high-marsh ratio with rising sea levels over the life of the project.

5.7 TOTAL PROJECT COST ESTIMATE

The total project cost estimate was developed in accordance with guidance contained in ER 110-2-1302, Civil Works Cost Engineering and ER 5-7-1, Total Project Cost Summary. The format of the cost estimate is provided in the standard USACE Micro-Computer Aided Cost Engineering System (MCACES) format. Equipment and material costs were taken from the MCACES database, obtained through verbal quotations from suppliers, or were based on details of construction costs of the current PIERP. Real estate, construction management, engineering and design, and adaptive management costs were provided by USACE-Baltimore District. Contingency amounts for each category of the estimates are also identified in the cost estimate in Appendix C, Attachment M. The MCACES estimate was reviewed and approved by the Cost

Engineering Center of Expertise at Walla Walla District. The contingency amounts were determined using the Crystal Ball software package, and have been calculated to provide a 75% confidence level to the estimate. Generally, contingency amounts are 20% for island construction including dredging, stone dike construction, and site management, which includes environmental monitoring, habitat development, site operations, and crust management, A contingency of 18% was used for James and Barren Island O&M, and a 12% contingency was used for the Barren Island wetland planting to be conducted in FY12. Detailed discussions regarding the cost estimating methodology, Crystal Ball analyses, supporting documentations and summaries of the total project cost estimates are included in Appendix C: Attachment M. The first costs at the FY08 price level with contingencies for implementing the recommended plan is $1,520,700,000 for James Island and $43,936,000 for Barren Island, summing to a total project cost of $1,564,636,000. The final, fully funded, cost estimate with contingencies for implementing the recommended plan is $2,757,653,000 for James Island and $47,891,000 for Barren Island, for a total fully-funded project cost of $2,805,544,000. The project costs for James Island are only for increments beyond the Federal Standard, which will continue to be funded through the Federal Operations and Maintenance Program.

The projects will not only restore valuable island habitat, but they will also protect the existing island remnants and the shallow water habitat in the lee of the restored landmasses. Whereas the James Island project component will restore 2,072 acres of habitat, it will protect another 80 acres of existing island and 23 acres of potential SAV habitat for a total of 2,175 acres. The Barren Island project will restore 72 acres, but will protect 197 acres of island and 1,325 acres of extremely valuable SAV habitat. When taken in total, the cost per acre of benefit for James Island is $699,172 and for Barren Island it is $27,563 (FY08 dollars). Furthermore, of the 813 total annual ICUs as reported in Section 4, the James Island component will produce 492 and Barren will produce 321. This yields an annual cost per ICU of $64,933 for the James Island component and $7,351 for Barren Island.

5.8 RISK AND UNCERTAINTY

Risks, uncertainty, and variability are inherent in water resources planning. Risk can be defined as exposure to the chance of injury or loss. Uncertainty is defined as unpredictability and indeterminacy. Risk and uncertainty arise from measurement errors and from the underlying variability of complex natural, social, and economic situations. The degree of risk and uncertainty generally differs among various aspects of a project. It also differs over time, because benefits from a particular purpose or costs in a particular category may be relatively certain during one time period and uncertain during another.

An evaluation of the risk and uncertainty associated with the quantification of ecosystem benefits and achieving the claimed benefits, as well as the risk and uncertainty of the impacts, costs, and construction follows.

5.8.1 Ecosystem Benefits

There are various sources of uncertainty and risk surrounding the quantification of ecosystem benefits. Very little peer reviewed and published information is available to characterize habitat use by the various guilds. Therefore, best professional judgment was heavily relied upon to develop the indices and guild weights used to quantify ecosystem benefits. The uncertainty associated with relying on best professional judgment is difficult to quantify, but is recognized. Incorporating the views of multiple experts reduces the riskiness of basing decisions on best professional judgment. Additionally, the uncertainty surrounding receiving funding in a timely fashion for a 50 year project will be an issue throughout the project life. The full realization of benefits as described is dependent on receiving the appropriate levels of funding throughout the entire project life. Any shortfall or delay in funding will compromise or delay the benefits. Risks are associated with the benefits that are projected to be provided by the recommended plan. Experience with the restoration at PIERP has shown that weather events, the composition of the dredged material, and variable consolidation of the dredged material are just a few difficulties that could arise to postpone or decrease benefits. Variability could also benefit the project. For example, habitats could develop or material could consolidate faster than expected. To evaluate the risk and uncertainty surrounding the ecosystem benefits quantification and their realization, the net benefit (ICUs) of a series of risk scenarios were determined for the recommended plan. Table 5-3 summarizes these results. This evaluation provides a minimum and maximum range for benefits that can be expected from the completion of the recommended plan. The following scenarios were considered:

1. Wetland failure due to large storm event(s).

2. Sea level rise. Sea level rise was evaluated by adjusting the ratio of low to high marsh. To compensate for sea level rise and prevent low marsh from becoming open water, more acreage could be devoted to high marsh. As sea level rises, the high marsh would become low marsh acreage. The recommended plan was developed with an 80/20 ratio of low to high marsh. This ratio is preferred by the resource agencies and was identified during the planning of PIERP. Two additional scenarios, a 50/50 split, and a 20/80 split were examined. The ratio of low to high marsh was held constant within any given scenario. In reality, it would change with sea level rise. Considering the three distinct evaluation marks together provides a range that could be expected as high marsh is converted to low marsh.

3. Failure of all colonial nesting waterbird nesting due to predation and extreme weather events.

4. Loss of all SAV resources.

5. Expansion of SAV resources to the maximum extent recorded.

6. Wetland dikes are not removed from interior of wetland cells. After the wetlands are mature and stable, the recommended plan includes removal of the interior dikes to reduce fragmentation and develop continuous wetland habitat within the island. Making larger expanses of wetlands increases benefits. If the dikes were not removed, benefits would decrease.

7. Additional localized wetland consolidation. Localized wetland consolidation has been documented in a small percentage (5-10%) of the wetland acreage at PIERP. Additional

consolidation compromises wetland plantings and development and postpones realization of benefits.

8. Removal of wetland dikes earlier than expected. Removal of interior wetland dikes increases the quality of the wetland habitat created. Under this scenario, the dikes would be able to be removed earlier (after year 10) than accounted for in the recommended plan where all interior dikes were removed in year 34 (ranges from year 11 to year 27, but most are after year 15).

9. Wetlands develop higher than expected biomass in year 1 and 2, but then experience die-off. This event has been witnessed in small areas at PIERP. Excessive nutrients in the dredged material are believed to fuel the excessive growth in years 1 and 2. However, by year 3, the density of plants has become so high that it prohibits growth and produces a die-off of plants.

10. Increase the intertidal acreage to provide optimal intertidal habitat. The recommended plan includes 32.6 acres of continuous intertidal acreage as well as a small amount of intertidal within each wetland cell. However, an optimal island would provide at least 200 ac of intertidal habitat to maximize benefits. Wetland cells were switched to intertidal cells for this scenario to evaluate the impact of providing optimal intertidal habitat.

11. Construct wetlands over sand borrow areas. The most efficient way to construct wetlands using dredged material is to minimize the depth needed to be filled with dredged material. This provides the greatest control to properly consolidate and dry the dredged material. However, although inefficient, circumstances may require wetlands to be constructed over deeper (>20 ft) areas where sand has been dredged for dike construction. To simulate this, 10 of the last wetland cells to be developed fail in year 2 due to additional consolidation. They are raised and replanted- two at a time per year until completed.

The range of benefits can be expected from the various risk scenarios is 28,784 to 55,456 ICUs. This range is dependent on the loss of all SAV and the recovery of SAV to a maximum with respect to current records. The success of SAV is not fully controllable by the project due to regional water quality and hydrodynamics. Therefore, disregarding SAV, the range of benefits that could be achieved based on controllable designs of the project is 33,207 to 42,512 ICUs. The minimum benefit (33,207 ICUs) results from reducing the low to high marsh ratio to 20% low marsh/80% high marsh to accommodate sea level rise. It is expected that under this scenario, benefits would increase over time as acreage shifts back to low marsh from high marsh with sea level rise. The maximum benefit (42,512 ICUs) is gained by providing the optimal intertidal acreage. The recommended plan includes 32.6 acres of continuous intertidal acreage as well as a small amount of intertidal within each wetland cell. However, an optimal island would provide a minimum of 200 ac of unvegetated intertidal foraging habitat to waterbirds, shorebirds, and wadingbirds.

For comparison, the recommended plan provides 40,649 ICUs. The analysis identifies that the benefits of the recommended plan could be increased by increasing the intertidal acreage and removing the interior dikes from the wetland cells as soon as feasible (year 10). The risks that could compromise expected benefits of the recommended plan include the decision to shift low to high marsh ratios to accommodate sea level rise, impacts from strong storms, the need to keep interior dikes within wetland cells, constructing wetlands over sand borrow areas, loss of nesting habitat for colonial nesting waterbirds, additional wetland consolidation after planting, and non-typical growth and die-off of plantings due to dredged material characteristics.

Although shifting acreage to high marsh from low marsh will result in a loss of benefits, this action will reduce the risks of the impacts from sea level rise on the project. Alternatively, material can be added to raise wetland elevations to keep pace with sea level rise. Construction techniques can be used to minimize some of the other named risks. An active predator and vegetation control program will be developed to reduce risks of predation and habitat loss to colonial nesting waterbirds. Allowing water levels within cells to rise to meet higher Bay water heights during storms is thought to be a way to greatly minimize storm damage to cells and dikes. Providing time and funding for efficient dredged material placement will minimize the risk of unforeseen wetland consolidation after planting has been completed.

With respect to the amount of risk associated with the various scenarios, it is very likely that the project will experience strong storm events over the 50 year project life. However, as discussed above there are a number of techniques that can be used to minimize the impacts and thereby, reduce this risk. Sea level rise is very likely, however much uncertainty still surrounds the expected magnitude of sea level rise. Various construction techniques can be utilized to reduce the risks of sea level rise.

The analysis shows that there are low risks to benefits, as measured by the difference in benefits provided by the scenario compared with that of the recommended plan, from the timing of interior wetland dike removal, unexpected plant growth and die-off, building wetlands over borrow areas, loss of colonial waterbirds nesting habitat, and additional wetlands consolidation. Changes to habitat development such as constructing wetlands over borrow areas may likely have more impacts on costs than benefits due to decreased efficiency of dredged material placement. The low risk to benefits due to loss of colonial nesting habitat is believed to be due to the characteristically small acreages (<5 ac) preferred for this habitat by the waterbirds and the resulting small part of the project this habitat consumes. However, this is a critically needed habitat in the Mid-Atlantic region and its importance to the project should not be minimized by this analysis. The likelihood of this habitat being lost is very low given the focus the project has to providing nesting habitat and the adaptive management tools available to develop colonial waterbird nesting habitat. The probability of losing all SAV habitat and alternatively, gaining the maximum expansion on a consistent annual basis is low. That is, it is not likely that either of these scenarios will occur on a permanent basis due to the large annual variability in SAV beds and the current water quality of the Chesapeake Bay. However, from the analysis, it is evident that the variability of SAV do impart a relatively high risk on benefits. Finally, there is a low probability of providing the optimal intertidal acreage. High and low marsh would be reduced under this scenario altering the low to high marsh ratio the resource agencies have agreed to and providing reduced flexibility to accommodate sea level rise.

Possibly the greatest control on risks and uncertainty in achieving ecosystem benefits and constructing the recommended plan is the experience gained in the past ten years at PIERP and through the incorporation of an adaptive management plan. Many unexpected problems have occurred and been successfully handled without compromising the environmental quality of PIERP. The USACE and MPA teams have an applied expertise in restoring remote islands in the Chesapeake Bay. PIERP has attracted national and international researchers to see the environmental benefits being achieved. It is not expected that this project will face any new risks or uncertainty not addressed at PIERP. Further, a detailed adaptive management plan is being developed for the Mid-Bay project (Section 8 and Appendix F). Adaptive management methods will allow the project to adjust to 'lessons learned' and allow for versatility if unforeseen issues arise.

5.8.2 Cost Risk Analysis

The primary purpose of Cost Risk Analysis is to quantify contingencies for the James Island and Barren Island Project as part of the Mid-Chesapeake Bay Island Ecosystem Restoration Project located in the Chesapeake Bay, Maryland. Probabilistic risk analysis methods were used to identify project cost estimate contingencies. This analysis was facilitated computationally by a commercially available risk analysis software package, Crystal Ball. This approach allowed for contingency to be set based on a desired level of confidence. The primary steps, in functional terms, of the risk analysis process that was completed are described herein.

5.8.2.1 Identify and Assess Risk Factors

Risk factors are events and conditions that may influence or drive uncertainty in project performance. They may be inherent characteristics or conditions of the project, or external influences, events or conditions such as weather or economic conditions. Risk factors may have either favorable or unfavorable impacts on project cost and schedule.

Project Delivery Team (PDT) meetings were held for the formal purpose of identifying and assessing project risk factors. Participation included capable and qualified representatives from multiple disciplines and functions, including project management, technical management, finance, design engineering, cost engineering and estimating, scheduling and risk analysis. Meetings focused primarily on risk factor identification using brainstorming techniques, but also included some facilitated discussions based on risk factors common to similar projects. The current PDT was very familiar with the current project site design and had significant experience with the Poplar Island Restoration Project, which was very similar in scope.

The results of risk identification meetings were summarized in the risk register tables provided with the James Island & Barren Island Cost Risk Analysis Report, dated 9 April 2008. A risk register was completed for the following elements of work; dike construction, dredging, site management, operations and maintenance, and wetland planting. Each risk register included risk factors such as; bidding climate, scope definition, scope growth and reduction, weather, schedule constraints, labor availability and pricing, equipment availability and pricing, material availability and pricing, fuel costs, innovation savings, and the method of acquisition. For each factor, the PDT assessed the likelihood (very likely to very unlikely) and impact (negligible to critical) to project cost and schedule. A standard risk level matrix was used to assign risk level for each factor (low, moderate, high).

5.8.2.2 Quantify Risk Factor Impacts (Model Input)

For each risk factor, the maximum, minimum and most likely value was calculated. Based on the assigned risk level, a probability distribution or density function was assigned to major groups of tasks. Using this model input, Monte Carlo simulations were run using the Crystal Ball Software. The complete set of model input and model output is provided with the James Island & Barren Island Cost Risk Analysis Report, dated 9 April 2008.

5.8.2.3 Cost Risk Analysis Results

The output of this analysis was to identify the appropriate project contingency for our estimate. Based on a desired confidence level of seventy five percent, the James and Barren Island contingency was set at 20%, the Operations and Maintenance contingency was set at 18%, and the Wetland contingency was set at 12%.

The cost risk analysis identified that the fuel and stone are the major cost drivers of the recommended plan. Fuel is needed for both transportation of the dredged material from the channels to the placement site plus transportation of the construction materials such as stone to the placement site. A significant amount of armor stone is required for dike construction of the proposed project. All stone was assumed to be available from a single quarry. There is some risk associated with this assumption. If a second source of stone is needed, it was assumed that it would be located further from the site than the initial quarry, adding overland transportation costs. The Corps will attempt to make it more convenient to obtain stone from local quarries in lieu of out-of-state quarries in order to minimize the risk of high fuel cost in transportation.

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SECTION 5

FIGURES

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Figure 5-1: Final Recommended Plan- James Island Site

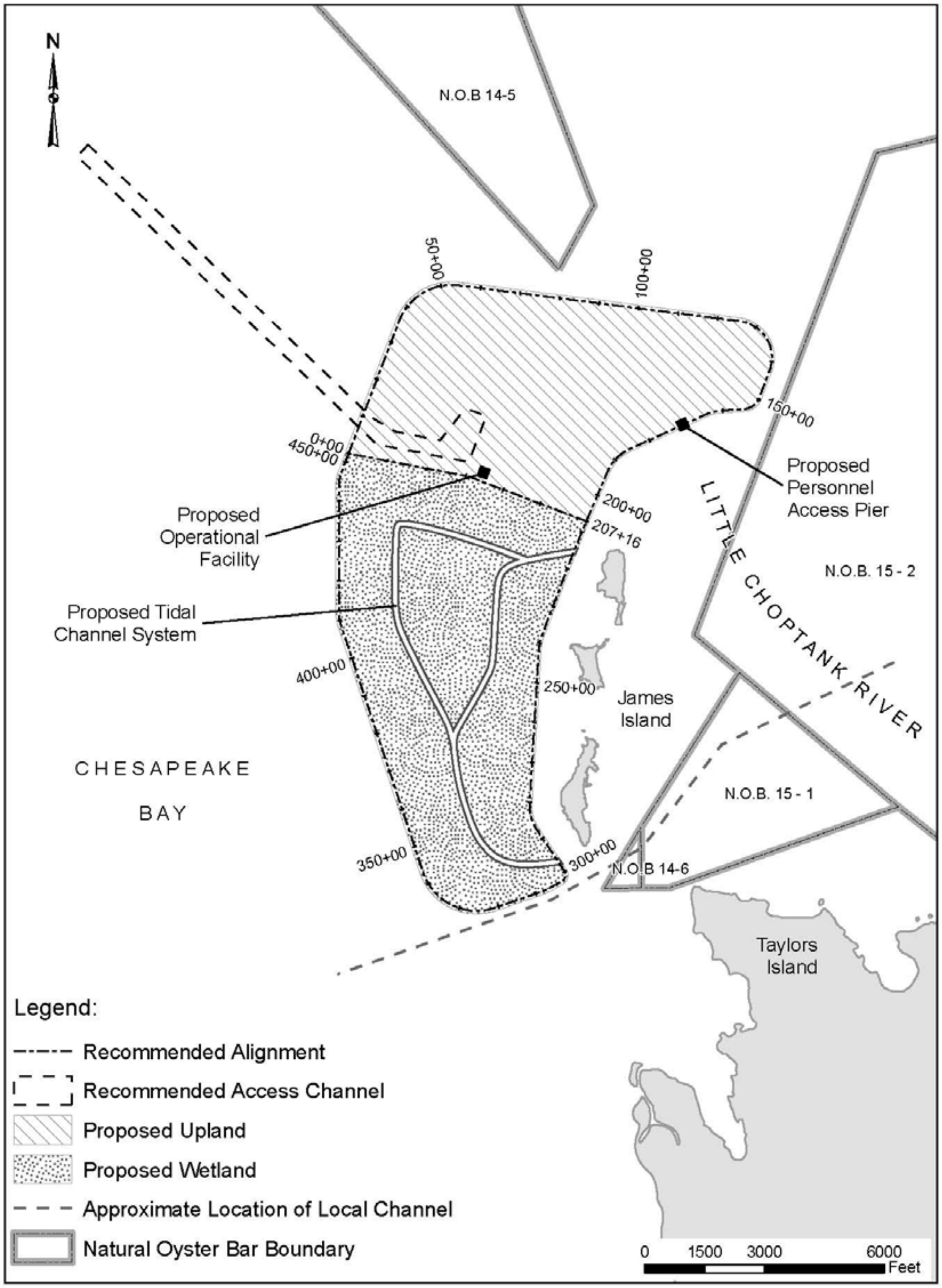


Figure 5-2: Sand Borrow Locations at James Island

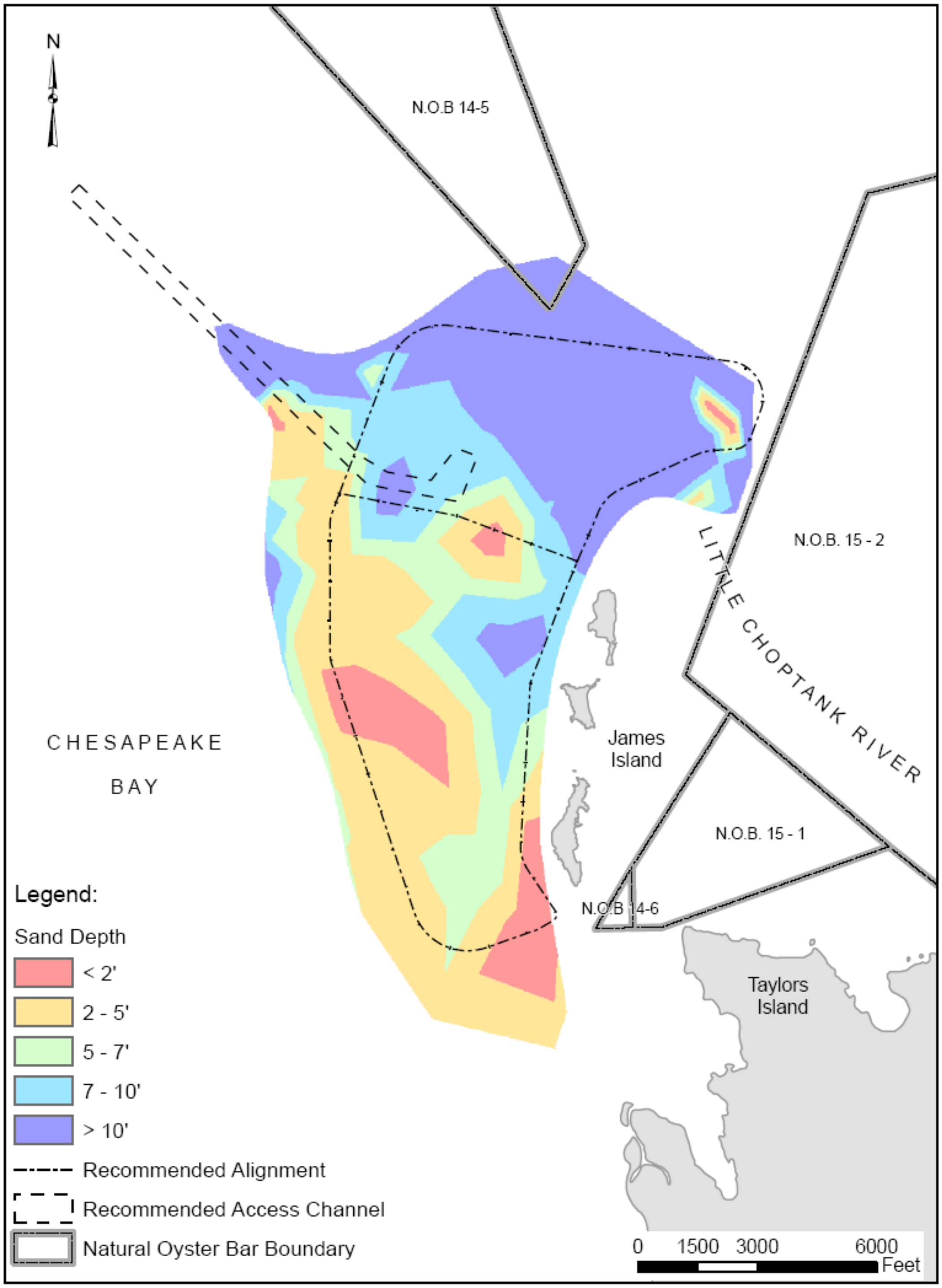


Figure 5-3: Final Recommended Plan- Barren Island Site

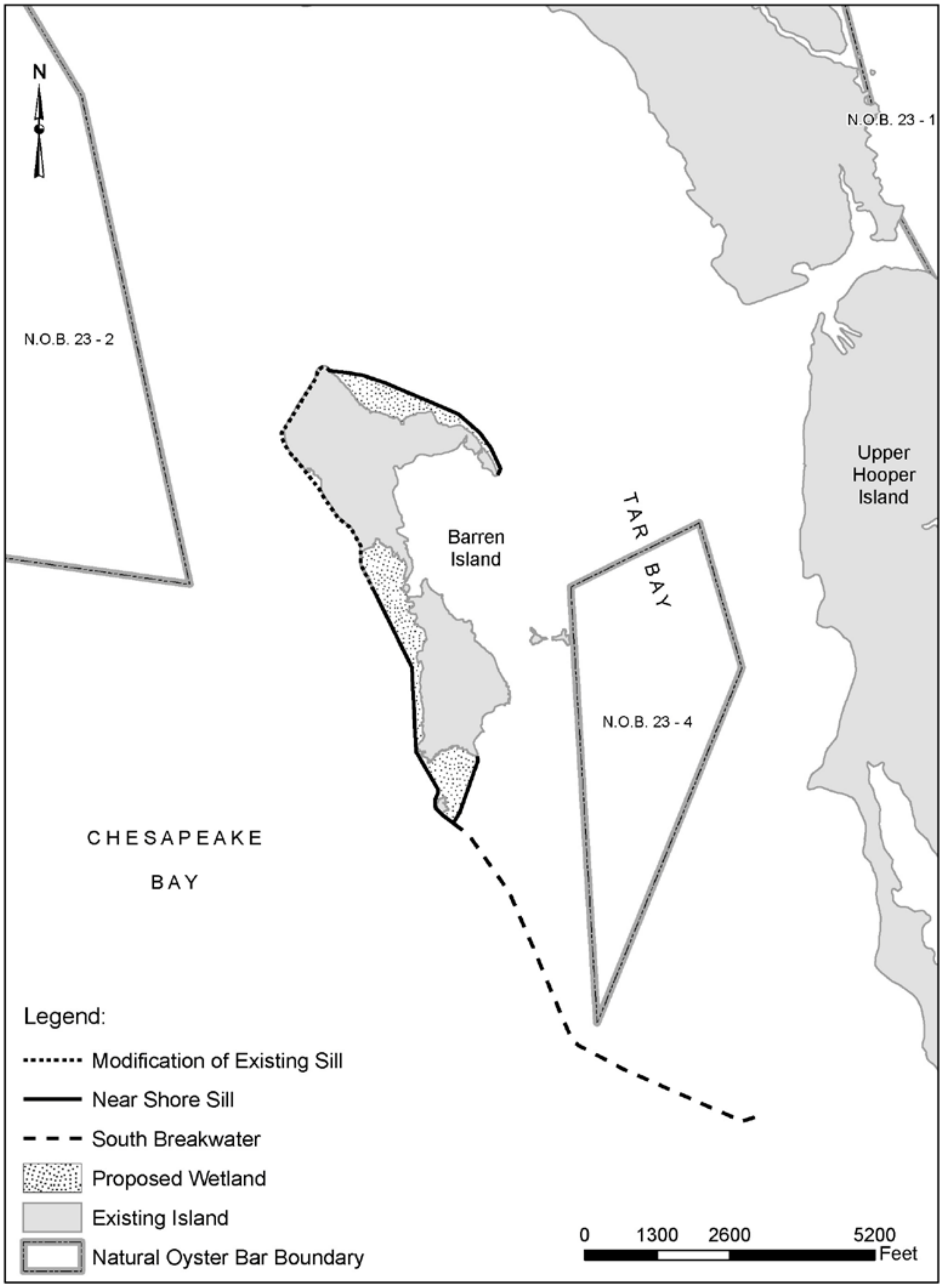
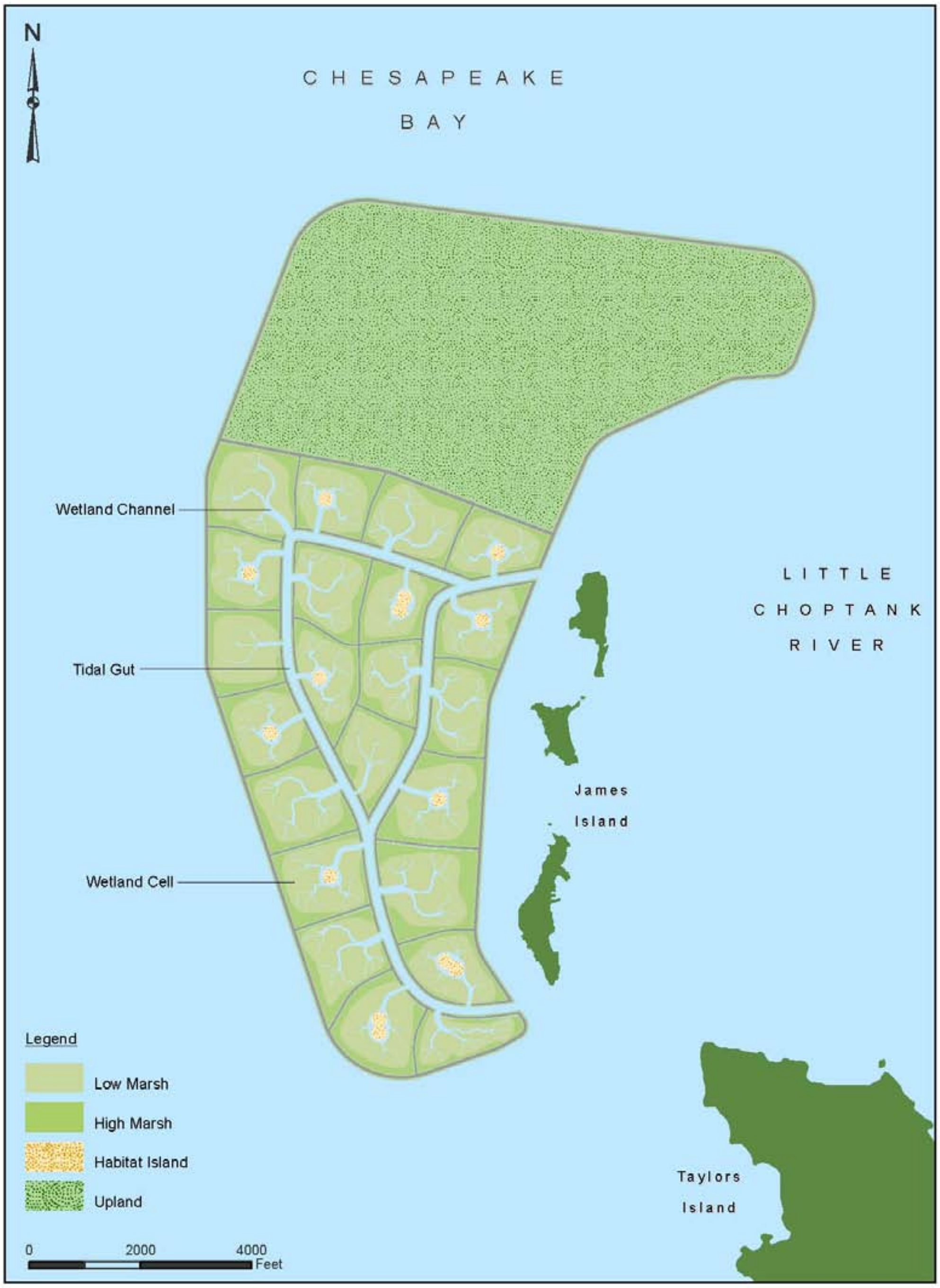


Figure 5-4: Wetlands Concept Plan for Recommended Plan at James Island



SECTION 5

TABLES

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Table 5-1: Components of Recommended Plan

		dike height (ft)	existing habitat to be protected (ac)[1]				habitat to be constructed (ac)[2]			Potential SAV acreage[5]
			wetlands	uplands	intertidal	beach	wetlands[3]	uplands	intertidal[4]	
Barren Island E + James Island 5, 45/55	Barren I	4	84.2	77.9	17.3	8.6	60	0	5	up to 1025[6]
	Barren II	max of 6	0	0	0	0	0	0	0	up to 300[6]
	James	20	17.4	53.5	8.4	0	930	853	113	up to 22.6
Total			**101.6**	**131.4**	**25.7**	**8.6**	**990**	**853**	**118**	**up to 1347.6**

[1] Acreage protected as of 2005. These values will decrease each year until containment dikes are constructed.

[2] These acreages do not include dike acreage (only cell placement area).

[3] 80% low marsh to 20% high marsh will be targeted.

[4] 'Intertidal' includes mudflats, beach, and other intertidal habitats. Distribution will be determined by adaptive management.

[5] This is the range of SAV acreage reported by VIMS from 1994-2003

[6] It has not been determined which SAV beds in the Barren Island vicinity are protected by the island and which are protected by the submerged sandbar remaining from the eroded island that extends south from the existing island. A goal of the Phase I modeling/monitoring will be to provide this information. At this time, these values are estimates based on the leeward SAV beds mapped by VIMS since 1994.

Table 5-2: Design requirements Necessary to Obtain Full Environmental Benefits

Upland:

1. Immature (newly constructed) uplands- the sparsely vegetated to open sand, soil, or shell is considered colonial nesting waterbird habitat. There will need to be intense predator control. Once vegetation is established uplands will no longer be used for colonial nesting waterbird habitat.
2. Include freshwater ponds to provide benefits to colonial nesting wading birds and waterfowl and herpetofauna.
3. Maximize forested edge adjacent to high marsh to provide benefits to waterfowl.
4. Where heronries are planned there needs to be >250 m (820 ft) buffer.
5. Forested edge adjacent to water should be >5000 feet to benefit raptors.

High Marsh:

1. Include intertidal ponds for colonial nesting wading birds, waterbirds, shorebirds, waterfowl, and herpetofauna.
2. Include acreage adjacent to uplands for waterfowl.
3. Incorporate hummocks for waterfowl.
4. Include channels to enhance habitat for waterfowl and herpetofauna, provide access for aquatic life, and foodweb support to Chesapeake Bay waters.

Low Marsh:

1. Bayside edge should slope upward from sand beach to provide benefits for colonial nesting wading birds and waterbirds, and waterfowl.

2. Low marsh needs to be cut with channels to benefit all communities with exception of raptors. Channels on eastern side will specifically benefit herpetofauna. Channels should not be constructed deeper than existing water depths prior to construction to prevent channels from sloping down from the tidal opening. A sufficient number of channels need to be included in design to allow adequate water circulation and tidal exchange with wetlands.

3. Include intertidal and tidal pools to benefit colonial nesting waterbirds, wading birds, waterfowl, and shorebirds.

Intertidal/Unvegetated mudflat:

1. Include channels to provide benefits to herpetofauna, resident/forage fish and commercial/predatory/higher trophic fish
2. Include sandy beaches to benefit colonial nesting wading birds, waterbirds, shorebirds, and herpetofauna.

3. Sand beaches cut with channels provide benefit to resident/forage fish and commercial/predatory/higher trophic fish.
4. Intertidal mudflats adjacent to channel provide benefits to herpetofauna.
5. Mudflats are below mean water and therefore need to be regularly inundated to prevent establishment of vegetation and to ensure their longterm viability as unvegetated mudflats.
6. Include at least one large (maximum benefit= >7.4 ac for waterfowl, >25 ac for wading birds, >100 ac for waterbirds, >200 ac for shorebirds) expanse of intertidal mudflats as foraging habitat).
7. Intertidal acreage needs to be 30-100 ft wide to provide maximum benefit to waterfowl.

Bird Islands:

1. Vegetation and predator control is needed to maintain the bird islands for colonial waterbird nesting habitat.
2. Isolated upland islands should be 2.5 to 5 ac and should have woody vegetation for wading birds, but shell/sand substrate for waterbirds.

Table 5-3. Ecosystem Benefits for Risk Scenarios of Recommended Plan				
Scenario	**Total Cumulative Benefit (ICUs)**	**Annual Average Cumulative (ICUs/yr)**	**Total NET Benefit (ICUs)**	**Annual Average Net (ICUs/yr)**
Loss of all SAV	28,784	576	10,209	204
Sea level rise- ratio of low to high marsh = 20/80	33,207	664	14,632	293
Sea level rise- ratio of low to high marsh = 50/50	34,990	700	16,415	328
Wetland failure due to severe storm	37,792	756	19,217	384
Wetland dikes remain throughout project life	39,675	794	21,100	422
Wetlands construction over borrow areas	39,709	794	21,134	423
Wetlands experience higher than normal biomass in first 2 years, and then die-off	40,372	807	21,797	436
Loss of all colonial nesting waterbird nesting	40,585	812	22,010	440
Additional wetlands consolidation	40,605	812	22,030	441
Recommended Plan- 2072 ac James Island with protection of Barren Island- 45% uplands/55% wetlands	*40,649*	*813*	*22,074*	*441*
Wetland dikes able to be removed early	41,394	828	22,819	456
Provide optimal intertidal acreage	42,512	850	23,937	479
Recovery of SAV to maximum in current records	55,458	1,109	36,883	738

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6 *IMPACTS TO PROJECT AREA

The NEPA process requires extensive evaluation of potential impacts from the proposed alternatives at James and Barren Islands discussed in Section 4 (Table 4-34). The proposed alternatives evaluated are: (1) Barren Island Alignment A with 45% upland/ 55% wetland (Barren A); (2) a combined James Island Alignment 5 and Barren Island Alignment D with 40% upland/ 60% wetland (5D); (3) implementing James Island Alignment 5 and Barren Island E (5E) with 45% upland/ 55% wetland, and (4) implementing no projects (no action). A habitat distribution for each of these alternatives is provided in Table 6.1.

As all the alternatives include island construction features, there are many similar impacts shared by each alternative and overall, the impacts do not vary greatly between alternatives. However, the extent of the impacts would differ based on the proposed size of the restored island. Moreover, the impacts would vary depending on whether the restored island is proposed for construction at James or Barren Island.

Impacts of the no action alternative generally include continued erosion of James Island and Barren Island, and possibly the Eastern Shore mainland that is now shielded by the current islands. Aquatic and terrestrial habitats that occur on these islands and in associated protected waters would be lost, and turbidity generated by erosion would reduce water clarity.

Impacts of the Barren A, James 5/ Barren E, and James 5/ Barren D alternatives generally concern protecting existing terrestrial resources on James Island and Barren Island through erosion control, and the burial or displacement of aquatic resources by converting shallow water habitats to wetland or upland habitats. The restoration components of the Barren A (1,354 ac), James 5/Barren E (2,144 ac), and James 5/ Barren D (2,682 ac) alternatives vary in size, and the degree of the resulting impacts, including the benefits earned from island protection, would often be directly related to the scale of the projects.

Section 4 provides the final analysis of the proposed alternatives, and formulates a recommended plan. Construction methods are described in Section 5.4. Table 6-2 presents a summary of the impacts of the four alternatives recommended for further evaluation, one of which is the "no action" alternative. The text of this section focuses on the analysis of the impacts of the recommended plan, as described in Section 5, to restore island habitat at James and Barren Islands through the beneficial use of dredged material, as well as provide protection to existing island ecosystem components at both islands. Resources in the project area were identified previously in Section 3 (Existing Conditions).

The effects/impacts described in this section include direct, indirect, and cumulative effects/impacts on resources in the vicinity of the proposed restoration sites. Direct effects are determined for both short-term and long-terms. Short-term impacts are impacts that occur during construction or dredged material placement activities, and then subside and return to normal shortly after construction or placement ends. Long-term impacts are defined as impacts that remain and do not diminish after construction or placement ceases. Indirect effects are those impacts that may be caused by the recommended plan, but are later in time or a further distance. Cumulative impacts are those combined effects on quality of the human environment that result from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions, regardless of what Federal or non-Federal agency or person undertakes such other actions [40 CFR 1508.7, 1508.25(a), and 1508.25(c)]. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time or taking place within a defined area or region. It is the combination of these effects, and any resulting environmental degradation, that should be the focus of cumulative impact analysis. The defined general area of impact is along the Chesapeake Bay's Eastern Shore between Eastern Bay and the Hoopers Island chain (USACE, 2004a).

The impacts discussed in this section were determined by utilizing information from technical reports regarding the existing conditions and natural resources in the project area, through modeling and evaluation of potential changes given the design of the recommended plan, and through comparison of the recommended plan to a similar island habitat restoration project at Poplar Island as discussed in the Poplar Island, MD Environmental Restoration Project Integrated Feasibility Report and Environmental Impact Statement (USACE, 1996) and the Final General Reevaluation Report and Supplemental Environmental Impact Statement for the Poplar Island Environmental Restoration Project, Chesapeake Bay, Talbot County, MD (USACE, 2005). The existing conditions and natural resource technical reports are cited as necessary, and the executive summaries from them are attached in Appendix I.

6.1 ENVIRONMENTAL EFFECTS

6.1.1 Setting

Implementation of the proposed projects is expected to beneficially impact the general setting around James and Barren Island. Erosion has reduced James from approximately 1,350 ac in the 1680s to less than 100 ac in 1994 for all three remnants (Leatherman et al., 1995; MES et al., 2002). The estimate of historical acreage at Barren Island ranges from 700 to 839 ac. That is, Barren Island has lost approximately 520 to 660 ac in the last 325 years. Comparisons of historical shorelines suggest that the long-term erosion rates for the western shorelines of James Island and Barren Island could be as high as 13 ft per year and 14 ft per year, respectively. This suggests that, based on the average width of each island, James Island could be substantially eroded in 26 years, while Barren Island could be substantially eroded in 69 years. Over the long term, this project would restore 2,072 ac of James Island to the west of the existing island. The stone sill/breakwater along the western and northern shorelines of Barren would protect the existing Barren shoreline, provide protection to the SAV areas on the east side of the island, and restore wetlands using dredged material from local Federal channels where possible.

The James Island component of the recommended plan would create additional uplands and wetlands bordering the existing island remnants. The James Island component would consist of 2,072 ac comprised of 55% wetland and 45% upland habitat. Restoring James Island would result in the permanent transformation of 2,072 acres of open water to island habitat. As described in Section 5, habitat would be restored within cells separated by dikes to create 1,043 ac of wetlands and 853 ac of uplands. Side slopes of the separator dikes between cells complete the 1,140 ac designated to wetlands and 932 ac apportioned to uplands. A tidal gut and channels would be constructed through the wetlands area to allow for tidal flushing. The final elevation of the upland cells would be plus 20 feet above MLLW. Over time, the island would evolve to support a variety of habitat types, resembling the existing island remnants.

The Barren Island component of the recommended plan would restore wetlands adjacent to the existing Barren Island. The project at Barren would consist of modification and construction of approximately 13,360 feet of sill along the northern and western shores of the existing island. The sills constructed along the current shoreline would be backfilled with dredged material to create wetland habitat resulting in a 1,300 foot containment area. Approximately 72 ac of habitat would be created by backfilling on the northern and western portions of the island. Sills would be built to an elevation of plus 4 feet MLLW. Additionally, monitoring would be carried out to evaluate the need for constructing breakwaters off the southern tip of Barren Island, following the historic shoreline in order to protect the SAV habitat to the south and southeast of Barren Island. If it is determined that the SAV habitat to the south and southeast require further protection, a maximum of 8,200 feet of structure is proposed at a maximum height of plus 6 feet MLLW. If built to maximum length, the southern breakwater would have a 9.5 ac footprint. In total, preliminary designs identify that Barren Island restoration measures would directly impact 92 acres of near-shore habitat (72 ac consumed for wetland restoration and 20 ac consumed by breakwater and sill construction). Therefore, it is projected that with refinement during final design no more than 100 acres of bottom would be impacted at Barren Island.

6.1.2 Physiography, Geology, Soils, and Groundwater

The proposed project is not expected to affect physiography, geology, and groundwater. The proposed actions at James and Barren Island would protect the remnants and their soil resources from further erosion. A letter received from the Dorchester Soil Conservation District on 27 June 2005, stated that no adverse impacts are expected on the prime farmland soils remaining on James and Barren Islands.

Construction of the project would have significant and long-term impacts in the project vicinity. Exposed sediments on the surface would evolve into upland or wetland soils and would eventually differ in composition from sediments placed below the final elevation. The primary borrow area for dike construction at James Island would be located within the northern portion of the alignment where the uplands would be created. Approximately 14.5 million cubic yards (mcy) of borrow sand would be excavated from the uplands footprint and 1.48 mcy of borrow sand would be dredged from the access channel on the northwestern side of the alignment. The combined amount is about 1.86 times the quantity of sand needed for dike construction and is considered marginally sufficient. It is preferable for the borrow source to contain approximately two times the dike volume to account for material that is unsuitable and cannot be used. Therefore, by dredging through a 2 to 5 foot silt and clay layer in the upland area, an additional 2.5 to 3.5 mcy of borrow sand would be made available. Currently, no borrow material is expected to be required for use at the Barren Island site.

Armor stone/crushed stone needed to protect the slopes of the exposed dike sections at James Island and in the breakwater structure of Barren Island would originate from off-site locations. Quarry run stone would be required for the core of the rock toe dike.

6.1.3 Hydrology and Hydrodynamics

Two levels of hydrodynamics and sedimentation modeling were completed. The first analysis was based on initial alignments proposed in 2002. As part of the plan formulation process, modeling was performed on modifications to these original alignments to focus on the James 5 and Barren E alignments in order to further evaluate impacts. Different configurations and widths for the primary tidal gut through the wetland were modeled at James Island. Various options including breakwater height and spacing were modeled for the Barren breakwaters to aid with their design. Water levels, current velocity and sedimentation were evaluated at key locations selected to identify conditions that might alter water quality and be a concern to environmental resources such as oyster beds and SAV. Figures 6-1 and 6-2 identify these key locations at James Island and Barren Island, respectively. For the locations selected for James Island, points 1 and 12 are located in the local navigation channel. Points 5 and 8 represent the tidal gut entrance locations. Points 7 and 9 are located in the tidal gut channel. Points 2 and 3 are located in the neighboring oyster bed ground. Point 4 is located in the SAV area. For Barren Island, points 2 to 8, and 10 are located in the SAV area, and points 9, 11, and 13 are located in the oyster beds. Points 14 and 15 are located in the north island cut (northward-most tidal gut). Points 16 and 17 are located in the up-wave side and lee side, respectively, of the south breakwater, Point 1 is located in the south local channel, and point 12 is located in the Honga River Channel at the Tar Bay entrance.

6.1.3.a Hydrodynamics

The affect of the 'best buy' alignments on currents and water levels was investigated for both normal tide and storm conditions. Changes to current velocities and water levels were the prime focus of hydrodynamic modeling. Modeling suggests that the proposed restoration at James and Barren Island would have minimal impacts on local astronomical tidal elevations. However, at James Island, the portions of the project footprint that would be converted to upland would permanently have a complete cessation of tides and currents.

Under normal tide conditions, the current velocity for the proposed alignments at James and Barren Islands is similar to the existing conditions, with a maximum speed of 2.1 ft/sec at the southeast corner of the James 5 alignment (Point 13) and 2 ft/sec at the north island cut of the proposed Barren alignment (Point 15). Tables 6-3 and 6-4 provide the calculated maximum normal current speeds at all modeled points at James and Barren Islands for normal tide conditions. Following construction (long-term impacts) at James Island, normal current velocities would be impacted with an estimated maximum increase of 1.0 ft/sec or decrease of 1.2 ft/sec. The stronger current at the southeast corner of the James alignment occurs because of the sharp turning angle of the current between the south tidal gut outlet and open bay. Current velocities are typically decreased in the waters adjacent to James Island is all areas except the southeast corner. Following construction (long-term impacts) at Barren Island, normal current velocities would be impacted with an estimated maximum increase of 0.1 ft/sec or decrease of 0.5 ft/sec. The stronger current at the north island cut of the Barren alignment occurs because of the increase in water surface gradient during high tide at the narrow cut and is the only area that is likely to experience an increase in current speed.

Modeling also simulated conditions under two hurricanes (Hazel and Isabel) and two northeasters (NE20 and NE33). For the simulated storms, the calculated maximum current velocity has a much greater magnitude for the hurricanes as compared to the northeasters and the normal tide condition for the alternative configurations. Maximum current velocities generally were produced during Hurricane Hazel, followed closely by Hurricane Isabel, and then NE20 and NE33. The maximum wave heights were produced during Hurricane Isabel, followed closely by Hurricane Hazel, and then NE20 and NE33.

Similar to the existing conditions, it can be expected that a high maximum current velocity would occur during strong hurricanes because the peak storm surge would partially or completely submerge the existing James Island. For the hurricanes, the current velocity was stronger at the tidal gut south channel (Point 7) than at the north channel (Point 9). The southeastern corner of the island alternative would still experience a strong current because of the sharp turning angle of the flow between the south tidal gut outlet and open bay. For the northeasters, the current velocity was stronger at the tidal gut north channel (Point 9) than the south channel (Point 7). The current velocity also became stronger in the local channel (Points 1 and 12) because of the narrower water exchange area between James and Taylors Islands for the local channel.

For the Barren Island alternative, the maximum current velocity is similar to existing conditions. The calculated maximum current is expected to be high during strong hurricanes because the existing island and constructed alternative would be either partially or completely submerged under the peak storm surge. Reducing the height of the south breakwater from 6 feet to 4 feet produces stronger current flows (Points 16 and 17) as does a segmented breakwater versus a continuous breakwater. A high (6 feet) breakwater significantly reduces current magnitude at Points 16 and 17, especially in a northeaster storm. The current can become strong at the tip of the south breakwater (Point 1) during a northeaster because of the sharp turning of the current flow.

6.1.3.b Waves

In order to evaluate shoreline impacts, wave height differences between the proposed alternatives, existing condition, and future without project condition (assuming the island completely erodes) for the maximum incident wave height for each of the four incident wave directions (northeast, south, west, and northwest) were modeled. Details of the wave height analysis are provided in Attachment O of Appendix C. The maximum differences in wave heights at James Island occur in the lee of the island (relative to the wave direction) and are typically 1 to 2 feet. James Island is relatively far from the shore, so the impact of the proposed island alternative on the shoreline is relatively small. The island reduces the maximum wave height near the shore by as much as 2 feet. No increases in wave height along the shoreline are expected from the proposed alternative. The future without-project condition increases the wave height at the shoreline slightly. Figures 6-3 through 6-10 present the resulting differences in wave height at James Island between the existing and proposed project conditions and between the existing and future-without project conditions.

Modeled wave height differences in the Barren Island vicinity are more substantial than those at James Island. As expected, the maximum differences occur in the lee of the south breakwater.

Barren Island is relatively close to shore compared to James Island, so the impact of the proposed island alternative on the shoreline is greater. The alternatives reduce the maximum wave height near the shore by up to 4 feet. Shortening the southern breakwater or the implementation of a segmented breakwater provides approximately 0.5 feet less reduction. Further, shortening of the breakwater reduces the region over which wave heights would be reduced. No increases in wave height along the shoreline occurred due to implementation of the alternatives. Future without-project wave heights near the shoreline are expected to be significantly different than the existing condition. An increase of up to 3 feet could be expected if Barren Island is completely eroded away. Figures 6-11 through 6-16 present the resulting differences in wave height at James Island between the existing and proposed project conditions and between the existing and future-without project conditions.

6.1.3.c Sedimentation

Two rounds of sediment transport analyses were made during the course of this feasibility study. The first investigation modeled sediment transport for both 0.10 mm non-cohesive sediments (very fine sand) and cohesive sediments under normal tide conditions for wind speeds of 0, 4, 13, and 16 mph and various wind directions.

The second analysis focused on the proposed James alignment (5) and Barren alignment (E). A sediment model was applied to predict the pattern of accretion and erosion in the study area during both normal tide conditions and extreme storms events (two hurricanes and two northeasters). A detailed description of the sediment modeling methodology and results is available in Appendix C, Attachment). Results from the sediment transport simulations are evaluated at the same location as in the current velocity comparison, shown in Figures 6-1 and 6-2. The evaluation of results is presented only for the storms because the calculated bottom elevation change was negligibly small under the normal tide condition as compared to the storms. In the case of the normal tide, locally generated wind waves are small and, therefore, sediment movement is insignificant under the weak tidal current.

The sediment transport simulation shows that the bottom elevation change is greater for hurricanes as compared to northeasters. Bottom erosion would take place in areas with strong currents and gradients in the current, whereas sediment shoaling occurs where the current is diminished. Under Hurricane Hazel conditions, erosion appears on the surface and along the perimeter of James Island and Barren Island as a result of inundation of these two islands during the peak surge condition under no project conditions.

6.1.3.c.1 James Island

It is anticipated that long-term impacts from the restoration at James Island would have beneficial effects on sedimentation rates and patterns, with less erosion of the James Island shoreline and the shallow areas surrounding the remnants of James Islands. Some protection would also be afforded to the shoreline of Taylors Island from wind and waves. This reduction in erosion would likely cause reduced suspended sediment and improved water clarity.

The results of the initial modeling of non-cohesive and cohesive sediments for normal tide conditions at James Island show that most of the sediment transport is caused by winds from the

NNW, SSE, and WNW with a minimum wind speed of 16-mph for cohesive sediments and 13 mph for non-cohesive sediments.

For James Island alignment 5, the modeling of storm conditions shows the greatest bed erosion occurred at the southeast corner of the alternative island (Point 13) as a result of the strong current (and gradient) and at the southern end of the existing island (Point 14). There was sediment accretion and erosion along the east and south sides of the alternative island (Points 6 and 10). Mild sediment shoaling also occurred in the access channel (Point 11). Bed erosion of as much as 10 to 20 cm was calculated to occur in the local channel (Points 1 and 12) for all alternatives in a hurricane because of the increased gradients in current velocity. Accretion of 20 to 60 cm was calculated to occur at the tidal gut south entrance (Point 5) under a hurricane as a result of scour of the tidal gut channel and erosion at the south end of the existing island, as well as erosion at the southeast corner of the island alternative.

Sediment accretion and erosion appear to be more significant along the bay side levee of the James alignment 5 under the strong hurricane (Hazel) than the northeaster (NE20). The pattern of accretion and erosion reverses on the north and south sides of the access channel for the hurricane (Hazel) and northeaster (NE20) indicating opposite sand transport directions across the access channel during these two storms.

Sediment transport from the modeled hurricanes and northeasters is not anticipated to negatively impact SAV beds or NOBs. Modeling results show minimal reductions in sediment accretion over these areas, but no erosion or accumulation.

6.1.3.c.2 Barren Island

It is anticipated that long-term impacts from the proposed project at Barren Island would cause the NOBs to the northwest and southwest and the nursery area north of Barren Island to experience almost no change in sedimentation rates and patterns because of the limited sheltered areas created by the proposed project. The long north-south profile of the proposed project would provide additional protection to Barren Island, Meekins Neck, and Upper Hoopers Island from erosion.

The results of the modeling of non-cohesive and cohesive sediments for normal tide conditions at Barren Island show that most of the sediment transport is caused by winds from the NNW, SSE and W with a minimum wind speed of 16 mph for non-cohesive sediments and 13 mph for cohesive sediments.

For the existing conditions, the modeling of storm conditions shows the highest sediment shoaling appeared at the north island tidal channel cut (Points 14 and 15) as a result of sediment being eroded from the existing island and carried by the current to the channel. The shoaling at the north island tidal channel cut is reduced with the alternative breakwater configurations. Regardless of the configuration of the southern breakwater, sediment accretion and erosion are expected to be more prevalent in the vicinity of the structure due to stronger wave-current and wave-structure interactions. Bed erosion is also significant at the southern end of the breakwater, where a strong surrounding current is generated at the flow spits to the east of the island.

For the existing conditions, the Honga River Tar Bay entrance (Point 12), between Taylors Island and Upper Hoopers Island, has the strongest current velocity, approximately 3.3 ft/sec, under the modeled storm conditions. As a result, sediment transport simulations show erosion of 10 to 50 cm in Honga River Tar Bay entrance during severe storms. Under existing conditions, the material eroded from the Tar Bay entrance is carried and deposited in portions of the channel and adjacent areas with lower current velocities. The proposed project options are expected to result in slightly less erosion in the Honga River Tar Bay entrance channel and a corresponding reduction in sedimentation along other portions of the Honga River Channel and adjacent areas. This trend is opposite to the future without-project condition, where the erosion occurs at the Tar Bay entrance of the Honga River Channel and along the bayside shoreline because Barren Island does not exist to provide the protection to Taylors Island and the Upper Hoopers Island.

The proposed project is not anticipated to greatly affect the rates of erosion and accretion over areas that support SAV or NOB beds in the vicinity. Modeling results propose no change or minimal reductions in sediment accretion over these areas (Points 3, 5, 9, 11, and 13 for hurricanes and northeasters; Points 6 and 7 for northeasters only), but no erosion or accumulation. A small increase in sediment accretion (0.1 cm) is projected for some breakwater configurations at Points 6 and 7 during hurricanes.

6.1.4 Water Quality

A water quality certification will be obtained from MDE prior to the start of construction, as required by Section 401 (c) of the Clean Water Act. Water quality monitoring will occur prior to construction to establish baseline conditions, as well as throughout dike construction, and during the inflow of dredged material in compliance with the State of Maryland water quality certificate. It is expected that construction of the recommended plan at James and Barren Islands would result in short term water quality impacts. As described in Section 5.0, construction at James Island would consist of dike and access channel construction, as well as dredged material placement to construct the restored wetland and upland habitat. Construction at Barren Island would consist of a stone sill/breakwater with backfilling of wetland cells with dredged material. Water quality impacts resulting from the proposed action would primarily result from access channel dredging at James Island and dike and sill/breakwater construction. The stone and gravel used to construct the dike would be imported from off-site. The sand and other sediments used for dike construction at James Island would originate from borrow areas either within the island or access channel footprint. No borrow material is expected to be required for construction of the Barren Island restoration/protection project.

Elevated turbidity is expected to be the primary short term water quality impact during construction of the proposed project. Turbidity is likely to increase as a result from re-suspending sediments in the water column during dredging the access channel, collecting borrow material, and constructing dikes at James Island. At Barren Island, turbidity is likely to increase during the construction of the sill/breakwater. Suspended sediments in the water can block light penetration to the bottom, affecting SAV growth. Suspended sediments also have potential to cover sensitive habitats, such as oyster bars or SAV beds when they settle out of the water column. Studies performed for similar dike construction techniques at the PIERP indicated that sediments would drop out of the water column within four hours of re-suspension. The tests conducted for the PIERP EIS also indicated that the turbidity plume would originate from the point of dike construction activities, would be long and thin, and shaped by the dominant north to south movement of the tides. Therefore, during tidal movement, the plume would be expected to measure approximately 5,000 ft long (north to south) by 500 feet wide (east to west). During slack tides, the plume would be expected to measure approximately 500 ft long by 1,000 feet wide (USACE, 1996).

As discussed in Section 3.1.6.f.2 of this document, there are NOBs near both James Island and Barren Island within the potential turbidity plume range. NOB 14-5, Hills Point, is located within 5,000 feet to the north of James Island. NOB 23-2 and 23-4 are located within 5,000 feet to the north and south, respectively of Barren Island (MPA, 2003i). Tidal currents would cause a turbidity plume to be mobile, and it is expected that only areas very close to the specific dike or breakwater construction location would be subjected to heightened turbidity for long amounts of time. Specific impacts of sedimentation to NOBs are discussed in Sections 6.1.3 and 6.1.6.e.

DO levels can be impacted in areas of the constructed access channel. Parts of the northwestern access channel at James Island that are dredged to depths of 25 feet or greater have the potential to become hypoxic or anoxic in warmer months of years when impaired water quality problems are pervasive below the pycnocline in the Chesapeake Bay. An access channel at Barren Island would not be necessary; therefore, the DO levels should not be impacted.

Dike construction has the potential to release nutrients into the water column if construction disturbs sediments associated with high concentrations of nutrients. Higher nitrogen concentrations are typically associated with smaller grain size sediments such as silt and clay, as the decomposing organic matter that releases the nitrogen compounds does not tend to be present in sandy sediments. Sediment sampling indicates that the proposed project areas at James Island and Barren Island primarily consist of sand (MPA, 2004b; MPA, 2003e). Due to the grain size of the sediments in the project areas at James Island and Barren Island, the release of measurable amounts of nutrients into the water column is expected to be minimal. If any nutrient releases occur, the distribution of areas with elevated concentrations would likely be similar to the distribution of elevated suspended sediment.

Water quality impacts from toxic substances are not expected from dike or access channel construction. The sediments to be used are relatively clean local sediments that are primarily original substrate from the remnant islands, and the environmental surveys documented no sources of toxic substances associated with James Island or Barren Island (MPA, 2004b; MPA, 2003e). No other water quality impacts are expected from construction of the dikes or access channel.

Dredging operations and construction operations are not expected to result in the release of any measurable amounts of contaminants into the water column. Dredged materials that are placed in containment cells at the James Island Project site at elevations above mean high water would be exposed to the atmosphere and weathering. Exposure of sulfitic marine sediments sets off a chemical reaction that tends to lower sediment/soil pH. This reaction and the exposure to rainfall (which also has a low pH) would cause some naturally occurring metals that are bound to the sediment to dissolve into the water. If present in sufficient concentrations, dissolved metals can be toxic to aquatic organisms, and could constitute a negative impact to the local biota in the immediate vicinity of the discharge of runoff water into the waters surrounding the restored island mass. After high marsh and upland soils have been conditioned, amended, and planted, the potential release of metals would abate and the pH of runoff water would increase. The channels that would provide the material for placement at Barren Island are removed from known point sources. Therefore, anthropogenic contaminant concentrations are likely to be consistent with background levels in the Chesapeake Bay sediments.

After construction of the dikes and access channel is completed, minimal water quality impacts are expected from removing water from within the dredged material cells at James Island. Initially, the water would consist of trapped Chesapeake Bay water and rainwater. Once dredged material placement for construction of the restored wetlands and uplands begins, the water would consist of a mixture of water transported with the arriving dredged material and local water used for pumping the dredged material into the cells. The interior cells would be designed to allow settlement of sediments out of the inflow water, and then the water would be returned to the Chesapeake Bay through weirs. Only clean dredged material is planned to be used for the habitat restoration project. Due to the clean nature of the material, significant water quality impacts are not expected to result from the material placement and effluent discharge operations.

The water to be discharged within the James Island project cells may have higher ambient concentrations of nutrients compared to local waters. Dredged material placement would typically not occur during the summer, which is used for de-watering the material. Water discharged from the habitat restoration project would be closely monitored. It is expected that a water quality certification would require water discharged from the James Island habitat restoration project to be within limits for nutrients, suspended solids, toxics, and metals (MPA, 2004h; MPA, 2005a).

Local dredged material placement at Barren Island would occur over an unspecified number of years, and should be considerably more infrequent than placement at the James Island project. When dredged material placement at Barren Island does occur, the water quality impacts associated with placement would be similar but not as significant to the impacts of the James Island project construction, due to the fact that less material is being placed there and would occur for a shorter period of time.

Beneficial long-term water quality impacts from the completed restoration project at James Island are expected to result from shoreline restoration/protection and wetland restoration. The project is expected to reduce suspended sediments in the area, by reducing erosion of the James Island shoreline and is also expected to provide a minimal amount of erosion protection to the shoreline in the lee of the island. The wetland cells in the restoration project would be opened to tidal flushing once they are completed, and are expected to provide similar ecological services as natural marshes. The wetlands are expected to convert nutrients in the water column to detritus, which would be available to the benthic community and other organisms. Channels within the wetland cells are also expected to support SAV growth, which would increase available DO in the water column. No adverse long-term water quality impacts are expected from construction of the restoration of James Island.

Positive long-term water quality impacts from the completed project at Barren Island are expected to result from restoration/protection of the existing Barren Island remnants and nearby Hoopers Island (MNE, 2004). The project is expected to reduce suspended sediments in the area, by reducing near shore wave heights in the lee of the island by up to 4 feet with an associated reduction in erosion along the shoreline. No adverse long term water quality impacts are expected from construction of the Barren Island restoration/protection project.

The Choptank River has been identified as an impaired water body and TMDLs would be developed for it by others. The pending TMDL requirements for nutrient limits in the Little Choptank River may be a consideration for construction of the restoration project at James Island, and any water quality certification that would be associated with the project. Fecal coliform is not an expected component of the discharge from the environmental restoration project based on the anticipated dredged material to be used.

The Honga River has been identified as an impaired water body and TMDLs would be developed for it by others. The pending TMDL requirements for nutrient and sediment limits in the Honga River may be a consideration for construction of the Barren Island restoration/protection project. Fecal coliform is not an expected component of the effluent discharge from dredged material placement.

6.1.5 Sediment Quality

During project construction at the proposed restoration project at James Island and restoration/protection at Barren Island, material used to create the upland and wetlands habitats would come from only clean sediments and not from potentially contaminated sediments in Baltimore Harbor. Therefore, sediment quality is not expected to be adversely impacted during construction of the projects. There may be a slight increase in fine grain sediments in the immediate areas outside of the outfalls of the proposed James Island restoration project due to the deposition of fine grain sediments contained in the suspended solids portion of the effluent. When a water quality certification is established for the James Island restoration project, it would likely include suspended solids limits. Exposed sediments on the surface would evolve into upland or wetland soils and would eventually differ in composition from sediments placed below the final elevation.

Sediment quality would be periodically monitored by bulk sediment analysis of the channel sediments being placed into the facilities during the life of the proposed restoration at James Island and restoration/protection at Barren Island. The bulk sediment analysis would include contaminants on the Priority Pollutants List and would be compared to other sediments collected elsewhere in the Chesapeake Bay. In addition, there would be periodic monitoring of sediment quality at various locations around the restoration projects to detect any changes in sediment quality. All testing and evaluation would be done in accordance with the Inland Testing Manual, *Evaluation of Dredged Material Proposed for Discharge in Waters of the U.S. – Testing Manual* (USEPA/USACE, 1998) and *Evaluation of Dredged Material Proposed for Disposal at Island, Nearshore, or Upland Confined Disposal Facilities – Testing Manual* (USACE 2003).

The reductions in current velocity as a result of the project shoreline restoration/protection would most likely result in accumulation of fine-grained sediments in the leeward side of the projects. This would result in a change in sediment quality, although most sediment would still be local in nature and are expected to be of good quality.

In the upland cells, the sulfidic marine sediments in the dredged material are exposed to weathering and the atmosphere, which can cause a chemical reaction, known as acid sulfurization, which tends to lower the pH of the sediments. This reaction, and the exposure to low pH precipitation, can cause some metals bound to the sediment to dissolve into the water column. High concentrations of dissolved metals are toxic to estuarine organisms and can adversely impact water and sediment quality when they come out of solution at higher pHs. Adverse impacts should be minimal because according to MDE regulations, pH is a factor considered before water is discharged from a site. Additionally, sediments that are likely to contain high metal content are primarily found within the Baltimore Harbor and are not eligible for placement in the study area.

In addition, during sediment quality data collection the sum of the already low metal concentrations in the channel material was found to be lower than the acid volatile sulfides (AVS) levels. When AVS concentrations are greater than the sum of the metals concentration, metals in the sediment are immobilized, preventing the potential uptake of metals by aquatic organisms (MPA, 2003e and MPA, 2004b). Through absorption and adsorption by soil particles and uptake by vegetation, the salt marsh wetlands proposed for the projects would act as a filter and should decrease the potential release of metals and nutrients from the sediment and should not have an adverse impact either short or long term, on sediment quality.

Restoring and protecting the existing James and Barren Islands would potentially increase the buffering or shadowing effect, providing more protection to the island remnants from erosive wave action. In addition, the shadowing effect may also decrease erosion of the shorelines of the mainland. This may have a long-term, beneficial impact on sediment quality, as well as sediment transport and deposition.

6.1.6 Aquatic Resources

At James Island, construction of the initial dike would include dredging a 12,720-foot long access channel from deep-water northwest of the proposed alignment (Figure 5.1). The channel would be dredged to a width of 400 feet and a depth of 25 feet, and approximately 1.7 mcy of material would be removed. Construction activities would disturb the bottom in the dredged channel, and would cause locally elevated turbidity and possibly nutrients in the surrounding waters during dike material placement, as discussed in Section 6.1.4. Dike construction would permanently bury existing areas of the bottom along the proposed alignment and may affect adjacent areas of the bottom through drift and settling of finer particles.

After initial dike or breakwater construction, dredged material from other channels in the Chesapeake Bay would periodically be placed within the diked area. Short-term localized elevations in turbidity would likely be associated with placement of material due to the operation of tug and barge traffic in the relatively shallow waters surrounding the proposed dike alignment, and in the access channel. The most noteworthy impacts to the aquatic resources of the area would be burial of 2,072 ac of Chesapeake Bay bottom at James Island, including 299 ac of shallow water habitat within the dike. A maximum of 100 ac of shallow water habitat would be impacted at Barren Island resulting from the wetland restoration and protection measures. The impacts of displacing shallow water habitat may be offset by the restoration of intertidal wetland habitat, but do represent a trade-off between open water habitats used by fishery resources, benthic invertebrates, and waterfowl and upland/wetland resources utilized by various avian and fishery species, plus herpetofauna, and benthic invertebrates.

The impact of filling open water at Barren Island (0.18 ICU/ac) was determined to be nearly double that of filling comparable bottom at James Island (0.37 ICU/ac) due to a diverse benthic community at Barren Island that increases the potential impact to both benthic invertebrates and fisheries resources. At James Island, open water impacts are greatest to the waterfowl community and would result in a permanent loss of foraging habitat. The gem clam and dwarf surf clam densities identified in seasonal monitoring at James Island suggest that there are abundant foraging resources for wintering waterfowl in the area that would be filled by construction of any of the James Island alternatives. Due to the limited sampling (3 points within the proposed alignment footprint) it is unclear if the high densities measured during sampling are representative of the entire footprint or are representative of 'hotspots' of high densities. Gem clams characteristically have a patchy density within sand substrates. Similar bivalve resources were not identified in the Barren Island vicinity. There is minimal impact to fisheries resources at James Island because there are not diverse benthic or planktonic communities, nor cover and structure in the form of SAV and oyster bars. Overall, the most significant impact of filling the open water column west of James Island is likely the loss of waterfowl foraging habitat. Although open water is not limited in the Mid-Bay region, foraging habitat for migrant waterfowl has not been fully delineated and may becoming a limited resource.

6.1.6.a Submerged Aquatic Vegetation

SAV was not found on the western side of James Island and therefore would not be impacted by construction of the preferred alignment. SAV is present however on the eastern side of James Island. Tier I, II, and III acreage (as defined by the Chesapeake Bay Program) surrounds all James Island remnants. It is estimated that 298.8 ac of bottom less than 2 m in depth (Tier II and III restoration targets are defined by the Chesapeake Bay Program as shallow water areas delineated as existing or potential SAV habitat, down to the 1- (Tier II) and 2-meter (Tier III) depth contour, respectively.) exist within the project footprint at James Island and it is expected that this area would be permanently lost as potential SAV habitat by island construction activities. However, there is no record of SAV in these waters since extensive monitoring began in 1994 and it is highly unlikely that any unprotected waters west of the current James Island would support SAV in the near future without a significant change in habitat and water quality. Restoration of James Island is expected to benefit tens to a few hundreds of acres of potential SAV habitat (based on a historical picture from 1952 provided by MDNR).

SAV at Barren Island was found primarily east of the Island between the Island and mainland. Tier I areas have been delineated to the northeast, east, and southeast of Barren Island. Tier II and Tier III zones surround Barren. All of the Barren project area, projected to be no more than 100 ac (preliminary designs identify 72 ac consumed by wetlands restoration and 20 ac consumed by breakwater and sill footprints), is less than 2 m in depth. Consequently, approximately 100 acres of otherwise Tier II/III SAV habitat would permanently be lost as potential SAV habitat by island construction activities if all phases are constructed. Restoration of Barren Island is projected to benefit over a thousand acres of SAV beds in the project area.

The primary degradatives of SAV, aside from pollution, are increased wave energy, higher local current velocities, and decreased water clarity. Without the expansion of the existing James and Barren Islands, erosion can be expected to continue at its current pace, and possibly greater, and the islands would be lost, ultimately eliminating existing SAV in the project areas as well. The mentioned degradatives of SAV are interrelated in that a primary cause of decreased water clarity is higher sediment suspension in the water column, which is in turn produced by increased land erosion and sediment mixing, byproducts of higher wave energy and current velocities.

Reduction of wave height can both directly and indirectly enhance SAV preservation. Directly, the beds and submerged land where the SAV resides would less likely be eroded in a calmer wave climate. SAV would have better opportunity to grow and establish root systems in areas experiencing a calmer wave climate because a greater amount of fine grain sediments are found in these areas. These finer sediments that have not been eroded provide a higher nutrient concentration for growth than a coarse grained bed, an indirect benefit for SAV. Available literature has shown that the tolerable wave height for SAV growth ranges from 0-6.6 ft, with an average of 3.3 ft (USACE-ERDC 2006). Construction of the James Island alignment would reduce wave heights in the lee of the island by 1-2 ft. Construction of the Barren Island alignment would reduce wave heights in the lee of the island by 2-3 ft. Neither of the recommended alternatives (James 5 or Barren E), nor any other alternatives, would increase wave heights near the islands. The future without project conditions, however, would increase wave heights slightly for James Island and by 2-4 feet for Barren Island. Overtopping analysis performed for the proposed breakwaters at Barren Island showed that the design breakwater crest height of +6 ft MLLW would reduce wave heights to the tolerable levels (+3.3 ft) for up to a 50-yr return period event (USACE-ERDC 2006). In addition, modeling shows that the existing conditions wave heights exceed the upper limit of the SAV tolerance for both a hurricane (Hazel) and northeaster (NE20). However, wave heights resulting from the preferred alternatives for the two subject storm events are below the SAV tolerance level of 3.3 ft (USACE-ERDC 2006). The end result is that construction of the alternatives would promote the future preservation of SAV by reducing wave heights in SAV areas.

Tolerable current velocities [1m/sec (3.3 ft/sec)] and wave heights [1m (3.28 ft)] for SAV were investigated through the hydrodynamic modeling exercises for Barren Island. Under normal tide conditions, the current velocities for the recommended alignments at James and Barren Islands are similar to the existing conditions, with a maximum speed of 2.1 ft/s at the southeast corner of the James 5 alignment and 2 ft/s at the north island cut of the preferred Barren E alignment (USACE-ERDC 2006). Following construction of the James 5 alignment, the normal current velocities would experience either an estimated maximum increase of 1.0 ft/s or decrease of 1.2 ft/s. Following construction of the Barren E alignment, the normal current velocities would experience either an estimated maximum increase of 0.1 ft/s or decrease of 0.5 ft/s (USACE-ERDC 2006). All of these velocities are below the tolerance level of 3.3 ft/s. Based on modeling, the maximum current velocities produced at James Island from hurricanes (Hazel) and northeasters (NE20 and NE33) are impacted much greater in magnitude by hurricanes than northeasters. The expected maximum current velocity produced at James Island from a hurricane (Hazel) event was 5.51 ft/s and that from a northeaster (NE20) event was 2.43 ft/s. Likewise, the expected maximum current velocity produced at Barren Island from a hurricane (Hazel) event was 3.9 ft/s and that from a northeaster (NE20) event was 3.31 ft/s (USACE-

ERDC 2006). The velocities produced by a hurricane (Hazel) event exceed the upper limit of the SAV tolerable conditions and those for a northeaster are at the upper limit of the SAV tolerable conditions. Alternative plans and alignments had a negligible impact on current velocity results from a hurricane. Given these results, the recommended alternatives for James and Barren Island are expected to benefit SAV by reducing local current velocities below the accepted tolerance level for SAV growth.

As stated earlier, water clarity is important to SAV growth and can be maximized by decreasing the amount of suspended sediments in the water column. Construction activities for James and Barren Islands would increase suspended sediment concentrations throughout the water column during construction. However, no direct impacts to SAV are expected from the construction of the western breakwater/sill at Barren Island. The northern breakwater/sill plans would be adjusted to minimize and if possible avoid direct SAV impacts. Additionally, restoration efforts on the south end of Barren are not expected to impact SAV resources. There are beneficial impacts to construction of shoreline restoration/protection at Barren Island, as the wave protection shadow created by the reconstruction of the island may promote additional SAV growth in the quiescent conditions created in the lee of the island. A similar situation has been observed at Poplar Island. Additionally, construction restrictions established by MDNR would be followed to minimize any potential impacts. Per these restrictions, no activity is permitted within 500 yards of SAV beds between April 15 and October 15.

Sediment transport from the modeled hurricanes and northeasters is not anticipated to negatively impact SAV beds of James or Barren Island. Modeling results display minimal reductions in sediment accretion over the James Island SAV beds areas, but no erosion or accumulation. Modeling results propose no change or minimal reductions in sediment accretion over Barren Island SAV beds (Points 3 and 5 for hurricanes and northeasters; Points 6 and 7 for northeasters only), but no erosion or accumulation. A small increase in sediment accretion (0.1 cm) is projected for the breakwater configuration at Points 6 and 7 during hurricanes. Because these results show so little change in sediment erosion and accretion in the face of modeled hurricanes and storms, it can be stated that once constructed, the expanded James and Barrier Islands are not expected to have a negative impact on water clarity. Thus, SAV resources in the project areas are not expected to be negatively impacted by decreased water clarity from increased suspended sediment in surrounding water.

6.1.6.b Phytoplankton and Zooplankton

In the short term, the turbidity associated with dredging and dredged material placement is likely to suppress light penetration into the water column and could locally depress the phytoplankton community. Significant increases in nutrient concentrations, such as ammonia, due to dredging activities are not expected, except in the immediate area of the discharge. These localized increases could tend to elevate phytoplankton concentrations, but this is not expected to be significant because of the small amounts of nutrients released. Since the projects are in exposed areas, tidal currents and wave action are expected to lessen localized effects on the phytoplankton through exchange with nearby waters. Phytoplankton and zooplankton would be entrained in sediment slurry at the borrow sites during construction; however, the majority of the plankton occurring at the site would be comparable to plankton that is widely dispersed and abundant over a broad region of the Chesapeake Bay. The impacts would be localized and not significant in the long-term. As a result, zooplankton communities that are dependent on phytoplankton densities are not expected to be limited by food availability. Effects on photosensitive zooplankton species due to localized light penetration are expected to be short lived due to current exchanges and rapid settling of most of the materials. Placement activities in the project area would continue over the life of the project, resulting in a relatively consistent area of higher turbidity within a specific distance of the discharge point. The affected area, however, would be small relative to the overall area of the islands. It is also important to note that the areas around James and Barren Islands already experience significant turbidity events daily due to island erosion. Based on the chlorophyll-*a* noted during the four quarters of environmental sampling at James and Barren Islands versus those observed at state monitoring stations (Section 3.1.4 and 3.1.6.b), there are no indications that the turbidity events have had any effect on the plankton.

There are members of the macrozooplankton community, such as copepods and some amphipods that have entirely planktonic lifecycles. These organisms are important food sources for higher trophic level species. Project construction impacts, such as increased turbidity, may produce localized depressions in the populations of these macrozooplankton. Impacts are expected to be temporary and are not expected to have a bay-wide effect on the populations of these organisms.

Reconstruction of the island communities, especially the wetland portion, is expected to have a stabilizing influence on the plankton community in the immediate vicinity of James Island. Restoration/protection of the existing wetlands at Barren Island would have a similar effect on the plankton community in the vicinity of Barren Island. Wetlands are known to filter nutrients from the water, moderating the availability of free nutrients that can cause rapid phytoplankton blooms followed by oxygen-depleting decay.

6.1.6.c Benthic Invertebrates

Benthic organisms or aquatic animals that live on the bottom substrate, such as clams, are especially dependent on the bottom substrate type. Due to low motility and their dependence on the bottom substrate, benthic organisms would be adversely impacted by the project beneath the dike and within the dike perimeter.

Short-term impacts would result from construction of the dikes, dredging of the access channel, material placement activities, and ship movement in the area. The benthic community would likely recover in the access channel and other places highly disturbed during construction within months to a few years after dredging is completed assuming no substrate change and that the area does not experience anoxia or hypoxia. Impacts of the dredged material placement within the restoration site would be dependent on the amount of material dispersion beyond the site. As evidenced at PIERP, benthos could be impacted up to 500 ft perpendicular to the dike and 5,000 ft to the north and south of the point of construction (USACE, 1996). Recovery of benthic organisms surrounding the dike would occur after disruptive activities outside the construction area are completed.

Any benthic organisms that cannot move would be lost under and within the dike, which is a primary long-term impact. The restoration at James Island consists of 2,072 ac of uplands and wetlands in which benthic habitat would be initially lost. Although not considered diverse and receiving low B-IBI scores, the benthic community west of James Island does support abundant gem clam and dwarf surf clam communities that would be lost to restore the island. Wetlands restoration behind the shoreline protection measures at Barren Island would initially displace up to 100 ac of benthic habitat. The wetlands restoration portion and dike wall or breakwater portion of both projects would create benthic and epibenthic habitat. The habitat restoration project at James Island would create 1,043 ac of wetlands within the diked cells and approximately 40,000 feet of rock in the dike perimeter that may provide epibenthic habitat for organisms such as oysters. The shoreline restoration/protection project at Barren Island consists of 72 ac of wetlands and up to approximately 16,600 feet of sill and breakwater that can serve as benthic or epibenthic habitat. Wetland restoration at both projects may provide benthic habitat for organisms, however, re-establishment of a benthic community in the wetlands and the island perimeter may take several years.

Restoration at James Island may provide the opportunity to improve benthic habitat for the island by possibly reducing erosion in the lee of the island and through restoration of wetlands. Restoration/protection at Barren Island may also improve conditions for the benthic community surrounding the island by increasing wetland acreage and promoting conditions for SAV acreage to increase. Additionally, food web exports from these systems would benefit benthic communities. However, benthic organisms would be negatively impacted in areas identified by hydrodynamic modeling to experience increased erosion and accretion. The southeast corner of the proposed James Island, the southern end of the existing James Island, the access channel and local channel south of James Island, areas along the western dike of the proposed James Island, the north island tidal channel cut at Barren Island, areas along the southern Barren breakwater, as well as the Honga River Tar Bay entrance would all be areas of changing conditions due to expected erosion, shoaling, and accretion. Benthic communities in these areas would be exposed to sudden changes in bottom conditions, particularly following strong storms. Further, significant erosion is expected along the bayside shoreline of James and Barren Island in addition to the Honga River channel if no restoration project is completed. The benthic communities would subsequently be lost in these areas.

6.1.6.d Fisheries Resources

Construction activities are expected to affect the fish community in several distinct ways. Dredging of the access channel and subsequent placement along the dike alignment could disturb up to 4,100 ac of bottom. This is the total project limit including a buffer, which allows a border around the project where adjustments could be made to the alignment if needed. Pelagic fishes (e.g. menhaden, striped bass) and more mobile members of the demersal fish community (e.g., flounder) are expected to easily move out of or generally avoid the area during dredging. The fishes most affected would be smaller, mostly resident species of limited mobility (e.g., gobies, blennies) and the young of fish utilizing the area as a nursery. The winter flounder, rough silverside, and northern pipefish were the only fish species solely identified in the ichthyoplankton surveys at James or Barren Islands. However, they were found in such low numbers and are known to be found in other areas of the Chesapeake Bay, therefore, it is not anticipated that there would be population level effects to any of those species as a result of project construction. The fish species within influence of the suction head would be entrained with the material being moved, and some of those along the alignment may be trapped and destroyed as the material is placed. This is expected to be a very small portion of the local fish community, and the action is not predicted to have lasting impacts on any species.

The short-term elevated suspended solids levels associated with dredging within the project area are expected to have a negligible effect on larger members of the fish community that would likely avoid the areas of highest turbidity. Early life stages are expected to be most affected: eggs and larvae/juveniles of many fish species are sensitive to high turbidity. Many fish eggs are adhesive and readily accumulate particulates, making them less buoyant (in the case of pelagic eggs) or smothering them (in the case of demersal eggs). Some larval fish are similarly affected by high concentrations of particulates. Suspended solids are also known to influence the feeding abilities of some larvae/juveniles, particularly those most dependent on vision to detect prey (e.g., young striped bass). These species, however, are all very common regionally and any impacts to the populations would be small and short term.

When construction is completed, fish enclosed within the proposed dike at James Island would likely be lost. Existing conditions surveys confirmed that all species currently using the area are common in the Mid-Chesapeake Bay region. The loss of fish habitat within the diked area at James Island is not expected to be a significant impact to fishery resources. This area provides no cover or structure. Seasonal monitoring did not identify a diverse planktonic community or a diverse benthic community that would make this open water particularly valuable to fishery resources.

The stone armor that would protect the dike at James Island in many areas and provide restoration/protection at Barren Island is expected to provide cover habitat for some fish species. In addition, the stone armor would provide a food source upon colonization of the rocks by epibenthic species. Exterior monitoring studies performed on similar exterior dikes at PIERP document abundant epibenthic organisms, which provide a potential food source for juvenile fish that take refuge and forage in the rock cover (MPA, 2004j). The submerged trees and snags along the shorelines of the remnant islands at James and Barren Islands provide significant cover for aquatic species. These have been noted as important habitat for striped bass (among other species). Some of this type of habitat area may be buried within the project area at James Island; however the submerged trees nearest the shore would be preserved in the open water between the project and James Island. The potential loss of some of the snag fields is of some importance because a structure of this type provides "reef" habitat within the relatively open homogeneous sand flats of the Mid-Chesapeake Bay region. The snags are, however, structures that would disintegrate with time and are not unique to James Island, but which exist throughout the Chesapeake Bay. The results of PIERP monitoring indicate that the expected epibenthic colonization of the dike provides a beneficial impact to aquatic species, and helps to offset the loss of snag habitat. As such, the benefits lost in the event that snags are buried would be considered replaced by the benefits provided by the created rock dikes.

An important habitat feature of islands is the associated shoreline. Shallow near-shore areas have been noted as being among the most productive habitat of some estuaries, second only to tidal marshes (Ayvanzian et al. 1992). This habitat is not unique to the region, but it is unique in its occurrence not adjacent to the mainland. Approximately 2,072 ac of near-shore habitat would be buried within the containment area at James Island and 100.8 ac would be disturbed due to the dredging of the access channel. Additionally, approximately 100 ac would be disturbed from the wetlands restoration and sills and breakwaters at Barren Island. This, however, constitutes only a minimal loss of shallow open water areas regionally within the main stem of the Chesapeake Bay. Additionally, the projects at James and Barren Islands would both alter and protect the shoreline. The construction of dikes would reduce the amount of natural shoreline, but in turn would diversify the habitat in the area; likewise, natural shoreline already existing at James and Barren Islands would be protected by the proposed projects.

The shift in the predominant aquatic habitat is expected to manifest fundamental changes within the fish community utilizing the area during the transition period following dike completion at James Island, particularly within and directly adjacent to the proposed dike alignment. The proposed restoration/protection at Barren Island should not impact the fish community to the extent of the James Island restoration, because it is not going to replace shallow water habitat with upland habitat. The Barren Island restoration/protection project would accommodate gradual replacement of shallow water habitat behind the breakwater with wetlands, but would preserve the remainder of the shallow water and near shore habitat outside of the breakwater for the existing fish communities.

The most noteworthy change in habitat character due to the James Island restoration is that existing open water within the project area would be reduced; however, the wetland portion of the habitat restoration areas would provide increased nursery habitat for aquatic species and add diversity to the existing habitat. The usage of the marsh creeks and ponds is expected to shift fish species populating the project area to earlier life stages and smaller species that commonly utilize marsh habitat. Following the establishment of smaller species, it is expected that larger species or life stages would utilize these areas as well for foraging. Species composition in the waters surrounding the proposed island is not expected to change significantly in the long term.

Section 3.1.6.e discusses Essential Fish Habitat (EFH) and the EFH species associated Habitat of Particular Concern (HAPC). An EFH assessment was compiled by USACE and sent to NMFS for review (available in Appendix E, Attachment A). NMFS response to the EFH assessment was received on 20 May 2005. NMFS recommended the incorporation of additional peripheral features to the James Island proposed plan to benefit fish resources such as diversifying the shoreline, and the addition of small coves, specifically at the northeast tip and the southern tip of James Island.

The recommended plan for James and Barren Islands would likely protect much of the existing SAV and potentially allow an increase in abundance. This in turn would increase the area of HAPC in the vicinity of the islands. Summer flounder is one of the species potentially utilizing the HAPC around James Island. Parts of the access channel at James Island that are dredged to -25 ft or greater have the potential to become hypoxic or anoxic in warmer months of years. Under these conditions, the bottom in the access channel would be unsuitable as habitat for summer flounder, and the species would be expected to avoid this area. This temporary loss of habitat would not be expected to impact summer flounder populations because of the abundance of suitable habitat still remaining elsewhere in the Chesapeake Bay. Additionally, there is currently minimal SAV (HAPC) acreage in the James Island vicinity and no SAV resources are adjacent to the location of the access channel. The USACE prepared an EFH Assessment for the proposed project (Appendix E). The proposed project footprints at James Island and Barren Island do not contain any documented SAV or other HAPC resources.

6.1.6.e Commercially Important Species

Two commercially important bivalve species, soft clams and razor clams, occur within the proposed dike alignment at James Island. Dredging and construction of the containment facility is expected to permanently eliminate the bivalve community that currently inhabits the bottom within the dike alignment. Moreover, there would be no potential for reestablishing that portion of the former Chesapeake Bay bottom shellfishery because the area would be completely covered with dredged material when the island is constructed. The harvesting rate of all clam species in the vicinity of the proposed restoration at James Island, as defined by MDNR, was not sufficient at any of the transect locations for these areas to be considered productive natural clam bars. Likewise, the four quarters of environmental sampling performed in the vicinity of Barren Island found that there were not enough clams to support a commercial clam harvest. Therefore, commercial clam harvest in the area around James or Barren Islands should not be adversely impacted by construction of the proposed island restoration project.

There are three natural oyster bars (NOBs) in the vicinity of James Island and two in the vicinity of Barren Island. Watermen have indicated that the NOB to the east of Barren Island was a very productive oyster bar at one time, but has since silted over. Currently there is no commercial harvesting of oysters in the vicinity of the project area at James or Barren Islands. The proposed restoration at James Island and the restoration/protection at Barren Island are configured in such a way that no dredging, construction, or filling activities would occur over any oyster harvesting areas. The staging area at James Island for material placement would be sufficiently far from the oyster bars to prevent impacts from resuspension of material due to barge traffic. No long-term impacts from the project on the adjacent oyster bars are, therefore, expected. Sediment transport from the modeled hurricanes and northeasters is not anticipated to negatively impact NOBs. Modeling results propose minimal reductions in sediment accretion over these areas, but no erosion or accumulation.

Additionally, it is anticipated that the proposed project at Barren Island would cause the NOBs to the northwest and southwest of Barren Island to experience almost no change in sedimentation rates and patterns. Modeling results propose no change or minimal reductions in sediment accretion over these areas (Points 9, 11, and 13 for hurricanes and northeasters), but no erosion or accumulation. Short-term impacts to these bars from the project could result from suspended sediment drift during dike construction, particularly to the planktonic larvae and spat (newly settled young).

Dredging time of year restrictions within the Chesapeake Bay in the summer (June 1st through September 30th) are designed to avoid entrainment of and provide protection for these life stages. These restrictions would be closely adhered to during construction. A second dredging restriction time occurs during periods of low metabolic rates when oysters are more susceptible to smothering by suspended sediments (December 16th to March 14th). This restriction applies to dredging or other sediment generating activities that occur within 500 yards of a NOB boundary. These beds are exposed to high natural turbidity levels from island erosion.

The waters surrounding James and Barren Islands have been identified as a regionally important area for harvesting of blue crabs. This was confirmed during the existing conditions surveys at both of the islands through observations of substantial commercial crabbing efforts in the area. A short-term impact to blue crabs could include a period of lower usage of the island restoration area during construction. Blue crabs are highly mobile and are expected to vacate the area during construction, except for crabs that are contained within the confines of the perimeter dike and those that may be over-wintering within the area. Winter crab densities are quite variable, but some annual surveys have indicated as many as 20 per 1,000 m^2 in the Mid-Bay at depths less than 40 ft. The losses are expected to be minimal, particularly if dike construction is completed when the crabs are in deeper waters (October through April). The main impact to this resource would be the loss of 2,072 ac at James Island of prime summer blue crab habitat to burial and island construction. The shallows surrounding the remnant islands provide habitat (cover and food sources) sought by juvenile and adult crabs in the summer.

The marsh creeks formed by the restored island construction are expected to provide excellent crab habitat in the future (particularly for young life stages and soft crabs). Likewise, the SAV beds that should be protected by the proposed projects would continue to provide prime blue crab habitat. Restoration at James Island would represent a net loss of currently productive blue crab habitat that is not associated with SAV. The largest impact is to the commercial crabbers who fish the waters within the proposed project area and would have to relocate their operations.

Existing conditions studies in the vicinity of James and Barren Islands found that five commercially important finfish species utilize the area. Of these, the most important in terms of poundage landed and dollar value were Atlantic menhaden and striped bass according to the MDNR catch data. As stated previously, the composition of the adult finfish community in the waters surrounding the proposed projects is not expected to be impacted significantly in the long-term. However, construction impacts such as bottom disturbance or turbidity may deter short-term usage by the adults and young of some commercially important species. In addition, burial of available cover items such as snags would remove preferred habitat for species such as striped bass. It is not anticipated that any long-term impacts to commercially important finfish would be significant, and, once the construction phase is completed, finfish are expected to move back into the area quickly. Impacts to commercial fin fisheries, specifically pound nets would be discussed in Section 6.3.3.d.

Periodically, benthic productivity may be enhanced if some of the nutrients are exported from the dredged material containment. Nutrients may originate from material placement, site development, and/or dewatering. The wetland component of the project may help to stabilize nutrient fluxes in the area surrounding the restoration site for James Island and the shoreline restoration/protection for Barren Island; however, the effects at Barren Island may be less due to the smaller size of the wetlands.

6.1.6.f Marine Mammals

Atlantic Bottlenose dolphin sightings south of James Island and off the western shore of Taylors Island were documented during the spring environmental survey. It is assumed that dolphins would be present in the waters surrounding Barren Island as well though dolphins were not observed during surveys of Barren Island. Consultation with NMFS concluded that Atlantic

Bottlenose dolphins are not Federally or State listed as an endangered species and that exclusionary techniques to avoid impacts would not be required (Nichols, 2005).

6.1.6.g Wetlands

A Clean Water Act Section 404(b)(1) evaluation was completed and is available in Appendix E, Attachment B. The proposed island restoration project at James Island is expected to have long-term and significant beneficial impacts to wetlands. The project is expected to provide shoreline protection to the James Island remnants, which contain beach, marshes, and freshwater wetland habitat. The project is also adding 1,140 ac of wetland habitat to the island complex.

The proposed Barren Island restoration/protection project may have adverse short-term impacts on wetland communities along the northern and western remnant shorelines, if they are disturbed by wetland restoration activities. However, wetland restoration in those areas would provide long-term beneficial impacts by restoring 72 ac of wetlands to the island complex. The shoreline protection provided by the proposed project would cause beneficial long-term impacts by preserving wetlands on the existing remnant islands.

The projects are expected to provide long term beneficial impacts to wetland vegetation by preserving existing wetland areas on James and Barren Islands from further erosion. The proposed project at James Island would restore 1140 ac of wetland habitat for desirable vegetation species. The proposed Barren Island would restore an additional 72 ac of wetland habitat to Barren Island.

Due to proximity, impacts may arise from seed exchange between the proposed projects at James Island and Barren Island, and their respective remnant islands (MES, 2004b). Wind, water, or animal movements can transfer seeds between the remnant islands and the proposed projects. The seed exchange may have beneficial impacts if desirable species are exchanged. Conversely, an invasive species such as *Phragmites australis* (common reed) can colonize new areas through wind driven seeds, complicating control efforts at the proposed projects or the remnant islands. Instituting vegetation monitoring and invasive species control plans must be a consideration for the proposed projects at either location according to Executive Order 13112 (February 3, 1999).

6.1.6.h Intertidal Flats Habitat

Intertidal flats, also referred to as mudflats, are known to support an important ecosystem of benthic and infauna species. The presence of these species attracts larger avian, macroinvertebrate, and finfish predators. Intertidal flats therefore facilitate the interaction of a diverse number of species.

Habitat surveys conducted on Barren Island determined that intertidal flats habitats covered approximately 17.3 ac of the island. Intertidal flats habitats were identified on the sand spit connecting the northern and southern island remnants and between the north and northeast remnant. The proposed island restoration/protection would be constructed on the western side of Barren Island and extend southward, and may include wetlands restoration adjacent to the existing intertidal flats. Although the presence of these intertidal flats may be a consideration during the wetland restoration component of the project, the project is not expected to have adverse long-term impacts to the existing intertidal flats habitats.

Environmental studies found no intertidal habitats on James Island. Consequently, the proposed action for James Island is not expected to have impacts to these habitats. The recommended plan, would restore 118 ac of intertidal/mudflat habitat (113 ac at James Island and 5 ac at Barren Island). During construction of James Island, there would be roughly 60 to 100 ac of mudflat temporarily created at any one time through the placement of dredged material.

6.1.7 Terrestrial Resources

The project area at James Island is located off of the western shore of the remnant island complex (Figure 2-1). The construction of the proposed project at James Island would not infringe on the existing shorelines of the remnant islands. Short-term impacts associated with the James Island restoration project would primarily result in disturbances caused by the close proximity of construction to the existing remnant islands. Beneficial long-term impacts are expected to result from project construction associated with preservation of approximately 100 ac of terrestrial habitats and animal communities on the existing James Island remnants, and the addition of 1,140 ac of restored wetlands and 932 ac of restored upland habitat for a total of 2,072 ac of restored terrestrial habitats.

The project area for the restoration and protection project at Barren Island is located off of the southern portion of the western shore of the remnant islands (Figure 2-2). Construction of the sills along the Barren Island remnants is not expected to infringe on the existing shorelines; however wetland restoration behind the sills would likely overlap portions of the northern and western remnant shorelines. The proposed project is not expected to infringe on interior portions of the Barren Island remnants. Long term impacts associated with the Barren Island restoration and protection project would primarily result from the project preserving 180 ac of existing terrestrial habitats and animal communities and adding 72 ac of wetland habitat (including dike acreage) to the existing Barren Island remnants.

6.1.7.a Vegetation Resources

No short-term impacts to vegetation are expected from the proposed restoration at James Island, as construction of the project is not expected to disturb the plant communities on the existing remnant islands. The projects are expected to provide long term beneficial impacts to terrestrial vegetation by reducing shoreline erosion on the remnant islands and by preserving upland forested areas. The proposed project at James Island would also provide 932 additional acres of upland habitat for desirable vegetation species.

The wetland restoration component of the Barren Island restoration and protection project may cause short-term adverse impacts to terrestrial vegetation along the northern and western shorelines of the remnant islands, as additional wetland acreage is restored adjacent to those shorelines. No short-term impacts are expected to terrestrial vegetation on the interior portions of the remnant islands or shorelines where wetland restoration is not planned to occur. The proposed project is expected to have beneficial long-term impacts for terrestrial vegetation by preserving existing upland.

Significant erosion is expected along the bayside shoreline of James and Barren Island if no restoration project is completed. Vegetative communities would subsequently be lost in these areas. The wave reduction benefits provided by the proposed Barren Island project is also expected to minimize shoreline erosion in the lee of the island and promote the continued existence of vegetative communities in those areas.

6.1.7.b Invertebrates, Amphibians, Reptiles, and Mammals

The James Island and Barren Island remnants provide habitat for several invertebrate, amphibian, reptile, and mammal species. Human activity and noise disturbances associated with construction and dredged material placement activities at the James Island restoration project and sill construction at the Barren Island restoration/protection project may have adverse short-term impacts to animal communities on the island remnants. The disturbance and degree of impact would vary depending upon the time and location of the construction activities. Short-term adverse impacts may occur at Barren Island during wetland restoration activities, as material placement and planting may displace or disturb of animals utilizing shorelines that are immediately adjacent to wetland restoration activities. Habituation of the animals to the disturbances, and also to increased boat traffic, may occur, as it has with PIERP. Long-term beneficial impacts to animals that currently utilize the existing James Island and Barren Island remnants are expected from restoration of 2,072 ac of additional habitat at James Island and 72 ac at Barren Island. If required, a management plan may be implemented to control non-target species that may be attracted to the restoration and restoration/protection projects. These species may require management because they over-consume the same resources used by desirable species, or their predation on rare or desirable species is determined to be too extensive. Instituting monitoring and control plans may be a consideration for the proposed projects at James Island and Barren Island.

The recommended plan for James Island is expected to provide long term beneficial impacts to terrapin nesting, by protecting existing nesting habitat on the remnant islands and potentially providing new nesting habitat. However, the proposed action has potential for some adverse short-term impacts to terrapin nesting. Diamondback terrapins have been documented nesting along the shorelines of James Island. Terrapins were noted utilizing the eastern shoreline of James Island. Disturbances associated with project construction and dredged material placement activities at James Island would be focused along the western shoreline of the remnant islands, which are the shorelines closest to the respective project area. Terrapin nesting has not been documented on the western shores of the James Island remnants that would be subject to the greatest disturbance impacts. Short-term adverse impacts may exist from the potential for increased boat traffic during construction of the projects at James Island, which could disturb or strike swimming turtles. Avoidance of impacts to nesting terrapin resulting from construction activities for the James Island restoration would be a consideration during project planning.

The recommended plan at Barren Island may have adverse impacts to terrapin nesting at Barren Island. Terrapins were noted nesting on the northern and northeastern shorelines of Barren Island. Long-term adverse impacts may occur to terrapin nesting on the northern shoreline of Barren Island if wetland restoration displaces terrapin nesting beaches. Additionally, Short-term adverse impacts may exist from the potential for increased boat traffic during construction of the proposed project at Barren Island, which could disturb or strike swimming turtles. Avoidance of impacts to nesting terrapin resulting from construction activities of the proposed action would be a consideration during project planning.

Diamondback terrapin began nesting on the beaches at PIERP before construction was complete. "Fences" were installed along the nesting beaches and annual monitoring was initiated during terrapin nesting season at PIERP to protect diamondback terrapin and their offspring and to increase nesting success. Similar monitoring and control measures may be used at the proposed projects if diamondback terrapin nesting activities begin on the shores of the projects or remnant islands prior to construction completion.

Horseshoe crabs have been documented nesting on James Island and Barren Island. Documented nesting activity at James Island was primarily concentrated along the eastern shoreline, with some nesting occurring on the north and northwest side of the middle remnant island. Approximately half of the documented nesting activity at Barren Island occurred along the western shoreline of the northern remnant. Disturbances from construction and dredged material placement activities at the restoration projects would be focused along the shorelines closest to the respective project areas. The proposed project at James Island is located on the opposite side of the island from horseshoe crab nesting, and is not expected to adversely impact their nesting. The recommended plan at James Island is expected to provide long term beneficial impacts to horseshoe crab nesting, by protecting existing nesting habitat on the remnant islands and potentially providing new nesting habitat. Adverse impacts may occur to horseshoe crab nesting along the northern remnant at Barren Island if wetland restoration displaces nesting beaches. Avoidance of impacts to nesting horseshoe crabs at Barren Island resulting from wetland restoration behind the breakwater may be a consideration during project planning.

6.1.7.c Avian Species

The James Island and Barren Island remnants provide habitat for resting, nesting, and foraging of several bird species. The primary short-term impacts to birds associated with construction of the habitat restoration and island restoration/protection projects would be disturbance from noise associated with dike construction and dredged material placement. The only identified long-term impact would be a loss of 2,072 ac of potential foraging habitat to waterfowl at James Island. The gem clam and dwarf surf clam densities identified in seasonal monitoring at James Island suggest that there are abundant foraging resources for wintering waterfowl in the area that would be filled by construction of any of the James Island alternatives. Due to the limited sampling (3 points within the proposed alignment footprint) it is unclear if the high densities measured during sampling are representative of the entire footprint or are representative of 'hotspots' of high densities. Gem clams characteristically have a patchy density within sand substrates. Similar bivalve resources were not identified in the Barren Island vicinity.

The behavior of birds utilizing the shorelines of the remnant islands near where construction and placement activities occur at James Island may be influenced by noise and nearby human activities. The disturbance may displace birds utilizing habitat in the immediate vicinity of dike segment construction, and the degree of impact would vary depending upon the time and location of the construction activities. Similar impacts may occur to birds using areas adjacent to construction activities during sill construction at Barren Island. Short-term adverse impacts may occur at Barren Island during wetland restoration activities, as material placement and planting may displace or disturb birds utilizing shorelines that are immediately adjacent to wetland restoration activities. Habituation of the birds to the disturbances and increased boat traffic may occur, as has been observed at Poplar Island, where least terns have successfully nested near truck traffic areas.

American bald eagles, which have been recently delisted from the Federal rare, threatened, and endangered species list, have been observed nesting on both the James Island and Barren Island remnants. Colonial waterbirds such as brown pelican, double crested cormorant, and great blue heron have been documented nesting on the southern remnant of Barren Island. As with PIERP, time of year restrictions that limit access to a specified radius around the nesting site may be used to regulate the proposed projects disturbances to rare species such as American bald eagles or colonial nesting waterbirds. Table 6-5 lists some of the time of year restrictions from PIERP that may apply to the proposed projects. The planned tidal gut would separate the restoration construction from any nesting sites of concern on the James Island remnants and would help minimize any impacts to nesting. The wetlands restoration component of the Barren Island restoration and protection project would be adjacent to the northern and western shorelines of the remnant islands.

The James Island portion of the recommended plan is expected to produce beneficial long-term impacts for avian species by protecting existing avian habitat, and producing approximately 2,072 ac of additional large island habitat for resting, nesting, and foraging. Similarly, the Barren Island component is expected to protect approximately 180 ac of existing remote island habitat and provide the opportunity for the restoration of 72 ac of additional avian habitat.

Although still under construction, the environmental restoration project at PIERP has begun providing beneficial impacts to avian species. PIERP annually attracts increasing numbers of nesting colonial waterbirds and terns. PIERP also serves as a resting place for migrating waterfowl, hunting grounds for herons and egrets from neighboring Coaches Island, and nesting habitat for upland birds (MES, 2004a). It is expected that the restoration at James Island and the restoration/protection at Barren Island would attract similar species, and provide similar beneficial impacts to bird species.

Nesting benefits for many avian species can be contingent upon levels of terrestrial predators or competition for resources with other avian species. Predators that may currently be residing on the remnant islands have the potential to move into habitat restoration areas and impact nesting bird species that have been attracted by the proposed project. There is also potential for populations of some avian species to “take over” preserved and restored habitats at the proposed project and displace desirable avian species. A management plan may be implemented to control non-target avian and other species that may be attracted to these restoration projects and occupy habitats similar to those of more desirable nesting species and consuming similar resources. Instituting avian monitoring and species control plans may be a consideration for the proposed projects at either location.

Visitation would be controlled throughout the construction period of the James Island project. This includes the establishment of the wetlands and uplands habitats. It is likely that after the project is completed and turned over to the local sponsor there would be some uncontrolled visitation. Visitors would likely use the dikes as footpaths. Visitation during periods such as nesting and rearing could have a potential impact to some species. Many bird species would use habitat deep in the marsh and would not be disturbed by visitors on the dike footpaths. However, some species may be disturbed by visitors using the footpaths. Appropriate signage would be installed to notify visitors of their potential impact and to advise them to avoid or use caution when near these areas.

6.1.8 Rare, Threatened, and Endangered Species

The presence of RTE species was coordinated with MDNR, USFWS, and NMFS. Initial coordination letters describing the presences of Federally listed species were received from USFWS on 1 December 2004 and from NMFS on 20 July 2004; and a letter describing the presence of State listed species from MDNR on 26 November 2004. An Endangered Species Act Section 7 Evaluation was prepared by USACE and submitted to NMFS and USFWS on 17 May 2005 (available in Appendix E, Attachment C). A letter dated 17 June 2005 communicates that USFWS concurs with USACE's determination that the proposed actions would have no adverse effect on Federally listed RTE. A similar letter was received from NMFS on 22 August 2005. Further, a Fish and Wildlife Coordination Act report was received from USFWS on 24 May 2005. The report summarizes the main environmental issues on the project and states that the USFWS enthusiastically supports the proposed plans for James and Barren Islands. A full record of all RTE agency correspondence is listed in Section 9.5.

No State or Federal threatened or endangered species are expected to be adversely impacted by the restoration at James Island or the protection at Barren Island. Although recently delisted, the American bald eagle are present on the James Island remnants, negative impacts are not expected since no encroachment to the existing remnants is anticipated. The recommended plan for Barren Island involves encroachment onto the shoreline though encroachment to the interior of the island is not expected. The single nesting pair of bald eagles on the northern remnant of James Island, and the potential nesting site at the southern end of Barren Island is not likely to be adversely impacted by the proposed action. Any effects on the eagles would be manifested by localized short-term disturbances during construction of the dike segments closest to the nests. Precautions may need to be taken during construction and dredged material placement to avoid working within the area one-quarter mile from the eagle's nest during the restricted periods. This distance would be expected to provide sufficient buffer to prevent abandonment of the nest. Coordination with USFWS has indicated that as long as time-of-year restrictions are observed, no impacts to the American bald eagle are likely to occur (Appendix E).

In addition, there is record of the state-listed endangered Eastern narrow-mouthed toad (*Gastrophryne carolinensis*) known to occur on Barren Island. This species was observed on Barren Island during the spring 2003 existing conditions survey. Consultation with MDNR is ongoing to determine how to avoid potential impacts to the Eastern narrow-mouthed toad. The island that currently provides habitat for the Eastern narrow-mouthed toad would be protected by the proposed project.

Short-nose sturgeon are suspected to be transient to the project area surrounding James Island and Barren Island. The closest short-nose sturgeon catches were documented from pound nets set eight miles from James and Barren Islands. Seasonal fisheries surveys conducted to characterize the existing finfish communities surrounding the James and Barren Islands during 2002 and 2003 did not identify any short-nose sturgeon within the study area. Because short-nose sturgeon are expected to be transient to the project area, coordination with NMFS indicate that adverse impacts are not anticipated (Appendix E).

Leatherback sea turtles, green sea turtles, Kemp's ridley turtles, and loggerhead turtles are State and Federally listed endangered species and have been recognized as being transient to areas surrounding James Island and Barren Island. Based on collected data Kemp's ridley and loggerhead turtles are the most frequent visitors to the Chesapeake Bay. Leatherback sea turtles typically continue migrating north past the Chesapeake Bay and prefer nesting on the high wave energy beaches of the eastern seaboard. No nesting by sea turtle species has yet been recorded in the Chesapeake Bay (Evans et al. 1997).

Although direct monitoring was not performed as part of the feasibility study, there were no sea turtles identified in any of the finfish surveys or wildlife monitoring at James or Barren Island (MPA 2005a, MPA 2005b). Sea turtles are migratory individuals that are seasonal transients to the project area and NMFS expects no impacts to these turtles (Appendix E). During cooler weather months, particularly, sea turtles are unlikely to be present

USACE-Baltimore District and MPA would continue consultation with the Federal and State resource agencies regarding time of year restrictions for construction and operations at James and Barren Islands as needed, since conditions could change prior to the start of construction.

6.1.9 Air Quality

The reconstructed islands would produce minimal fossil-fuel emissions from equipment. Construction and placement activities would cause some emissions due to boat activity and use of other gas-powered equipment and vehicles. Some potential for suspension of particulates exists during filling/grading activities. As the dredged material dries and is subjected to wind, lighter materials may become airborne. These are expected to be short-lived events with no significant impact on air quality. Once the island is revegetated and the soils stabilize, the potential for airborne particulate would be minimized. Impacts to air quality from dike construction and material placement are, therefore, expected to be localized and short-term. As discussed with MDE on 23 May 2005 (See Section 9.5), Dorchester County is not in a non-attainment zone for either ozone or particulate matter (2.5). Therefore, no long-term impacts on air quality are expected and no further consultation is needed for air quality compliance.

6.1.10 Noise

6.1.10.a With-Project Noise Conditions – James Island

The highest *sustained* noise levels generated by construction and dredged material placement at James Island are likely to be around 90 A-Weighted Decibel (dBA) at 50 feet. This sound level represents several pieces of heavy equipment (e.g., dump trucks, dozers, compactors) working simultaneously in close proximity to one another. Although noise transmission depends on many factors including air temperature, wind and atmospheric conditions, a standard noise transmission model that factors attenuation over water, molecular absorption, and analogous excess attenuation, can provide estimates of sound transmission under average or typical atmospheric conditions. Using that model, a 90-dBA sound is estimated to decrease to typical daytime neighborhood background levels (55 dBA) within 3,200 ft of the noise source. The 55 dBA standard is typical threshold level for noise regulation in rural areas. GIS analysis results determined that three privately owned parcels and no improved residential or commercial parcels fall within 3,200 ft of the proposed island perimeter indicating that few if any people would notice these noises under typical conditions (Figure 6-17). This noise zone also does not extend into the recreational areas used by most boaters.

Of the activities associated with island construction, back-up beepers create among the highest periodic sounds and their sound level can vary from 85-110 dBA at 50 ft. The placement of rock during initial phases of construction would also be in this sound range. These activities generally occur during daytime hours. A sound at the 110-dBA levels would be expected to attenuate to daytime background levels within about 10,000 ft of the source under typical atmospheric conditions. GIS analysis indicates that about 12 improved waterfront parcels and 17 improved non-waterfront parcels (agricultural, residential, and commercial) fall within this range of the proposed project perimeter (Figure 6-17) and thus are likely to be affected by elevated noise levels during certain construction phases. Because sound is attenuated more rapidly over land by vegetation and structures, the sound reaching the 17 parcels that are not on the waterfront would most likely be attenuated below background levels under typical conditions. Several unimproved waterfront parcels on the northern edge of Taylors Island have the potential to be developed, suggesting that the future population affected by noise could be marginally higher. This zone of periodically elevated noise levels also extends west of the island over a major portion of the neighboring recreational fishing area.

Some sound-generating activities would occur day and night such as movement of tugs and barges and operation of pumps. These activities are associated with inflow and therefore would persist for the duration of the project development. Inflow is likely to occur only from September to March, so these effects are expected to be seasonal. Sound levels associated with these activities would be in the range of 82 dBA for barges, 81 dBA for generators used to power lights, and 76 dBA for pumps. These sounds would combine into the equivalent of a single source generated of 85 dBA at 50 feet. That sound level was estimated to be attenuated to a nighttime background level of 40 dBA in about 6,000 feet. Three improved parcels and five unimproved parcels on Taylors Island are within this range of the project. Table 6-6 shows estimated duration and time of noise levels at James Island with numbers based off of the typical noise conditions of restoration at PIERP (UMCES, 2004b).

Generally, noise impacts associated with the restoration at James Island would be minimal and not interfere with activities. The loudest sounds would be periodic or of relatively short duration. Occasionally, noise levels at 10-20 nearby waterfront residences or businesses may exceed levels typical to quiet, suburban neighborhoods. During times of the year when residents are primarily inside, the noise levels should not be noticeable by residents (UMCES, 2004b). Noise impacts to animals resulting from the project are discussed in Section 6.1.10.

The potentially significant effects would be to recreational boaters and the three closest improved parcels on Taylors Island (approximately one half a mile from James Island). Recreational boaters that typically use areas west of the island may be disturbed by the periodic noises, particularly during dike construction, which would exceed typical ambient noise levels. Raised noise levels may also periodically disrupt recreational use of James Island by the three landowners or their guests. Three residences on Taylors Island may notice elevated nighttime noise levels when outside their homes or when windows are open. However, these noise levels would typically be in the 40-45 dBA range and not considered very loud (Table 6-7). In addition, the sounds heard at night (associated with material inflow) would not tend to vary greatly in pitch or volume and therefore would not be among the most annoying types of noises (UMCES, 2004b).

Sound levels associated with sustained activities (e.g., operation of vehicles, pumping of dredged material) would generally not be noticeable to residents or boaters. Once the restoration project is complete, the occasional boat traffic that might be associated with limited visitation to the island would be consistent with pre-existing noise levels. Because the areas of noise disturbance do not extend far inland, any future residential development of unimproved or agricultural parcels in the vicinity should not have a significant effect on the number of people affected by noise (UMCES, 2004b).

Boat noise and traffic at the completed project is not expected to be any greater than pre-construction levels. The project is not located near a populated area and it is unlikely that it would become a popular weekend boating destination like Hart Miller Island which is in a populated area and adjacent to a state park. Waters to the east of the project are shallow and although the water to the north and west is deep it is exposed to a wide fetch. Additionally, the toe-dike on the north, south, and west sides would extend approximately 100 ft from the center of the dike thereby making the project inaccessible by boat. A small beach is planned on the east but it would not be large enough for many boats to land. This beach is expected to be used for diamond-back terrapin nesting and appropriate signage would be installed cautioning boaters to avoid this area during nesting season. The pier used for construction would likely be left standing and could be used by a few boats.

6.1.10.b With-Project Noise Conditions – Barren Island

The proposed restoration/protection at Barren Island is a much smaller project than the restoration at James Island. The project is expected to be constructed in less than 2 years and therefore would create only short-term noise disturbances. However, more homes and businesses are located close to Barren Island than James Island, so noise impacts, while of a shorter duration, and may affect more people. Table 6-8 shows estimated duration and time of noise levels at Barren Island based off of the typical noise conditions of restoration at PIERP (UMCES, 2004b).

Since the main noise-generating activities of the breakwater project are likely to be rock placement, UMCES evaluated one noise zone (Figure 6-18). The GIS analysis showed that 337 improved and 76 unimproved parcels were located within 10,000 ft of the proposed extension of the existing breakwater. Most of the affected parcels are residences, but a few restaurants, churches and other uses are present (UMCES, 2004b).

Construction activities are likely to take place only during the day, so noise levels associated with the project would not conflict with local noise ordinances. Noise levels are likely to be noticeable to most residents and visitors of the western waterfront area of Upper Hoopers Island during rock placement. As with James Island, any recreational boaters choosing to fish within 10,000 feet of the Island are likely to experience noticeable noises periodically. The Barren Island remnants are likely to experience periodic noise levels that would be perceived as moderately loud (UMCES, 2004b). Noise impacts to animals resulting from the project are discussed in Section 6.1.10.

6.1.11 *Light

Lighting at PIERP was used as a model for analyzing potential light impacts associated with the recommended plan at James Island and Barren Island (Tables 6-9 and 6-10). Many light levels are specified by OSHA regulations and are therefore, not flexible. The brightest lights used at PIERP are shielded to direct light downwards toward operations, so glare does not typically reach nearby residences or affect boaters. Brightness of navigation lights are mandated by the Coast Guard and are typically designed to be visible for 2 miles. Lights on barges must be visible for 3-5 miles depending on size and mast lights should be visible from 360° when boats are at anchor (US Coast Guard Navigation Rules and Regulations), such as when offloading dredged material. Light trespass from PIERP has been an infrequent source of complaints by neighboring residences. Due to the rural setting of the mainland, the primary complaint from PIERP is a loss of the darkness that residents are accustomed to seeing. However, most waterfront homes adjacent to James and Barren Islands are at least as far from the proposed site construction as waterfront homes nearest to PIERP, so light impacts can be expected to be similar.

Similar to PIERP, a noticeable increase in nighttime light can be expected at James Island when work occurs 24 hours a day. Specifically, nighttime activities occur during the sand dredging portion of the construction phase and during the material inflow. Light from these activities is likely to be visible for many miles but would not necessarily be perceived as bothersome over that range. The inflow activities use the highest power bulbs of any project activity. These lights are raised to roughly 30 feet above sea level and have the potential to be seen over 10 miles away by an observer at 15 feet above sea level, under very clear atmospheric conditions (UMCES, 2004b).

The duration of nighttime activities varies. Sand dredging is continuous over the first several months of the project, while inflow activities occur seasonally once initial construction is complete. Therefore, light impacts associated with these phases of activity would be temporary and seasonal. These operations use lights that are shielded, so glare should be minimal and not reach residences. Similarly, the restoration/protection project at Barren Island may have short-lived nighttime operations related to sand dredging, introducing temporary increases in lighting levels (UMCES, 2004b).

A minor increase in nighttime light associated with illumination of any permanent facilities at James Island is likely to occur over the long-term. Structures (docks, piers, breakwaters, channels) are required to be lit temporarily during construction either by floodlight and/or by Federally maintained aids to navigation. Any structures remaining after construction are likely to be permanently lit by aids to navigation or low-intensity lighting (e.g., for piers). Additionally, marking the uncharted, restored James Island with aids to navigation would be a courtesy to watermen and recreational boaters in the area. These navigation lights may be visible at nearby residences, but would be consistent with existing lights in the waterway. Long-term impacts at Barren Island would be minimal since there would not be permanent facilities (i.e., buildings) at the project (UMCES, 2004b).

In summary, implementation of the proposed project would introduce additional nighttime light to the project areas during the construction and inflow phases. The group primarily affected by this increased lighting would be the waterfront homes in close proximity to the project, and any impact would depend on their perception of these increased light levels. Evidence from Poplar Island suggests that lighting would be considered tolerable to those in support of the project. Permanent lighting of structures on James Island or aids to navigation used to mark the project would be comparable with existing lighting in the area. Therefore, long-term lighting impacts are expected to be minimal (UMCES, 2004b).

6.1.12 Hazardous, Toxic, and Radioactive Wastes

The restored islands would serve primarily as wildlife habitat and no other uses besides passive recreation would occur. As noted in Section 3.1.14 of this EIS there have been no findings of HTRW on James or Barren Islands and there is no reason to suspect that James Island (USACE, 2003) or Barren Island (USACE, 2004b) contains HTRW that would in any way influence the proposed restoration projects. The proposed restoration projects are not expected to pose any significant environmental liability concern.

MEC may potentially be found in areas of the Chesapeake Bay as a result of historic or ongoing military activities. Therefore on occasion, MEC may be deposited through normal dredged material placement methods similar to occurrences at Hart-Miller Island (HMI). At HMI, MEC have been sighted in the immediate vicinity of hydraulic inflow pipe outlets after surface material has begun to dry. Generally, such MEC has consisted of a few hand grenades or small caliber shells. Any suspected MEC at James and/or Barren Island would be investigated and cleared by qualified explosive ordnance disposal (EOD) personnel, normally from the county bomb squad.

There would be need to be fuel tanks on James Island for fuel storage during construction. A permit would be obtained for a fuel farm from MDE.

6.1.13 Impacts to Protected Areas

Due to their location in the Chesapeake Bay, James Island and Barren Island could be associated with various types of protected areas such as navigation channels, coastal zones, critical areas, floodplains, and wild and scenic rivers. The proposed restoration at James Island and restoration/protection at Barren Island may impact protected areas that are present within or around the project area.

6.1.13.a Navigation

Navigational uses closest to the project areas consist of recreational boating and commercial fishing and crabbing. Impacts of the proposed projects on navigation related to recreational boating are discussed in Section 6.4.2.b. As with recreational boating, the restoration/protection project at Barren Island is in water too shallow for most boats (1-3 ft) and is not expected to influence navigation or movements of watermen (UMCES, 2004b). The restoration project at James Island would likely displace some popular fishing and crabbing areas for watermen, and watermen would have to navigate around the project to reach fishing grounds. Local watermen would be subject to increased barge traffic, which would be servicing dike construction and bringing dredged material to the projects. It is estimated that 6,920 barge-loads of dredged material would be required to build the James Island restoration project over the life of the project (USACE, 2005). The area used by construction vessels such as tugs and barges would not be suitable for commercial fishing activities. These areas would be well marked during the construction phase, and any gear placed within them would be destroyed by vessel traffic.

Commercial shipping traffic for Baltimore Harbor utilizes a shipping channel in the central portion of the Chesapeake Bay. The recommended plan at James and Barren Islands is located outside of this shipping channel. Some impacts to commercial shipping may result from increased barge traffic in the shipping channel transporting dredged material to each of the project sites; however, both projects are expected to beneficially impact commercial navigation by providing a destination for material dredged out of the Baltimore Harbor approach channels.

6.1.13.b Coastal Zone Management

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

6.1.13.c Coastal Barrier Resources Act

Barren Island falls within the jurisdiction of the CBRA; however, it is classified as an "Otherwise Protected Area" (OPA). Under the Act, OPAs are not subject to restriction of Federal funds; therefore no consultation with USFWS is required (Appendix E). The beneficial impacts derived from shoreline restoration and protection and wetland restoration at Barren Island are consistent with the goals of the Act. James Island is not within the jurisdiction of the CBRA.

6.1.13.d Critical Areas

Barren Island and James Island are designated as Resource Conservation Areas under the Critical Area Law (MDNR, 2004e). Rare, threatened, and endangered species have been documented utilizing both Islands (see Section 3.1.10), and Barren Island is a designated colonial waterbird nesting site. Potential impacts to rare, threatened, and endangered species are discussed in Section 6.1.8. The beneficial impacts from the projects would be minimization of Critical Area habitat loss due to erosion, which is consistent with the goals of the Critical Area regulations. The MPA would consult with the Critical Areas Commission as the project progresses.

6.1.13.e Floodplains

All of Barren Island and most of James Island is classified as 100-year floodplain. The proposed projects at James and Barren Island are not expected to have adverse impacts to the existing floodplains. Construction of the project would actually create land located in the floodplain at James and Barren Island. Executive Order 11988 was taken into consideration for this project, although the project requires construction of a beneficial use project in an area that was once classified as a 100-year floodplain. Because the Federal government is self-insured, flood insurance is not necessary for the Mid-Chesapeake Bay project and a variance to the County's Floodplain Management Regulations is not applicable.

6.1.13.f Wild and Scenic Rivers

No water bodies with a "Wild and Scenic River" designation are located in the vicinity of the James Island or Barren Island project areas. Therefore, no impacts are expected to water bodies with Wild and Scenic River designations as a result of this project.

6.2 IMPACTS TO CULTURAL AND ARCHAEOLOGIGAL RESOURCES

Cultural resource studies at both James and Barren Islands were undertaken in accordance with Section 106 of the National Historic Preservation Act (NHPA) of 1966 as amended through 1992. These studies included archival research as well as a Phase I underwater archeological surveys conducted by PCI in the spring of 2004.

At James Island, archival research showed four historic or archeological sites located off the eastern shore of the southern remnant. Several of these sites are eroding into the Chesapeake Bay. No structures on James Island were listed or eligible for listing on the NRHP. During the Phase I underwater survey, four clusters of magnetic anomalies were found within the footprints of the proposed dike alignments. However, all four clusters appear to be geological features and not significant cultural artifacts. No further investigation was recommended by PCI (MPA, 2004k) and the State Historic Preservation Office (SHPO) concurred with this recommendation (Langley, personal communication, June, 2004).

There would be no adverse impacts to either terrestrial or submerged cultural resources from the proposed James Island restoration project. Present cultural resource sites on the Island remnants and shorelines eroding into the Chesapeake Bay could be beneficially impacted by the restoration through decreased erosion due to the shadowing effects of the project.

Archival research revealed five recorded archeological or historic sites along the northern and eastern shore of Barren Island, with most eroding into the Chesapeake Bay. There are no structures on Barren Island listed on the NRHP (MPA, 2002c). The Phase I underwater survey revealed three clusters of anomalies within the footprints of the proposed alignments. Two of the clusters could potentially represent significant submerged cultural resources, most likely shipwrecks, and were recommended for avoidance or further investigation by PCI (MPA, 2004l) and the SHPO concurred (Langely, personal communication, June, 2004).

The plan for the restoration/protection of Barren Island was modified since the archeological surveys were completed. The two clusters would not be within the current restoration/protection proposed in the recommended plan, so no impact is expected. However, due to its proximity to the proposed restoration/protection project, Cluster 1 would be avoided during construction operations.

The terrestrial cultural resource sites on the Barren Island remnants and shorelines currently eroding into the Chesapeake Bay could be beneficially impacted by the restoration by decreased erosion due to the shadowing effects of the project.

6.3 IMPACTS TO SOCIOECONOMIC RESOURCES

6.3.1 Future Land and Water Use

Changes in land use patterns could affect the level of potential impact of the Island restoration and protection projects. Residential trends in the vicinity of James and Barren Islands do not show high growth rates for either area. Most of the shoreline with views of both Islands is already developed, although the potential for increased density of development is possible. In The Neck County Subdivision at Taylors Island near James Island, some open agricultural areas have the potential to be converted to residential uses and Madison County Subdivision has experienced some residential development.

Since some traditional fisheries are in decline and tourism is being promoted in the county, commercial areas on Hoopers Island, near Barren Island, have the potential to be converted to residences or tourist destinations. Although oystering and clamming are in decline, fishing for crabs and finfish remains strong in the area.

The James Island restoration project is not expected to affect land use development patterns on the mainland. The project is well off-shore from the majority of developable lots that have views of the project. The Barren Island restoration/protection project has the potential to enhance the attractiveness of residential or tourism-oriented commercial development on the mainland, relative to the no-action scenario since it is expected to enhance aesthetics and habitat over the life of the project.

The proposed project is projected to affect wave heights impacting shorelines in the project vicinity. The future without-project wave heights near the shore in the lee of James Island are similar to the existing condition, with small increases in height over limited area. James Island is relatively far from the shore, so the impact of the proposed island alternative on the shoreline is relatively small. It is estimated that the proposed island would reduce the maximum wave height near the shore by as much as 2 feet. No increases in wave height along the shoreline occurred due to implementation of the alternatives.

Alternatively, the future without-project wave heights near the shoreline in the lee of Barren Island are significantly different than the existing condition. Wave heights at the shore could increase between 2 and 4 feet if the island degrades, thus posing a significant risk by increasing shoreline erosion and potential destruction of SAV habitat. Wave height increases of this magnitude would have significant consequences on land use and property. Barren Island is relatively close to shore compared to James Island, so the impact of the proposed island alternative on the shoreline is greater. Various breakwater configurations analyzed reduce the maximum wave height near the shore anywhere between 1.5 feet and 3 feet. No increases in wave height along the shoreline were identified due to implementation of the proposed project.

6.3.2 Employment and Industry

Table 6-11 summarizes the statewide impacts of the proposed James Island restoration project. The statewide economic impacts of dredging, material transport and placement, island restoration, and site maintenance and monitoring at James Island, are expected to be approximately $1.1 billion over 43 years and create approximately 8,000 direct person-years of employment over the life of the project. After multiplier effects are considered, this spending is expected to generate approximately of 18,500 total person-years of employment in Maryland. Project spending creates direct impacts associated with the project itself, but this spending also generates indirect impacts or multiplier effects that are associated with purchases and sales by businesses that supply inputs to businesses that are directly impacted by project spending. Businesses unrelated to the project may also benefit as increases in household incomes that result from direct and indirect economic impacts generate additional consumer spending and induced impacts. Total (direct, indirect, and induced economic benefits) statewide business sales are expected to generate $2 billion in direct business sales in Maryland over the life of the project (UMCES, 2006).

Table 6-12 summarizes the statewide impacts of the proposed Barren Island restoration project. The statewide economic impacts are expected to be approximately $36 million over 3 years and create approximately 300 direct person-years of employment over the life of the project. After multiplier effects are considered, this spending is expected to generate 690 total person-years of employment in Maryland. Project spending creates direct impacts associated with the project itself, but this spending also generates indirect impacts or multiplier effects that are associated with purchases and sales by businesses that supply inputs to businesses that are directly impacted by project spending. Businesses unrelated to the project may also benefit as increases in household incomes that result from direct and indirect economic impacts generate additional consumer spending and induced impacts. Total (direct, indirect, and induced economic benefits) statewide business sales are expected to generate $65 million in direct business sales in Maryland over the life of the project (UMCES, 2006).

Analysis shows that because of the imported inputs and labor, about half of the positive economic impacts associated with spending on dredging and material placement in Maryland are transferred outside the state. Analytical results also show that the use of dredged material to restore a Mid-Chesapeake Bay Island would generate economic long-term positive impacts that would last approximately 40 years from the time of initial site selection, through site development and construction, material placement, and site operation and restoration. Economic impacts would persist beyond 40 years as a result of long-term commitments to site monitoring and maintenance (UMCES, 2006).

Due to purchases of labor and inputs from elsewhere in Maryland and from out-of-state, Dorchester County would experience few direct economic impacts associated with dredging and material transport activities. However, the county would experience local economic impacts associated with material placement and transport activities that would involve work crews being stationed at nearby James and Barren Islands, and a significant share of economic impacts associated with habitat restoration work and long-term site operation, monitoring and management.

Table 6-13 summarizes the economic impacts of James Island restoration to Dorchester County. The analysis shows that of the $1.1 billion in overall project spending over 43 years, approximately $549 million would be spent in the vicinity of the James Island restoration/placement sites on site construction, management, and monitoring. A significant amount of the indirect and induced economic impacts of local spending would be transferred outside the region because of the need to import labor and material to the restoration sites. However, direct spending on the project is expected to generate nearly 3,000 person-years of employment in Dorchester County over the life of the project. After considering multiplier effects, the total number of Dorchester County jobs created by spending on the project, including new jobs for existing county residents or those who would relocate to Dorchester County, is estimated to be approximately 6,000 total person-years of employment over the 43 year life of the project, if the entire amount is spent within the county. If spending were spread over a larger economic area, jobs would shift to other counties within the area. Local multiplier effects of direct spending on James Island restoration is expected to result in indirect and induced spending of approximately $750 million over the life of the project (UMCES, 2006).

Table 6-14 summarizes the impacts of Barren Island restoration to Dorchester County. The analysis does not include spending on dredging, transport, and placement of dredged materials from Chesapeake Bay shipping channels. Therefore, much of this spending may be local. A significant amount of the indirect and induced economic impacts of local spending would be transferred outside the region because of the need to import labor and material to the restoration sites. However, direct spending on the project is expected to generate nearly 90 person-years of employment in Dorchester County over the life of the project. After considering multiplier effects, the total number of Dorchester County jobs created by spending on the project, including new jobs for existing county residents or those who would relocate to Dorchester County, is estimated to be approximately 300 total person-years of employment over the 3 year life of the project, if the entire amount is spent within the county. If spending were spread over a larger economic area, jobs would shift to other counties within the region. Local multiplier effects of direct spending on Barren Island restoration is expected to result in indirect and induced spending of approximately $50 million over the life of the project (UMCES, 2006).

[The numbers reported in the above section were determined by UMCES analyses in 2006. These numbers do not reflect the latest cost estimate that was based on October 2007 price levels.]

6.3.3 Economic Impact to Aquatic Resources

The impacts on commercial fisheries of Island restoration projects are associated with potential changes in the fishery resource, such as changes in the abundance, availability, or catch per unit effort, of fish. In addition, potential impacts on fishing operations are reflected by changes in travel time, searching time, or fishing time associated with the restoration projects. During development of the recommended plan, the project partners maintained a dialog with commercial fishermen to minimize any impacts caused by the projects. Details of the meetings and coordination are captured in Appendix G.

6.3.3.a Soft-shell and Razor Clam Fishery

The soft-shell clam (*Mya arenaria*) and the razor clam (*Tagelus plebius*) are the two commercially important clam species in the Chesapeake Bay. However, the soft clam has shown dramatic declines in catch and value in the vicinity of James and Barren Islands and baywide, over the past seven years. Dredging studies near James and Barren Islands show the densities of both soft and razor clams within either footprint are well below commercially harvestable levels.

No evidence suggests that clam densities would rise, so the level of future impact cannot be estimated. In summary, due to the lack of commercially productive beds and the low value of the potential catch, impacts on the commercial clam fisheries from restoration project at James Island and the restoration/protection at Barren Island appear to be negligible.

6.3.3.b Oyster Fishery

The areas around James and Barren are not currently commercially productive for oysters although they have been productive in the recent past. Potential adverse short-term impacts to any existing oyster beds in the area could result from suspended sediments caused by dike construction. No NOBs or current restoration areas are within either of the projects footprints, so if productivity were to increase in these nearby beds in the future, the projects would not be expected to have negative long-term impacts on oyster abundance.

Sediment transport from the modeled hurricanes and northeasters is not anticipated to negatively impact NOBs at James or Barren Island. Modeling results propose minimal reductions in sediment accretion at James Island (monitored points 2 and 3), but no erosion or accumulation. Modeling results for Barren Island propose no change or minimal reductions in sediment accretion over the NOBs (Points 9, 11, and 13 for hurricanes and northeasters), but no erosion or accumulation.

6.3.3.c Blue Crab Fishery

Based on interpretation of the crab surveys at James Island, most of the proposed footprint of the habitat restoration project is productive commercial crabbing area (Table 6-15). An estimated 1,900 ac of productive crabbing area would be displaced by the restoration project. The largest impact would be to the commercial crabbers who harvest the waters within the proposed project area and therefore would have to relocate their operations. Depending on the area they relocate to may increase fuel and equipment expenses if longer travel time is necessary to access the new location. The associated impact on the blue crab fishery would depend on the current productivity of the displaced area and the ability of crabbers to shift pots to new locations. Adverse impacts to crab abundance are not expected, as there would be no effect on spawning and critical habitat areas at James Island. There could be beneficial long-term impacts on crab abundance if SAV beds increase, providing increased blue crab nursery habitat. This would suggest the projects should have a negligible impact on catch rates and expected economic returns from crab fishing, as both crabs and waterman relocate to nearby areas. Due to the higher concentration of crabs in these nearby areas, catch rates may slightly increase (crab catch per ac), but increased fishing pressure in these areas (pots per ac) may offset these beneficial impacts. Based on evidence that the project would not affect crab abundance, it is expected that the economic impacts of the project on crab fisheries would be negligible.

The Barren Island restoration/protection project would be built in shallower water and would remove little, if any, amount of available area for crabbing. In addition, there should be no effect on travel time to place, tend, or collect crab pots. Therefore, the proposed restoration/protection project at Barren Island should have no impact on crabbing in that area.

6.3.3.d Finfish Fishery

The James Island restoration project is expected to result in short-term negative economic impact on the finfish fisheries during site development, followed by long-term positive economic impact. During initial site development, the placement of rip-rap and other construction activities may disturb both bottom sediments and water quality, causing increased turbidity. Also, construction activities may cause small, but unavoidable conflicts between equipment involved in site construction and fishermen as they travel to and from fishing areas and set gear. These impacts would be temporary and would subside once construction ends. After construction, there would be long-term beneficial impacts as the island habitats develop and provide improved fish habitat and fishing areas, and reduce turbidity in nearby fish habitat areas.

At James Island, the quantity of low value sand and mud bottom fish habitat would be reduced, however this area is considered too small to result in any decline in fish abundance, as most impacted fish populations are expected to find suitable alternative habitat nearby. The loss in the quantity of bottom fish habitat is expected to be offset somewhat by improving the quality of nearby fish habitat by reducing turbidity and providing underwater habitat structure in the form of rock reefs. Some commercial species may become more abundant as a result of the expected expansion of SAV beds, which provide nursery habitat, due to the wave and erosion-control that is expected to be provided by the restoration projects. Also, the restored wetlands would provide nursery habitat for some important commercial species. This is expected to be a long-term beneficial impact on commercial catch rates for some species.

At James Island, there would be impacts to non-active pound net sites, but not active pound nets. Pound net #290 crosses the proposed western dike, while northern #241 and the western (southern) #241 crosses the proposed approach channel, but would remain open water. The eastern #241 lies within the proposed footprint (Figure 3-15). Sediment modeling tracked bed elevation and maximum current speed changes in the vicinity of the James Island pound nets (Points 10 and 11). Modeling of Hurricane Hazel conditions and a northeaster (NE20) identified the potential for erosion (0.6 to 1 cm) at Point 11 in the approach channel. Conversely, Hurricane Isabel conditions and a northeaster (NE33) estimate a minimal amount of sediment accretion (0.2 to 0.3 cm) and no change, respectively. Bed elevation changes in the approach channel are therefore, expected to be dynamic with varying responses to storm conditions. Maximum current speed modeling results varied depending on the storm conditions that were simulated. Hurricane Hazel conditions estimate no change at Point 10 while Hurricane Isabel and NE20 resulted in an increase of approximately 0.5 ft/sec, and NE33 results identified a slight decrease in speed. Maximum current speeds at Point 11 responded more uniformly, identifying a decrease (0.26 to 1.55 ft/sec) for all storms. No significant impacts are expected to the James Island pound nets (even if they become active) as a result of changes to sediment transport from the proposed James Island alternative.

At Barren Island, there is a possibility that inactive net #194 and active net #20 would be affected and if the southern breakwater is extended, active #67 could be affected (Figure 2-16). Any impacts to active pound nets may result in the fisherman having to relocate. Although no monitoring points were evaluated in the vicinity of active net #20 there does not appear to be any significant changes to the hydrodynamic conditions that would affect net #20. Minor decreases in wave height during storms are the only perceivable impact. Sediment modeling reported bed elevation changes and maximum current speed for two points (16 and 17) in the vicinity of active pound net #67. Maximum current speeds resulting from proposed actions greatly depend on the type of breakwater implemented. Options involving 6 ft (high) breakwaters tended to reduce maximum current speeds during modeled hurricanes and northeasters. Low (4 ft) breakwater configurations had minimal affect on hurricane currents, but decreased northeaster hurricanes. Segmented breakwater options resulted in as much as doubled maximum current speeds at Points 16 and 17 under hurricane conditions. Conversely, modeled northeaster conditions produced reduced maximum current speeds at these two monitoring points. Bed elevation increases and decreases were slight for most breakwater configurations under modeled hurricane and northeaster conditions. However, segmented breakwaters resulted in anywhere from the erosion of approximately 42 cm to the accretion of 32 cm at Points 16 and 17 for modeled hurricanes. Low breakwater configurations also resulted in a modest change in bed elevation, particularly for Hurricane Isabel, ranging from erosion of approximately 3.4 cm and accretion of 4.7 cm. Hurricane Hazel conditions produced a smaller change of +/- 1 cm. Northeasters caused a minimal change to bed elevations. These bed elevation changes could be large enough to change the productivity of active net #67, resulting in the need to relocate #67.

The footprint of the planned restoration/protection project at Barren Island would not remove a significant amount of fin fishing area from use. The plan to place the dike in shallow waters ensures that the project would not overlap with areas used for pound net placement or gill net use.

For both sites, evidence suggests that the rocks used to build the dikes or the protection option would provide underwater structure and act as a fish attractor, potentially increasing abundance of certain species in the vicinity of the Island and potentially increasing commercial catches as a long-term beneficial impact.

6.3.4 Impacts to Environmental Justice

Environmental justice is the protection from negative health, environmental, and economic impacts from a project to every person regardless of color, race, culture, or income (USEPA, 2004b; E.O. 12898). The economic and environmental impacts of the recommended plans for James and Barren Islands are expected to be largely beneficial, so there would be no adverse impact, either short- or long-term, to environmental justice concerns.

6.3.5 Impacts to Public Safety

No health or safety risks to children or the public associated with the project have been identified so there should be no impact to public safety. Visitors to James and Barren Island during construction would be required to sign-in and follow all USACE safety policies. Following construction of Barren Island project components, USFWS would oversee visitation as Barren

Island is part of the Federal Wildlife Refuge system. Additionally, because the project is located offshore, the public would not have general access to construction areas located on site.

On April 23, 1997, President Clinton issued Executive Order 13045, "Protection of Children from Environmental Health Risks and Safety Risks." Under this Executive Order, Federal agencies are required to make it a high priority to identify and assess environmental health risks and safety risks resulting from its policies, programs, activities, and standards that my disproportionately affect children.

> *"A growing body of scientific knowledge demonstrates that children may suffer disproportionately from environmental health risks and safety risks…Therefore, …each Federal agency: (a) shall make it a high priority to identify and assess environmental health risks and safety risks that may disproportionately affect children; and (b) shall ensure that its policies, programs, activities, and standards address disproportionate risks to children that result from environmental health risks or safety risks." (Executive Order 13045, April 21, 1997).*

Children are particularly prone to potential environmental health and safety risks because a child's bodily systems are still developing and they ingest more in proportion to their body weight than adults do. A child's size and weight may reduce the effectiveness of standard safety features, and children's behavior patterns make them more susceptible to accidents because they are less able to protect themselves.

No health or safety risks to children associated with the project have been identified. The types of activities associated with the project would not generate chemical constituents that may pose health risks to children. Additionally, because the project is located offshore, children would not have general access to construction areas located on site.

The U.S. Navy Restricted Area 334.200 is located south and southwest of Barren Island. The only portion of the project that falls within the restricted area is the potential breakwaters extending south from Barren Island. There are not expected to be any adverse impacts to public safety by the location of these breakwaters within the northeastern tip of the restricted area.

6.4 IMPACTS TO AESTHETICS AND RECREATIONAL RESOURCES

6.4.1 Aesthetics

The general landscape character of the region's visual resources was discussed in Section 3.4.1 of this EIS. Some important aspects of the landscape for evaluating visual impacts are the characteristically long views enjoyed by observers on the water or shoreline, the low and relatively flat elevation of the region, and the lack of public access points to the waterfront (Figures 6-19 and 6-20). Due to these characteristic features, the Islands in this region are highly visible for viewers on or near the water, but, due to the flat terrain, are not generally visible from inland areas. Little of the shoreline in this region is publicly owned or accessible and therefore, visual effects on the shoreline primarily affect a relatively small number of residents and water users.

The affected land area for James Island includes primarily residential and agricultural areas along the Little Choptank River and Chesapeake Bay mainstem (Figure 6-21). Near James Island, 79 land parcels are likely to have a view of the project. Of these, 20 are agricultural (12 are improved), 1 is tax-exempt (owned by The Nature Conservancy), and the remaining 58 are residential parcels, although only 31 of those parcels currently contain houses or other structures indicating regular use. The Nature Conservancy (TNC) parcel, located at the northwest tip of Taylors Island, was previously the O'Donnell Island preserve, but the Island is completely under water and the parcel is no longer managed as a preserve. The level of aesthetic impact to that parcel should be minimal because the proposed footprint is north of the parcel and would not occupy a significant portion of the view. It is evident that the James Island restoration has the potential to be a significant element in the landscape for some sensitive viewpoints, but from the majority of vantage points the Island would blend into the existing landscape. The perceived level of dominance in the landscape would depend on the observer's sight line and distance to the project. Water users can be assumed to operate anywhere in the vicinity of the project, but the greatest number of boats in view of the restoration project at James Island would be passing through the area along the Chesapeake Bay mainstem channel and channels leading to the Choptank River. Transient boaters would have lower visual sensitivity than boaters using the waters around the Island. All boaters using the areas near James Island would have a clear view of the restored Island.

The restoration of James Island is generally harmonious within the setting since it is a restoration of the Island to the scale of its historical footprint. However, the shoreline of the Island is more regular than the natural shoreline and thus would contrast with existing shoreline. The effect of low dikes and breached dikes associated with wetland cells has the potential to minimize this contrasting effect from some views.

For Barren Island, the affected land areas are residences, commercial areas and roads on Upper Hoopers Island (Figure 6-22). Near Barren Island, 155 parcels would likely have a view of the project. The types of non-residential areas with views of the Island include boat launches, churches, and a waterfront restaurant. Transient views of the Island may be seen from secondary roads where the roads are close to the shoreline. Boaters near Barren Island would be able to see the existing Island, but would only see the protection from the western side of the Island. Further, the rocks and sand that make up the restoration/protection project are likely to be noticeable only by those within a half-mile of the Island.

The breakwater at Barren Island is an extension of an existing breakwater and a significant portion is out of view of the residences on the adjacent shoreline. For these reasons, the breakwater is expected to have minimal aesthetic impacts. Boaters using areas close to the site may notice some level of incompatibility between the natural shoreline and the breakwater. Any adverse impacts of the breakwater and restoration/protection project at Barren Island are expected to be offset by the aesthetic enhancements of preserving the existing Island. Barren Island introduces an element of natural land cover to views of the region that are otherwise dominated by residential and commercial uses. By preventing erosion of the Island, the project improves many measures of the quality of the view including land use diversity, percent of tree cover, proportion of natural land use in view, and range of vertical elevation.

6.4.2 Recreation

The intent of on-site recreation is to provide an educational and recreational experience that is consistent with project habitat restoration goals. Features would generally consist of signs, kiosks, trails or similar low impact elements.

The perimeter and cross dike roads built during construction of the James Island project are likely to be the main footpaths used for recreation. A few trails would include 6-foot wide boardwalks extending into some of the wetlands to provide wildlife viewing opportunities.

There may also be some small piers which would extend 30 to 50 feet from a road and cover a very small portion of wetlands and open water. The plants in the wetlands area under the piers would likely be shaded-out. The water under the piers would be shaded somewhat but would still provide aquatic habitat.

The pier would provide structure for fish to use and is likely to support a fouling community that would serve as a food source. The pier and pilings would provide cover for small fish and predators. It is anticipated that the area covered by the boardwalk and piers that lead into the marsh would likely cover less than an acre in total. The small piers constructed into the cells to permit water quality monitoring could also be used for recreation purposes but are not anticipated to increase the impact area beyond an acre.

The recommended recreation plans were discussed with Maryland State Office of Planning (SOP) (Joe Passone,pers comm). The recommended plan is not expected to conflict with the draft Maryland Lands, Preservation, Parks and Recreation Plan (LPPRP) that is currently being prepared.

6.4.2.a Fishing

An assessment of fishing areas indicates that little of the prime recreational fishing areas in the vicinity of James Island would be lost and remaining fishing areas have the potential to be enhanced. The high usage of the waters around James Island during certain seasons suggests there may be some potential for increased "fishing congestion" as the Island restoration project displaces some fishing activity to other areas. However, because the project footprint primarily takes up the shallow waters that are not prime fishing areas, and is not on routes between most fishing ports and fishing areas, the project's impact on the spatial allocation of fishing effort appears to be small.

The restoration of James Island would take up area of shallow Chesapeake Bay bottom, resulting in the loss of some shallow-water recreational fishing areas. For the James Island project, 2,072 ac of soft sands and muds and the overlying water would be converted to upland. However, the areas of primary interest to recreational fishermen in the vicinity of James Island are reported to be areas deeper than 15 ft. A moderate number of fishermen also use intermediate depths of roughly 5 to 15 ft and a small number of enthusiasts use the very shallow areas primarily to fish for red drum and spotted sea trout (Gary, personal communication, 2003). Because the number of recreational fishermen who seek out the shallow areas is relatively small, they should be able to shift to the abundant shallow areas adjacent to or near the site with minimal effect on congestion levels or catch rates.

For fishermen who target fish attracted to hard bottom, dike construction has the potential to increase local fish abundance and catch rates of these recreational species in nearby fishing areas. Few studies have been done to quantify effect on fish abundance of the "rock reefs" that are created by dike construction, but evidence suggests that the rocks serve to attract fish to an area. Observations from PIERP and other artificial reefs indicate that fish make use of the rocks at the base of dikes for feeding and shelter. Striped bass, in particular, have been observed in the vicinity of rock dikes around Poplar Island and thus appear to be among the fish attracted to the artificial reef created through rock placement (Paynter, personal communication, 2003). The addition of new rock piles associated with dike construction of the Islands is therefore expected to increase catch rates of the same types of fish currently targeted at James and Barren Islands.

In addition to the potential benefits of rock reefs, some recreational species may become more abundant as a result of the expansion of SAV beds due to the wave and surge protection and erosion-control that is expected to be provided by the restoration projects. Proximity to the high quality habitat provided by SAV beds would also be expected to enhance recreational catch rates for some species.

Other potential impacts of the project on recreational fishermen include changes in travel time or quality of the fishing experience. The effect of Island restoration on travel times to fishing destinations is not expected to be significant. Recreational fishermen would tend to use the same boat access channels and routes as commercial fishermen. Following the analysis done for commercial fishermen, it is expected that there would only be negligible effects on the time it takes most boaters to reach fishing destinations at either project location. Project construction is expected to have a temporary impact on fishermen due to noise and visual disturbances associated with construction activities.

6.4.2.b Boating

During and after project construction, fishermen wishing to access shallow waters and approaching James Island from the east might need to travel a mile or so farther west to reach open water, but this group represents a small proportion of fishermen. Most fishermen would already be traveling this distance to access the more popular deeper water fishing areas. In general, boats approaching the Island from the east, north and south would not change their routes significantly because Island remnants and shallow water already prevent passage of most boats directly through the zone of the proposed footprint. The passage from the south of James, between James Island and Taylors Island, into the Little Choptank River would remain accessible during and after Island restoration. Even the small boats that choose to use the shallow waters adjacent to the channels would not typically be required to change course to avoid the Island. Boats not under power (e.g., kayaks and canoes) are not major users of this area and are typically directed by tourist literature to inland destinations (Dorchester County Dept. of Tourism, Water Trails of Dorchester County).

The restoration/protection project at Barren Island is in water too shallow for most boats (1 to 3 ft) and would have no influence on navigation or movements of transient recreational boaters.

Because Barren Island is a wildlife preserve, it does serve as a destination for small motor or sail boats and boats not under power. The project would not prevent these small boats from reaching areas near the Island, or prevent access to the Island itself since the eastern side of the Island, which is the most convenient access point for small boaters, would not be hardened. In the long run, the project would tend to enhance this area as a destination for small boats since without the project, erosion is expected to reduce the size and the biological productivity and diversity of the Island.

Boaters in the vicinity of either Island during construction would be exposed to temporary noise and visual disturbances. Boats that are not fishing or lingering in the area would experience these effects for a short duration only. Boaters that wish to avoid the areas immediately around the project have many alternative boating areas and would not be prevented from reaching common boating destinations in the Choptank River. Some impact to small recreational boats approaching Barren Island should be expected during construction. Boaters would likely avoid the immediate area of Barren Island during the relatively short period when heavy equipment is in use. However, recreational boating areas that are similar to those near Barren Island and equally accessible are abundant in the area, so these temporary disruptions should not result in significant adverse impacts on local recreational boaters.

6.4.2.c Hunting

The recommended plan at James and Barren islands is highly likely to attract a variety of waterfowl to the area, and nearby hunting opportunities are expected to increase. Alternatively, loss of potential foraging habitat for waterfowl in the James Island vicinity could reduce hunting opportunities by decreasing waterfowl numbers in the area. Due to its status as a wildlife refuge, hunting is controlled and restricted at Barren Island. James Island is privately owned, and hunting at the privately owned existing island would be permitted at the discretion of the owner. While hunting may not be permitted on Barren Island, the waters near the Island have the potential to support hunting from boats or from adjacent shoreline. Waterfowl hunting is a popular type of hunting in the region and trends indicate that it would continue into the future.

6.4.2.d Wildlife viewing

Wildlife viewing opportunities are likely to increase with the restoration at James Island and the restoration and protection at Barren Island. If James Island is developed in a manner similar to that for PIERP, it is expected that a comparable level of trips to view wildlife would be generated as a result. The project would provide the opportunity to view the diverse wildlife living on James and Barren Island by preventing loss of island area and thus of species available for viewing. During construction, the project may detract from uses related to wildlife viewing in the area. Visitation during periods such as nesting and rearing could have a potential impact to some species. Many bird species would use habitat deep in the marsh and would not be disturbed by visitors on the dike footpaths. .However, some species may be disturbed by visitors using the footpaths. Appropriate signage would be installed to notify visitors of their potential impact and to advise them to avoid or use caution when near these areas.

Birding is likely to be the largest component of wildlife viewing trips to James and Barren Islands. Roughly 22% of Maryland residents participate in birding (USFWS, 2001). Continued interest in viewing waterbirds and shorebirds is likely to drive interest in viewing birds both from James and Barren Island and from the water surrounding both islands into the future.

6.4.2.e Educational Uses

Similar to wildlife viewing, educational opportunities would be expected to increase with the development of a publicly accessible Island at the restored James Island and by preserving educational opportunities at Barren Island.

6.4.2.f Other Recreational Activities

The areas adjacent to James and Barren Islands are promoted as scenic destinations by both State and county promotional materials. During construction, the project may detract from uses related to sightseeing in the area. Also, noise during rock placement may have a minor impact on outdoor social activities of residents and tourists such as outdoor dining and backyard picnics by introducing higher than normal background noise levels.

The long-term impact of the James Island restoration on sightseeing would not be expected to be significant, although this would depend on final configuration of the restored James Island. Since James Island is several miles offshore from most scenic vistas, the restored James Island is likely to become part of the background landscape adding an area of natural vegetation to the view as vegetation matures. The project at Barren Island would be preserving part of the diversity of views in the vista and is likely to enhance sightseeing.

6.5 ECOSYSTEM BENEFITS

6.5.1 Ecosystem Restoration

The proposed James Island restoration project would preserve approximately 100 ac of existing wooded, fringe marsh, and beach Island habitat that is subject to rapid erosion. The restored James Island habitat would consist of approximately 1,140 ac of wetlands such as fringe marsh and 932 ac of upland habitat within the cells. The proposed Barren Island restoration and protection component would create approximately 72 ac of wetland habitat and preserve approximately 180 ac of existing wooded, fringe marsh, and beach Island habitat that is subject to rapid erosion.

Island habitat is important to Chesapeake Bay ecology because it contributes nesting, foraging, and resting habitat to birds, aquatic species, and other animals that is isolated from human disturbances. This habitat is rapidly disappearing from the Chesapeake Bay (USACE, 1999). The projects at James Island and Barren Island are also expected to produce long-term reductions in suspended solids in the surrounding waters by reducing shoreline erosion on the remnant Islands and nearby shoreline. Improved water clarity is expected to promote SAV growth, which would provide additional beneficial habitat to animal species. PIERP, the existing environmental restoration project using dredged material, has been documented to provide habitat to nesting diamondback terrapins, fish, nesting birds, and SAV (MES, 2004a). Similar habitat utilization has been documented on James Island and Barren Island, and it is expected that the shoreline protection and environmental restoration project would attract similar species and uses.

The proposed recreational features are expected to have minimal impacts on the quantified environmental benefits (ICUs). The impacts of typical recreational features are discussed under Section 6.4.2.

6.5.2 Beneficial Use of Dredged Material

Clean dredged material has the potential to be a valuable natural resource when beneficially used. USACE policy directs dredging projects to maximize public benefits, and beneficial uses of dredged material are included as a component of that policy. Beneficial use options include habitat restoration and enhancement, beach and shoreline nourishment, parks and recreation, agriculture and forestry, strip mine reclamation, landfill cover, industrial or commercial development, or combinations of multi-purpose land uses (USACE, 1992). By beneficially using suitable dredged material, a restored Island(s) or shoreline protection can be constructed to replace or preserve hundreds of acres of wetland and upland habitat. The restoration and preservation of this habitat would provide long term beneficial impacts of improved productivity to the surrounding area, while providing an environmentally sound method for the use of dredged material removed from Chesapeake Bay channels as currently identified in the Federal DMMP study process. Island restoration is a particularly suitable use of dredged material from the upper Chesapeake Bay shipping channels, as the sediments are too silty to be used for beach replenishment activities.

6.6 IRRETRIEVABLE USES OF RESOURCES

During construction of the restoration project, some resources would be either expended in construction activities or impacted by those activities. If the resource is not renewable (e.g., something that reproduces), it may be irretrievable. Irretrievable resources come from both on-site and off-site sources. The most significant off-site irretrievable resource would be the stone (gravel and armor) required for dike construction. This would be quarried from off-site locations and, once placed, would become a permanent component of the Chesapeake Bay bottom in that area. The sand required for dike construction would be borrowed from on-site locations, although it would no longer be available for alternate uses. Since open water sand mining has never been likely here, this use would be considered insignificant. The consumption of the fossil fuels used for project construction is also a significant irretrievable committal of resources.

The most significant on-site irretrievable loss would be the covering over of approximately 2,072 ac of Bay bottom (which includes 299 ac of shallow water habitat) at James Island and approximately 100 ac of shallow water habitat at Barren Island, a total of 2,172 ac. These losses have been considered among the impacts of construction and would be offset, in the long-term, by the increased productivity associated with functioning salt marshes, the addition of rock jetties, and the increased habitat value of protecting the existing SAV beds and potential promotion of additional beds at both James and Barren Islands. Although, open water would be replaced with island habitats by the recommended plan, this is open water that historically was island habitat and the long-term effects to aquatic resources are expected to be beneficial. Foraging waterfowl would be displaced at James Island. It is expected that they would be able to find similar foraging grounds nearby.

Additionally, current project costs are estimated at $1.56 billion, which would not be available for use on other projects.

6.7 CUMULATIVE IMPACTS

6.7.1 Definition

Cumulative impacts are those combined effects on quality of the human environment that result from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions, regardless of what Federal or non-Federal agency or person undertakes such other actions [40 CFR 1508.7, 1508.25(a), and 1508.25(c)]. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time or taking place within a defined area or region, or from these minor impacts combined with major impacts. It is the combination of these effects, and any resulting environmental degradation, that should be the focus of cumulative impact analysis. Thus the cumulative impacts of an action can be viewed as the total effects on a resource, ecosystem, or human community of that action and all other activities affecting that resource.

'Effects' include both direct effects and indirect effects, as defined in Section 5.2. Consistent with the CEQ regulations, effects and impacts are used synonymously (USEPA, 1999). Effects include ecological (such as the effects on natural resources and on the components, structures, and functioning of affected ecosystems), aesthetic, historic, cultural, economic, social, or health, whether direct, indirect, or cumulative. Effects may also include those resulting from actions that may have both beneficial and detrimental effects, even if on balance the agency believes that the effect would be beneficial (40 CFR 1508.8).

6.7.2 Sources of Cumulative Impacts

Activities warranting greatest attention in the cumulative impacts subsection are those activities that in combination with the proposed project at James and Barren Island would potentially magnify what are perceived by resource agency personnel and the public as the most significant impacts of the proposed work in the Mid-Bay Region of the Chesapeake Bay. These activities meriting particular scrutiny include: 1) conversion of significant areas of open water and Chesapeake Bay bottom habitat, including shallow water habitat, to island habitat, 2) creation and/or restoration of Chesapeake Bay tidal wetlands, and 3) alterations to aesthetics and visual qualities of existing viewshed conditions. Other categories of environmental and socioeconomic impacts also warrant scrutiny for comprehensiveness as listed in the discussion of 'effects' presented above. To fairly assess and evaluate the cumulative impacts of anthropogenic influences in these categories, it is also appropriate to incorporate consideration of how ongoing pertinent natural processes interact with human activities.

The cumulative impacts of the proposed action in association with other known Federal projects in the cumulative impact area are addressed in this section. The recommended plan is an island restoration project at James Island and island restoration and protection at Barren Island. The introduction of Section 6 of this report identifies the cumulative impact area as the area along the eastern shore between Eastern Bay and the Hoopers Island Chain. Recent and reasonably foreseeable human actions that have converted or would convert open water habitat to island upland and tidal wetland habitat include the existing PIERP, an authorized expansion of PIERP, the Smith Island Ecosystem Restoration Project, the Tangier Aquatic Ecosystem Restoration Study, the Taylors Island Ecosystem Restoration Study, and the wetland restoration in Dorchester County (Blackwater NWR). The cumulative areal impact of these USACE projects would total approximately 3,900 acres of open water habitat. However, together the completed PIERP, its proposed expansion, the proposed projects at Smith Island and Tangier Island, and the proposed action would restore approximately 3,565 ac of island habitat for birds and wildlife in the Mid-Bay. These losses and gains are discussed in more detail by resource and by project in Section 6.7.3 below.

Federal and State laws generally restrict filling of open water to protect the Chesapeake Bay ecosystem, other than for some reclamation of lands lost to recent erosion. Consequently, there are no other public or private actions foreseeable at this time that would contribute substantially to the cumulative open water impacts of the USACE projects described above. Historically, more than 10,000 acres of large island habitat have been converted to open water in the Mid-Bay region since European settlement (Kearney and Stevenson, 1991; Leatherman, 1992; Wray *et al*., 1995).

Because of the value imparted to tidal wetlands by society, this resource is largely being protected from direct loss by anthropogenic influences. Consequently, although development and dredging historically caused the loss of substantial tidal wetlands in the Chesapeake Bay, this is not occurring today nor is it likely to occur in the foreseeable future. Still, anthropogenic tidal wetlands losses result as an indirect consequence of shoreline stabilization practices that interrupt the flow of sediments necessary to create and maintain tidal marsh substrates and/or that prevent landward migration of these ecosystems as sea level rises are likely occurring on a significant scale in the Chesapeake Bay (Titus *et. al*, 1998) and most likely, the mid-Bay as well. Inventory data to characterize tidal wetlands trends in the Mid-Bay is available, but no recent characterization of trends has been made. However, based on trends through the 1990s (Tiner *et. al*, 1994), it is likely that a net loss is occurring.

The island restoration/creation projects described in the paragraphs above could also be considered to have some cumulative effect on visual and aesthetic qualities of the region. However, the views of people and land or water are limited by the distance to the horizon. Since most of these projects are tens of miles apart, the cumulative aesthetic and visual impacts of the proposed work would likely only be a valid concern when the area is viewed from high altitudes.

6.7.3 Cumulative Adverse Impacts

The recommended plan would permanently convert a total of 2,172 ac [2072 ac at James Island (including 299 ac of shallow water habitat) and approximately 100 ac at Barren Island of open Bay bottom near James Island and Barren Island to wetlands and upland habitat; bottom substrates along with any existing benthic community or SAV resources and waterfowl foraging habitat would be buried. Any transient aquatic species and commercial fishing activity in the 2,172 ac area would also be displaced.

The existing PIERP facility and the authorized lateral expansion of approximately 575 acres distributed as 167 ac wetlands (29%), 270 ac upland (47%), and 138 ac open water embayment (24%) are also evaluated as part of the cumulative impacts. The proposed Smith Island Ecosystem Restoration Project (Smith Island project) would use segmented breakwaters to restore approximately 24 ac of wetlands, protect an additional 216 ac of wetlands, and protect up to 1900 ac of SAV habitat. The Tangier Island Aquatic Ecosystem Restoration Study (Tangier Island study) proposes to restore approximately 3 ac of wetlands and protect an additional 359 ac of wetlands. Additionally, there is an annual, regional loss of shoreline/gain of shallow open water associated with shoreline erosion. The Taylors Island Ecosystem Restoration Project (Taylors Island project) is proposing to protect approximately 150 acres of tidal wetlands that are adjacent to the Taylors Island Wildlife Management Area from erosion; stabilize the shoreline along Punch Island Road; and use dredged material to create approximately one acre of wetland on the northwest shoreline of Barren Island. Given the trends of island and wetland loss, the need to place dredged material provides an opportunity to address this loss.

The 1 acre wetland restoration at Barren Island as part of the Taylors Island project is still under consideration. If it should become a recommendation and is constructed, it would be incorporated into the Barren Island measures being proposed as part of the Mid-Bay Islands Project. The authorized PIERP expansion would extend the facility northward, converting approximately 575 ac of shallow water habitat actively used by commercial crabbers. The proposed SAV and wetlands restoration projects at Smith and Tangier Islands would convert 24 ac of open water and 3 ac of shallow water habitat, respectively, to wetland habitat. The combination of the recommended plan, the PIERP expansion, the proposed Smith Island project, and the Tangier Island study have potential for adverse cumulative impacts to result from the net conversion of shallow water habitat that supports commercial crabbing. This conversion is in addition to the approximately 1,140 ac of converted bottom to fisheries resulting from construction of PIERP. Beneficial use of dredged material was recommended as a method of replacing habitats lost through development, sea level rise, and erosion activities within the study area (USACE, 2004a); impacts of shallow water losses incurred from beneficial use projects may be offset by these mechanisms of habitat loss. Due to beneficial use, commercial crabbing and other fisheries are likely to receive long-term benefits from additional SAV and fringe marsh habitat being created in the Chesapeake Bay, as these habitats act as nurseries, refuges, and feeding grounds for commercial species.

Armoring, or “hardening”, a shoreline is a protection measure that typically consists of installing dikes, riprap, or bulkheads adjacent to a shoreline to prevent erosion. Shoreline hardening has been estimated to be occurring at a rate of 10 to 25 miles per year on the Maryland portion of the Chesapeake Bay shorelines (Titus, 1998). Shoreline hardening can be considered an adverse impact because it can replace natural shoreline, and because it results in a trend of losing ecologically important intertidal areas such as marshes, beaches, and mudflats. The Taylors Island project would contribute a stone revetment along Punch Island Road and 12 breakwaters. The Mid-Chesapeake Bay Islands project proposed action would add approximately 40,000 ft of armored shoreline at James Island and a maximum of 3,350 ft at Barren Island, for a total of approximately 43,350 ft of additional armored shoreline to the Chesapeake Bay watershed. Eventually, some of the hardened shorelines on the eastern side of the constructed island would eventually be exposed to the Chesapeake Bay.

6.7.4 Cumulative Beneficial Impacts

Section 2.1, 3.1, and 3.1.7 of this report have documented the continued loss of remote island habitat in the Chesapeake Bay due to erosion. Although there is insufficient data available to estimate long-term trends of tidal wetlands acreage in the Chesapeake Bay, data indicates that the Chesapeake Bay has suffered a net loss of tidal wetlands as a consequence of development, agriculture, and rising sea level. It is estimated that the Chesapeake Bay has lost about 9% of its tidal wetlands to dredging, filling, and impoundments between the 1950s and early 1980s (USGS, 2003). The high productivity of tidal marshes and their trophic linkage to the water column supports many important ecological functions of the Chesapeake Bay. The proposed action would protect existing marsh habitat and natural shorelines on the remnant islands, and create additional wetlands habitat, which would produce energy for the ecosystem. The upland restoration component of the James Island restoration project would contribute organic materials and litter to the aquatic and wetlands systems. The energy derived from the tidal exchange with the marshes and the contribution of the upland areas is expected to support the aquatic food web that supports finfish and shellfish such as striped bass, spot, bluefish, oysters, crabs, and clams.

The recommended plan combined with the authorized PIERP expansion, the proposed Smith Island project, the Tangier Island project, and the Taylors Island project is expected to have cumulative beneficial impacts in the long term by restoring and protecting Chesapeake Bay island ecosystems from further shoreline erosion, adding a total of approximately 3,565 ac of remote island habitat in the Chesapeake Bay, including Sensitive Species Project Review Areas (SSPRA). This acreage includes 1,872 ac of wetlands and 1,693 ac of uplands. The proposed Dorchester County wetland restoration at Blackwater National Wildlife Refuge could provide an opportunity to restore thousands of more wetland acres within a region where over 10,000 acres of remote island habitat have been lost. Many of the cumulative benefits of protecting and creating additional island habitat are associated with the ecological services provided by restoring wetland habitats, protection of existing habitats, and habitat diversification. This amounts to approximately one-fourth of the Mid-Chesapeake Bay Island acreage that has been estimated to have been lost.

The protection that the proposed action would provide to James Island, Taylors Island, Barren Island, and the Hoopers Island chain would promote improvements in water quality and aquatic resources in the project area. Although elevated levels of suspended sediments are expected to be a short-term impact during dike construction, the proposed action is expected to have beneficial long-term impacts to water clarity in the mouth of the Little Choptank River (for James Island) and in the vicinity of Hoopers Island (for Barren Island) by controlling erosion. Continuous erosion of the existing James Island and Barren Island remnants is contributing to elevated concentrations of suspended sediments in the water column. As discussed previously in this section, high levels of suspended sediments are stressful for aquatic species and reduce SAV growth. Long-term erosion control provided by the proposed action is expected to improve water clarity, and potentially DO levels in the water column by encouraging SAV growth. In addition to restoring the James Island remnants, and restoring and protecting the Barren Island remnants from further erosion, the recommended plan is expected to also protect surrounding shoreline on populated Taylors Island and Hoopers Island, respectively (MNE, 2004). The proposed Smith Island, Tangier Island, and Taylors Island projects would also greatly slow the rate of erosion along the shorelines of these islands, protecting substantial acreage of existing tidal wetlands from erosion and associated impacts to local water quality. Long-term beneficial impacts associated with preserving existing natural shoreline areas on James Island, Barren Island, Hoopers Island, and Taylors Island from further erosion can potentially offset adverse impacts caused by necessary armoring of the James Island restoration and Barren Island restoration/protection project perimeters. The existing PIERP facility, its expansion, the proposed Smith Island project, the Tangier Island project, the Taylors Island project, and the proposed action are expected to create long-term beneficial impacts to local water clarity along the eastern shore between Eastern Bay and the Hoopers Island chain.

Loss of island habitat in the Chesapeake Bay reduces local biodiversity. James Island and Barren Island are valuable habitat in the Chesapeake Bay ecosystem, and are designated as critical areas. Barren Island is also part of Blackwater National Wildlife Refuge. James Island and Barren Island are important breeding, foraging, and resting habitat for waterfowl, wading birds, and other wildlife species. Islands provide refuge for birds and other wildlife from human disturbance, and some protection from potential predators. The design of the proposed action would maximize the habitat value of shallow water, wetland, and upland habitats. PIERP has attracted a variety of nesting, resident, and transient species such as colonial waterbirds, wading birds, and terrapins before the habitat restoration at that site is completed. The proposed action is expected to attract similar species, which would be monitored as per Section 8. Together, the completed PIERP, its proposed expansion, the proposed projects at Smith Island and Tangier Island, and the proposed action would create approximately 3.565 ac of island habitat for birds and wildlife in the Mid-Bay.

Cumulative impacts from the preservation of the existing James Island and Barren Island, construction of the proposed action, the existing PIERP site, the authorized expansion of PIERP, and the proposed projects at Smith Island, Tangier Island, and Taylors Island would benefit habitat for some rare, threatened, or endangered species. As discussed in Section 3.1.10, James Island and Barren Island provide habitat for several State or Federal rare, threatened, or endangered species, such as bald eagle, royal tern, and least tern. The proposed action would preserve the existing James and Barren Islands that are currently utilized by the documented endangered species, and also create 2,144 ac of additional habitat for nesting and foraging of these species. PIERP has demonstrated the ability to attract endangered species such as least tern for nesting, and the proposed habitat restoration project at James Island and the restoration/protection at Barren Island are expected to attract similar species. The proposed action in combination with the existing habitat at the PIERP facility, the authorized PIERP expansion, and the proposed projects at Smith Island, Tangier Island, and Taylors Island would protect existing rare, threatened, and endangered species habitat along the eastern shore of the Mid-Chesapeake Bay, and create approximately 3,565 ac of additional nesting, resting, and forage habitat.

Estuarine wetlands and shallow water environments serve as nursery and foraging grounds for finfish and shellfish. Approximately 700,000 ac of the Chesapeake Bay mainstem and rivers have a depth less than 6 ft. Although the proposed action would displace bottom used for shellfisheries, it is expected to provide beneficial cumulative impacts to finfish and shellfish habitat by creating 1,232 ac of intertidal and wetlands habitat at James Island and Barren Island that would provide detrital input to the ecosystem. The proposed action would also restore a complex of upland, wetland, and nearshore habitats that would provide the trophic foundation, cover, nursery function, and forage area for all life stages of desirable commercial species. The habitat provided by the existing PIERP, its expansion, the Smith Island project, the Tangier Island project, the Taylors Island project, and the proposed action would contribute to the production of the commercial fishery and also attract various life stages of commercial species to nearshore environment around the projects.

6.8 COMPLIANCE AND ENVIRONMENTAL REQUIREMENTS

To help assure environmental acceptability of the project, implementation of the recommended plan must comply with applicable Federal regulations. This EIS and feasibility study process is a mechanism for meeting the environmental compliance needs of the project during the planning phase. Table 6-16 lists Federal statutes, executive orders, and other regulations that are potentially applicable to the recommended plan and identifies its level of compliance with each. Additional details on these statutes and documentation of compliance is provided in Appendix E.

CEQ regulations also mandate consistency of the proposed project with all applicable state, regional, and local guidelines. Compliance with State and Federal regulations is achieved through the environmental studies conducted for this EIS, and through consultation with the appropriate agencies and public groups. Public involvement and agency coordination are discussed further in Section 9.0. Additional consultation with state agencies may be required for construction and dredged material placement operations of the proposed projects at James Island and Barren Island. For instance at PIERP, MDE has requested that the similar island habitat restoration project perform water quality sampling above what is designated in that facility's water quality certification or wetlands license.

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SECTION 6

FIGURES

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Figure 6-1: Hydrodynamic and sediment model output locations at James Island

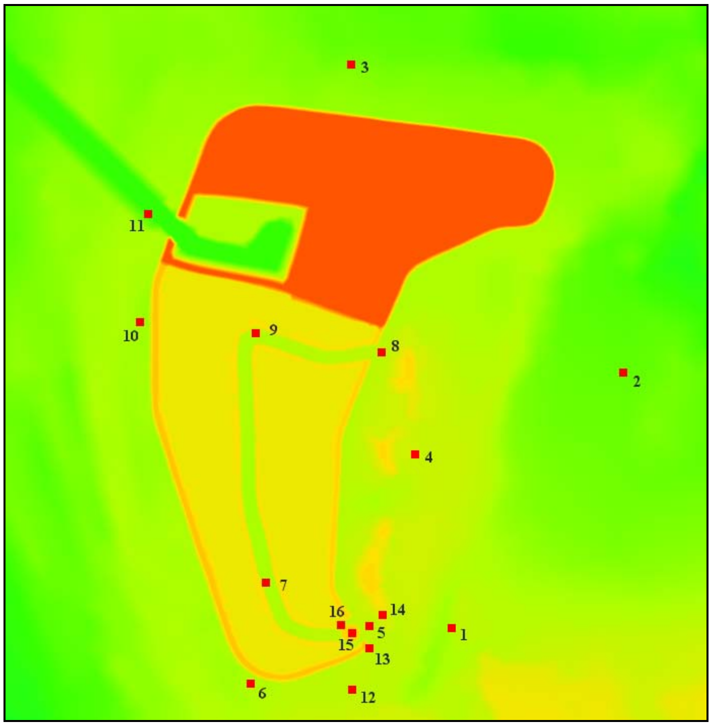


Figure 6-2: Hydrodynamic and sediment model output locations at Barren Island

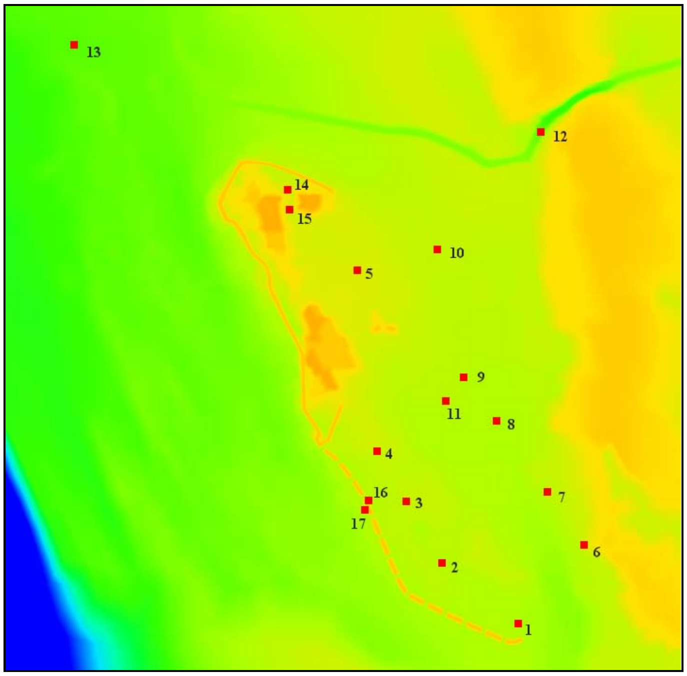


Figure 6-3: James Island wave height difference in feet (Alt – existing). Northeast grid, H = 5.0 ft, T = 5 sec, water level = 2 ft (mtl), wave direction = 30 deg

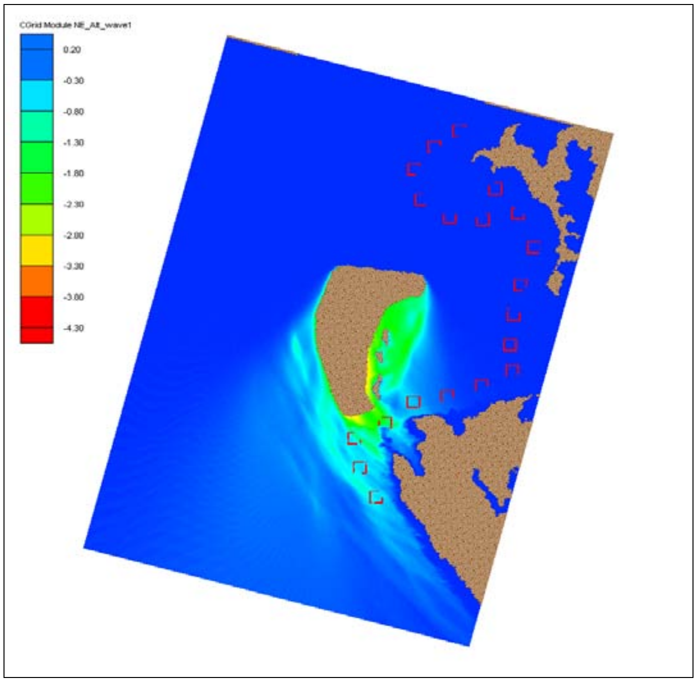


Figure 6-4: James Island wave height difference in feet (Alt – existing). South grid, H = 10 ft, T = 7 sec, water level = 5 ft (mtl), wave direction = 170 deg

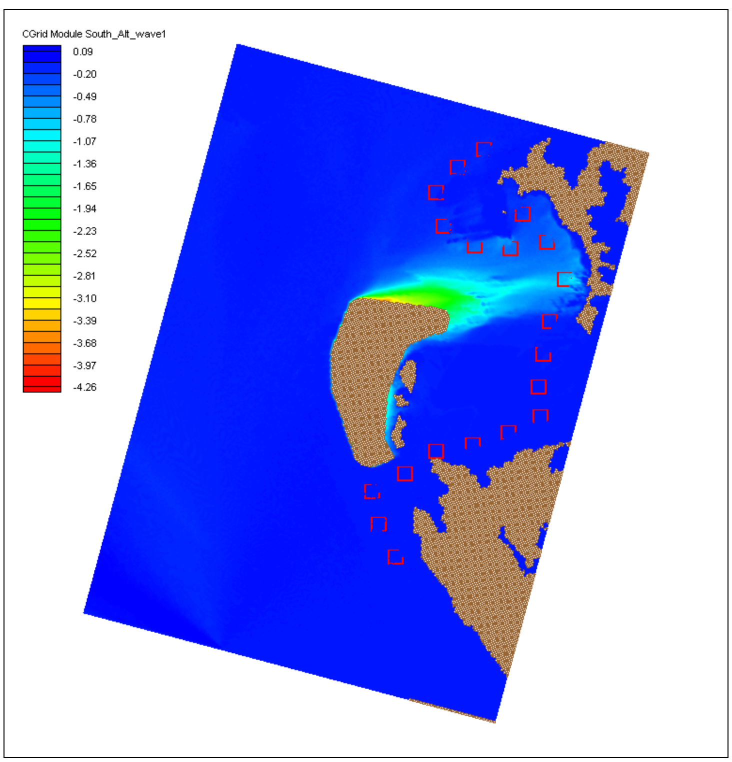


Figure 6-5: James Island wave height difference in feet (Alt – existing). West grid, H = 4 ft, T = 4 sec, water level = 4 ft (mtl), wave direction = 270 deg

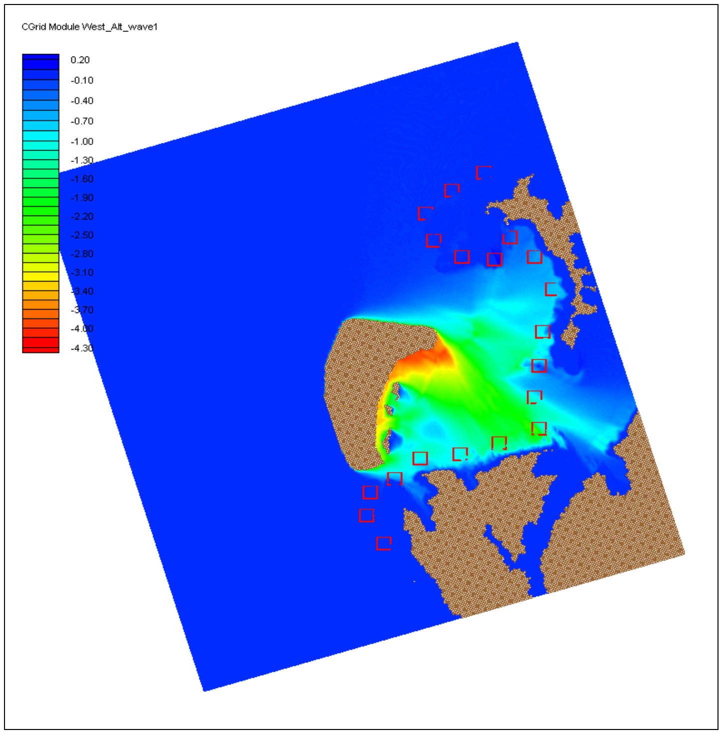


Figure 6-6: James Island wave height difference in feet (Alt – existing). Northwest grid, H = 7 ft, T = 5 sec, water level = 2 ft (mtl), wave direction = 343 deg

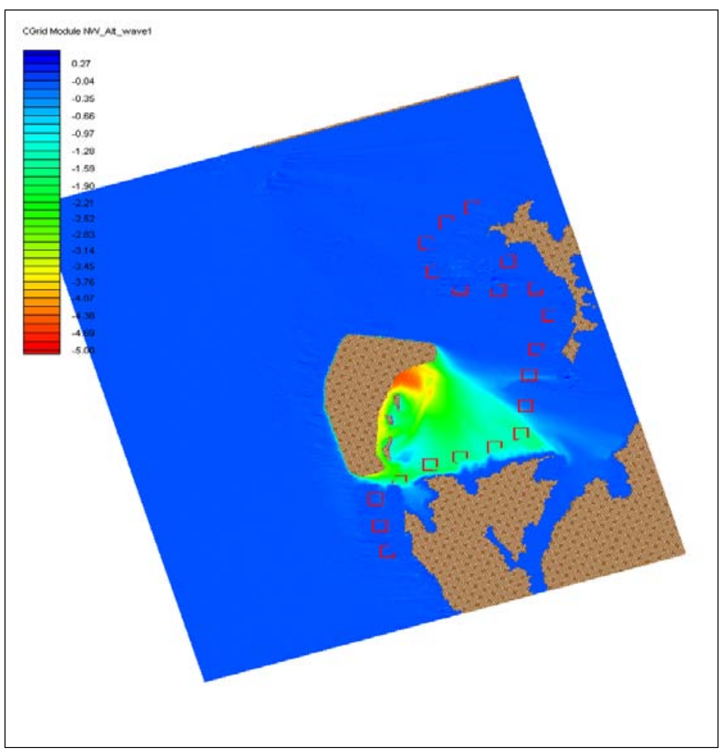


Figure 6-7: James Island wave height difference in feet (future without-project – existing). Northeast grid, H = 5 ft, T = 5 sec, water level = 2 ft (mtl), wave direction = 30 deg

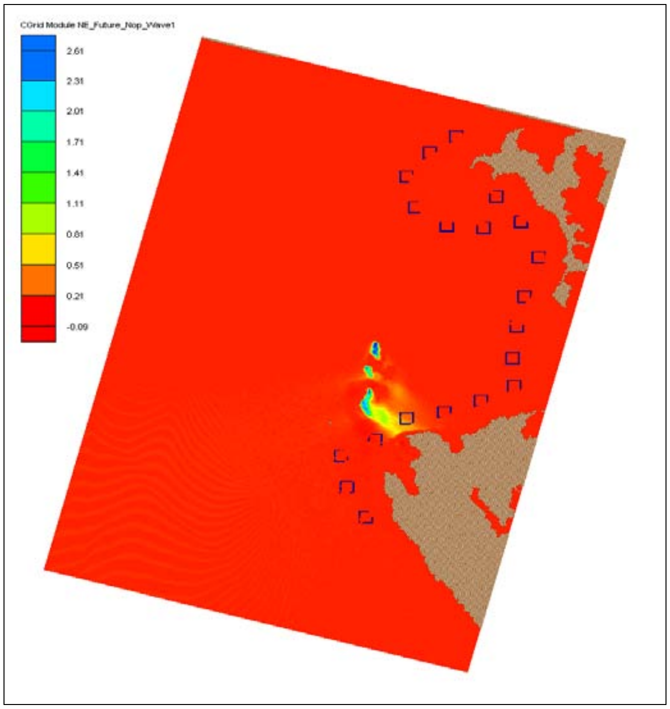


Figure 6-8: James Island wave height difference in feet (future without-project – existing). South grid, H = 10 ft, T = 7 sec, water level = 5 ft (mtl), wave direction = 170 deg

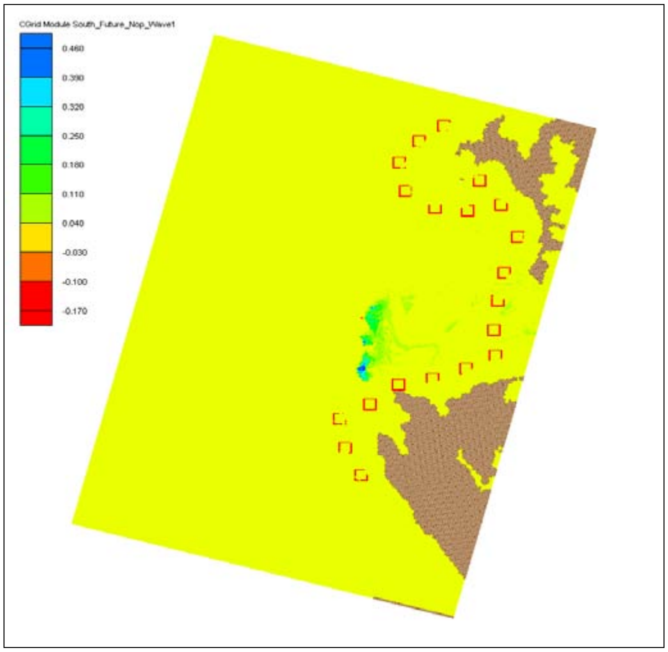


Figure 6-9: James Island wave height difference in feet (future without-project – existing). West grid, H = 4 ft, T = 4 sec, water level = 3 ft (mtl), wave direction = 270 deg

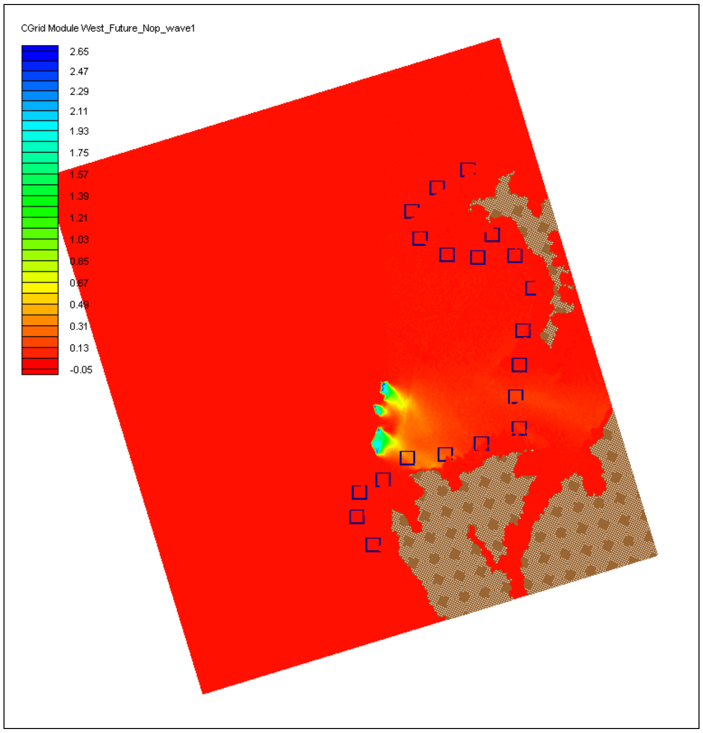


Figure 6-10: James Island wave height difference in feet (future without-project existing) Northwest grid, H = 7 ft, T = 5 sec, water level = 2 ft (mtl), wave direction = 343 deg

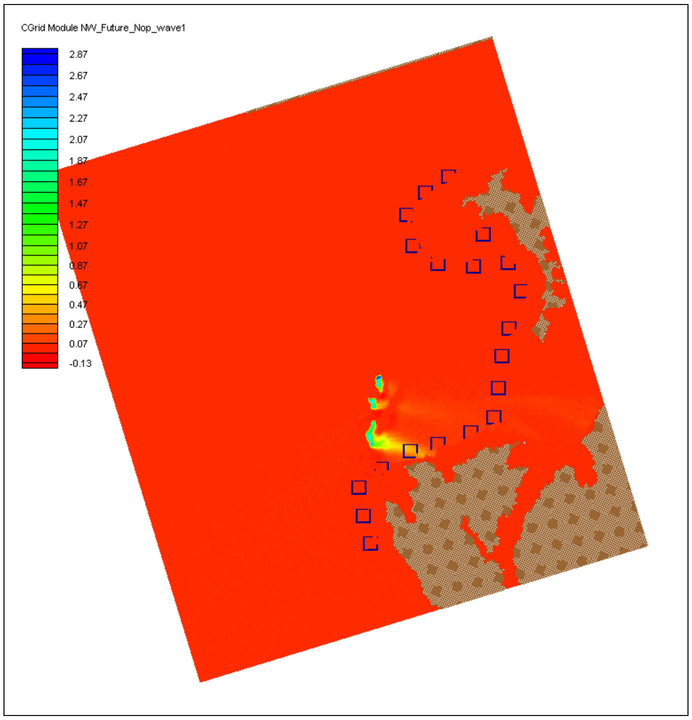


Figure 6-11: Barren Island wave height difference in feet (Alt BI-1 – existing). Northwest grid, H = 6.5 ft, T = 5 sec, water level = 3 ft (mtl), wave direction = 330 deg

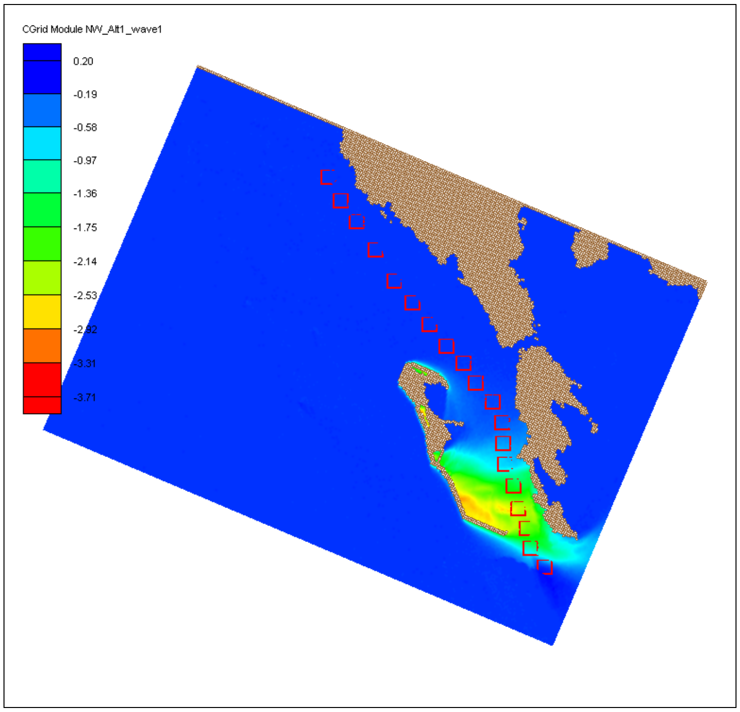


Figure 6-12: Barren Island wave height difference in feet (Alt BI-1 – existing) Southeast grid, H = 14 ft, T = 7 sec, water level = 5 ft (mtl), wave direction = 170 deg

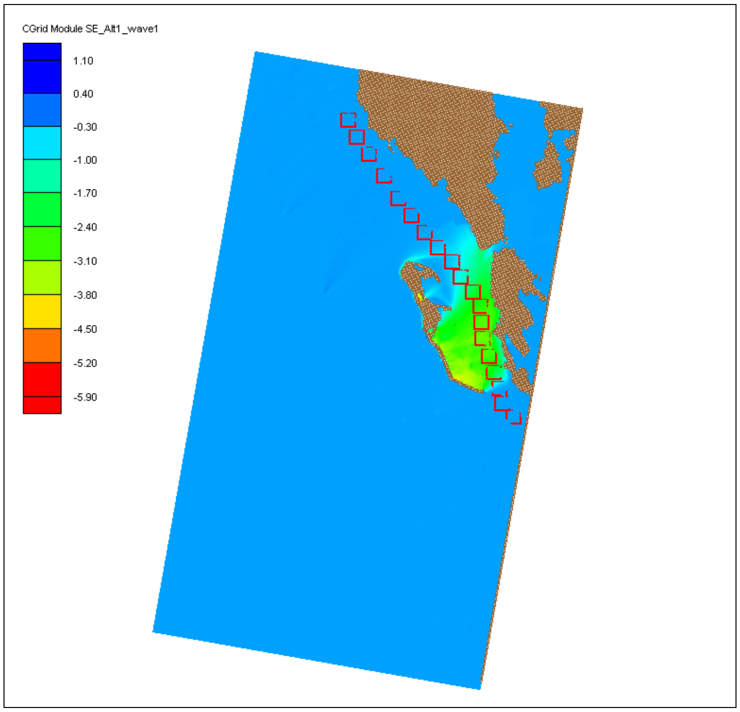


Figure 6-13: Barren Island wave height difference in feet (Alt BI-2 – existing). West grid, H = 3 ft, T = 3 sec, water level = 3 ft (mtl), wave direction = 260 deg

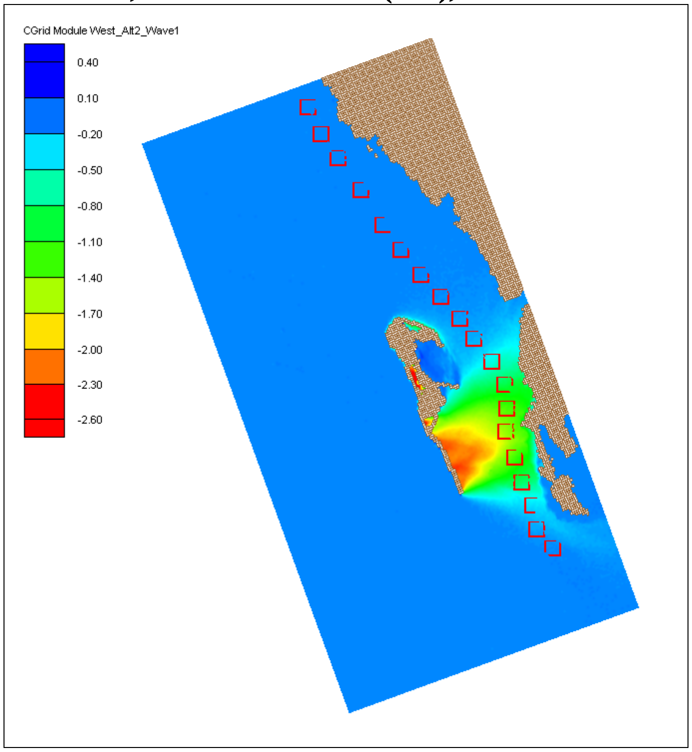


Figure 6-14: Barren Island wave height difference in feet (future without-project existing). Northwest grid, H = 6.5 ft, T = 5 sec, water level = 3 ft (mtl), wave direction = 340 deg

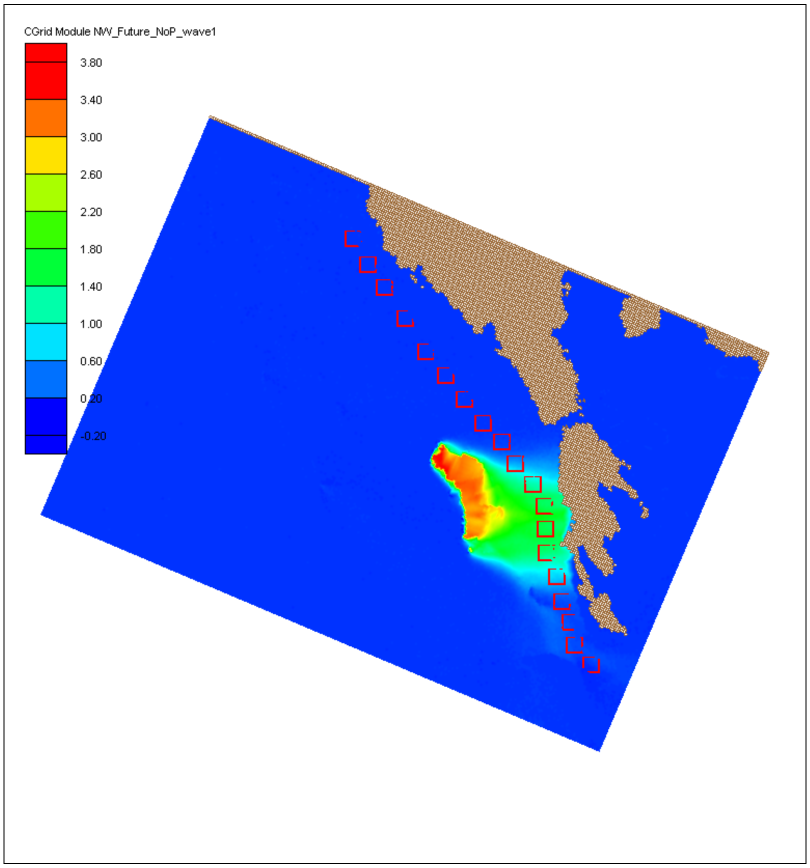


Figure 6-15: Barren Island wave height difference in feet (future without-project existing). Southeast grid, H = 14 ft, T = 7 sec, water level = 5 ft (mtl), wave direction = 170 deg

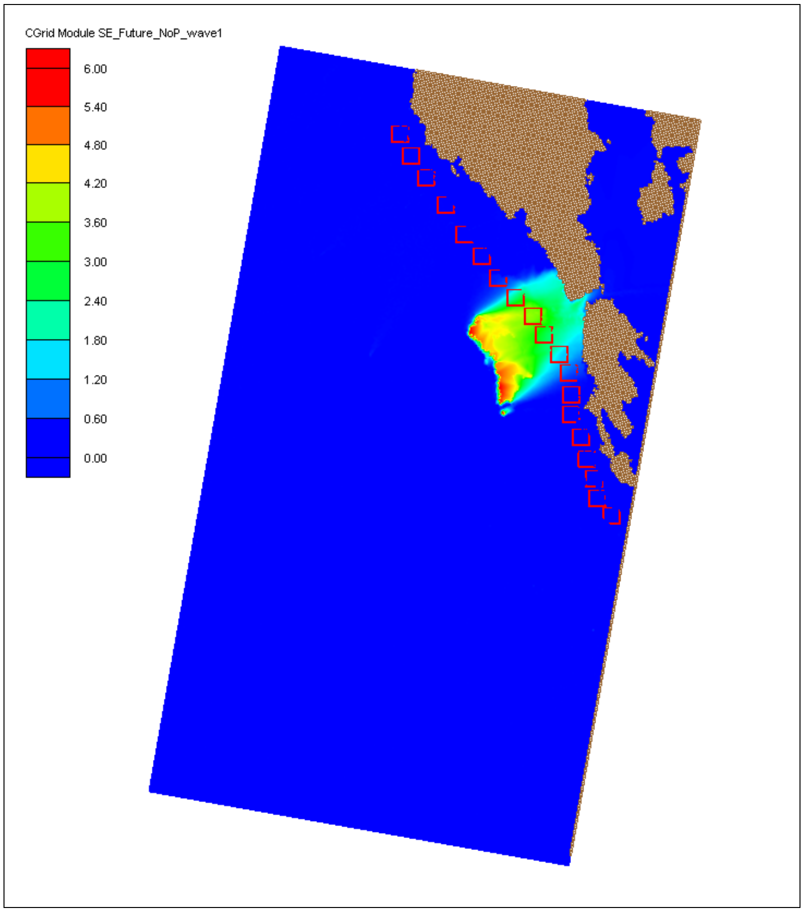


Figure 6-16: Barren Island wave height difference in feet (future without-project existing). West grid, H = 3 ft, T = 3 sec, water level = 3 ft (mtl), wave direction = 260 deg

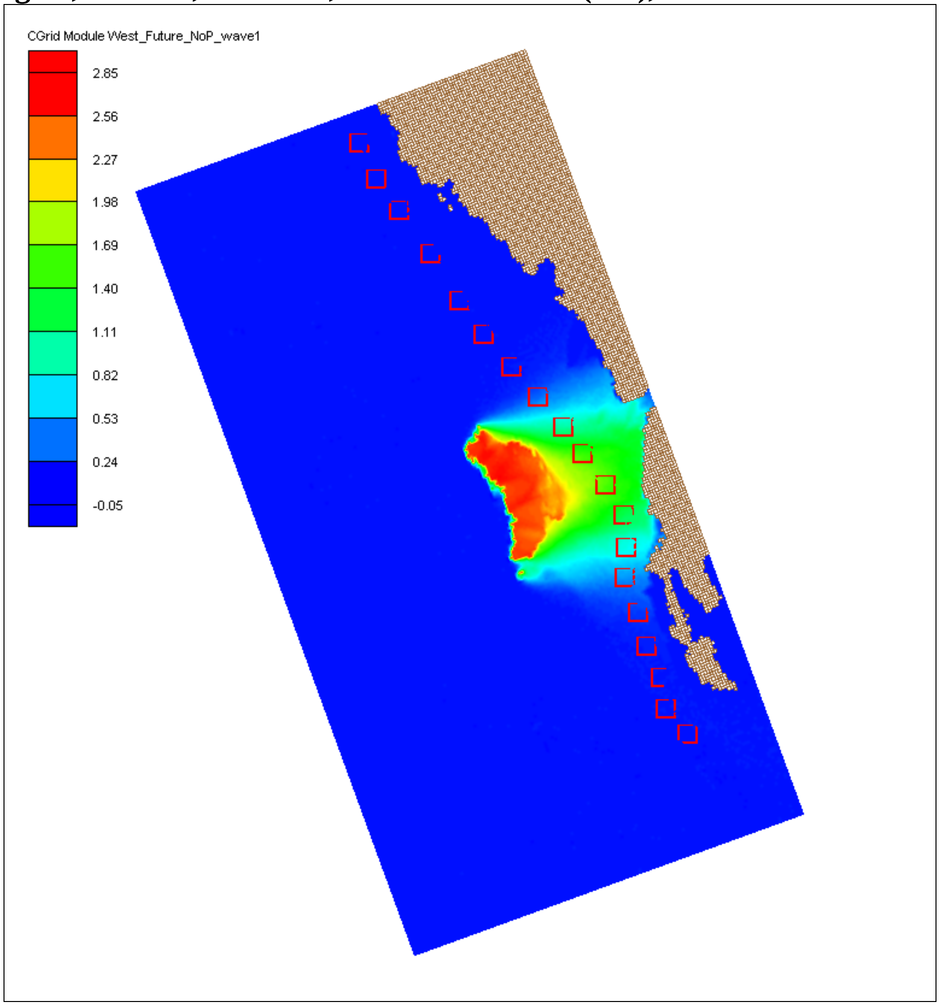


Figure 6-17: Zones used for noise analysis at James Island. Dots representing parcels show the centroid of the parcel (UMCES, 2004b)

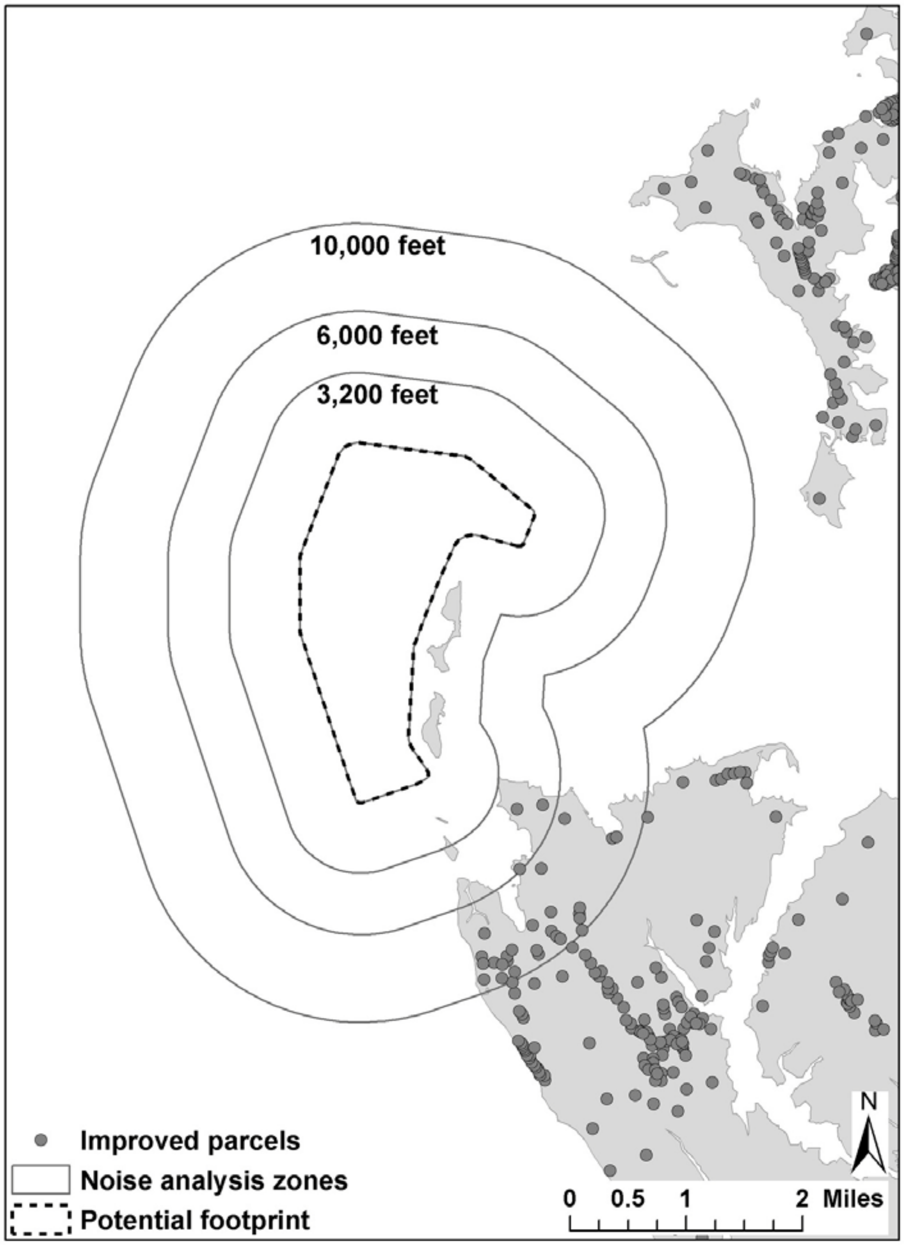


Figure 6-18: Zones used for noise impact analysis at Barren Island. Dots representing parcels show the centroid of the parcel (UMCES, 2004b)

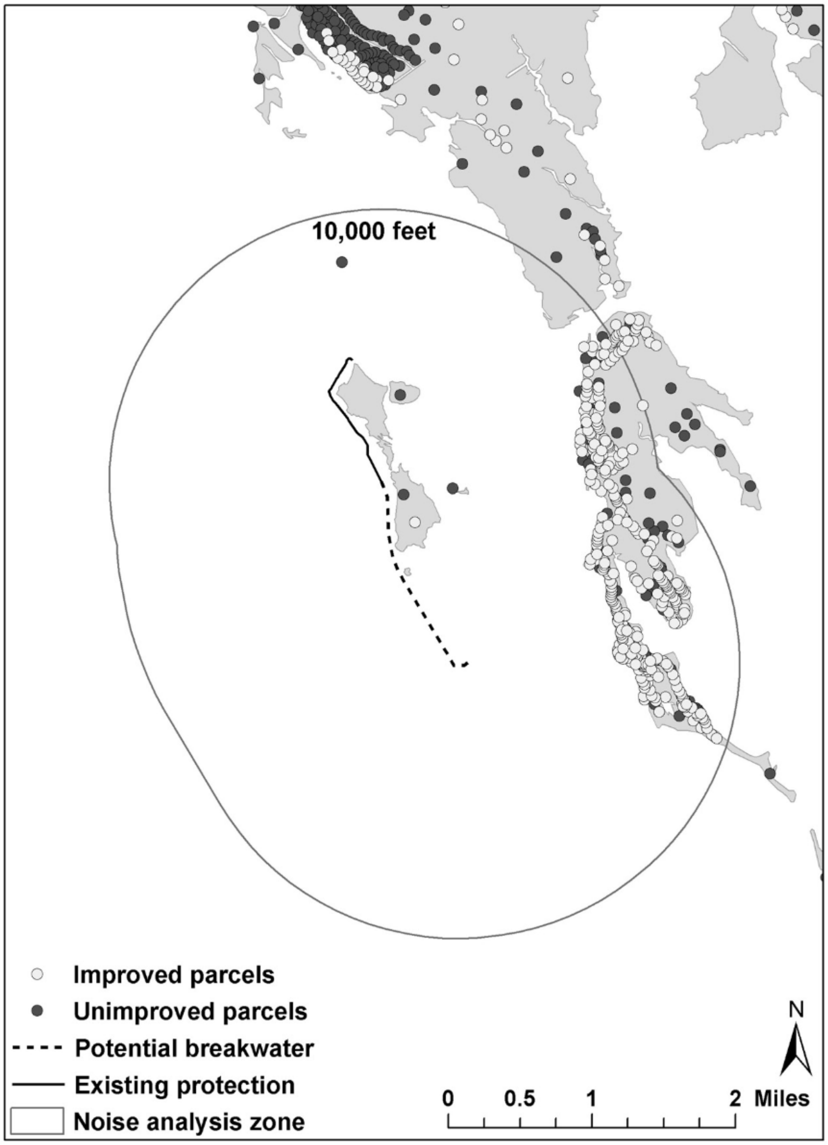


Figure 6-19: Area of potential visual impacts near James Island
(MDNR)

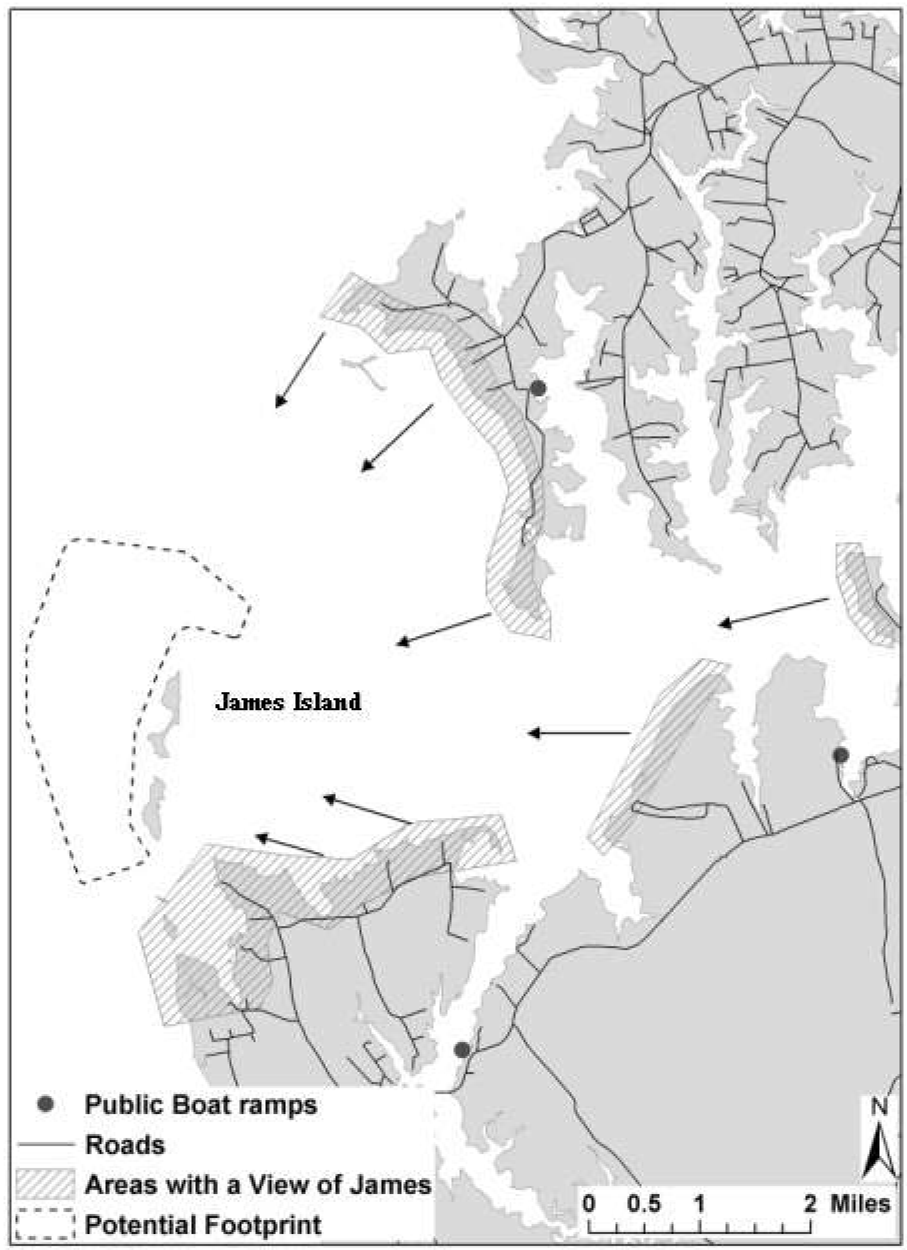


Figure 6-20: Area of potential visual impacts near Barren Island
(MDNR)

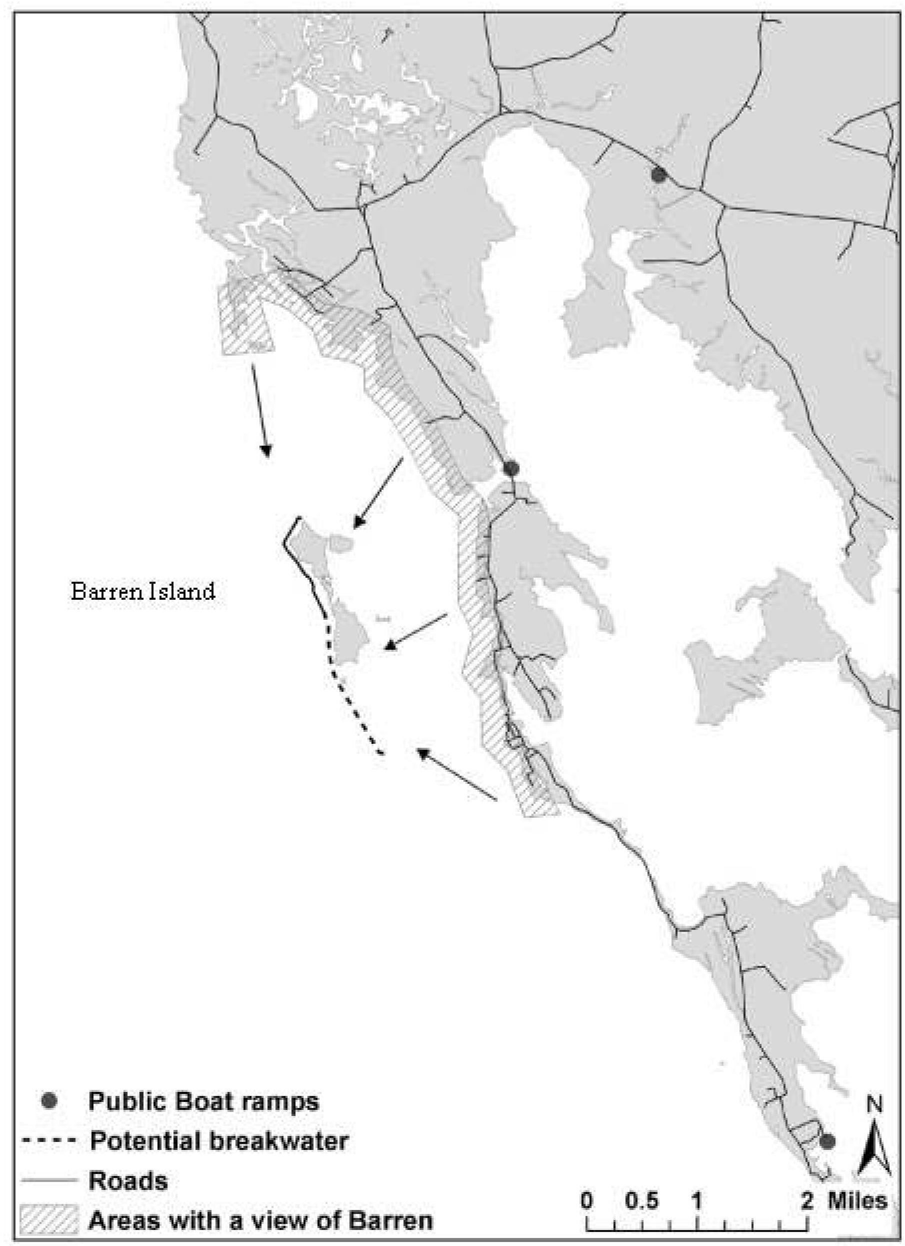


Figure 6-21: Landscape Character Near James Island
(source data from Maryland Department of Planning)

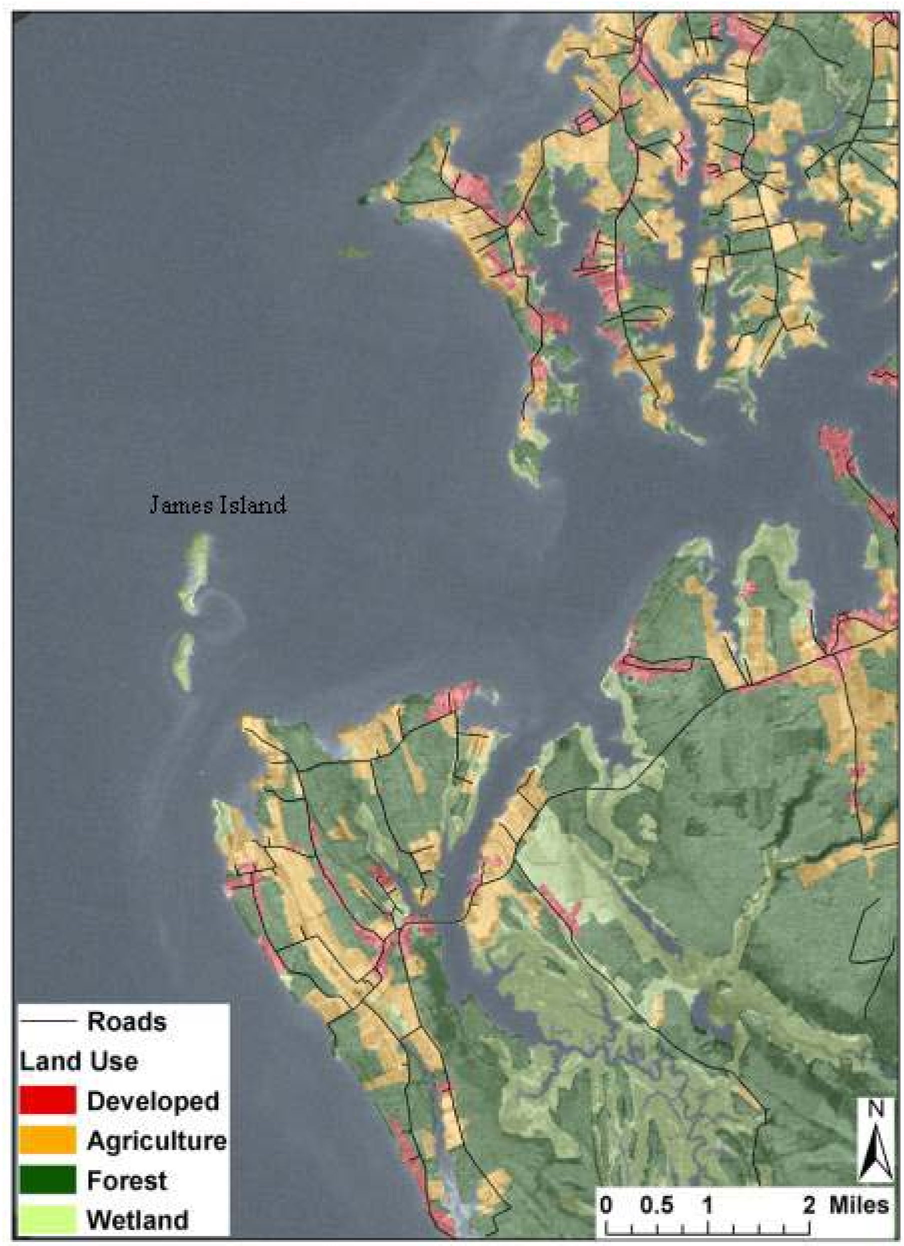
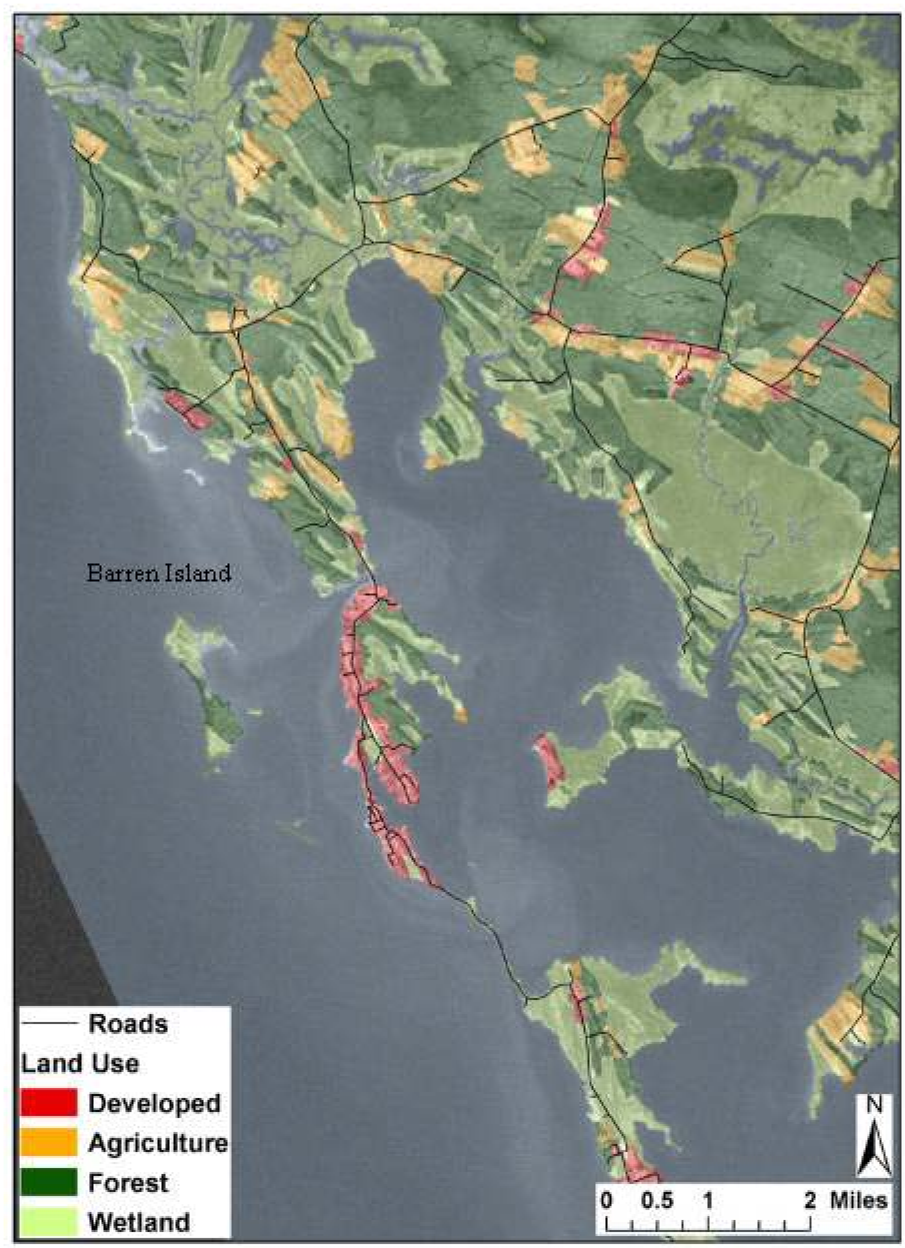


Figure 6-22: Landscape character near Barren Island
(source data from Maryland Department of Planning)



SECTION 6

TABLES

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Table 6-1: Habitat Distribution Summary of Best Buy Plans

		dike height (ft)	existing habitat to be protected (ac)[1]				habitat to be constructed (ac)[2]			Potential SAV acreage[5]
			wetlands	uplands	intertidal	beach	wetlands[3]	uplands	intertidal[4]	
Barren Island A, 45/55		**25**	**84.2**	**77.9**	**17.3**	**8.6**	**596**	**577**	**81**	**up to 1325**
Barren Island D + James Island 5, 40/60	Barren	20	84.2	77.9	17.3	8.6	312	250.8	62	up to 1325
	James	20	17.4	53.5	8.4	0	1018	758	120	up to 22.6
Total		**20**	**101.6**	**131.4**	**25.7**	**8.6**	**1330**	**1008.8**	**182**	**up to 1347.6**
Barren Island E + James Island 5, 45/55	Barren I		84.2	77.9	17.3	8.6	60	0	5	up to 1025[6]
	Barren II						0	0	0	up to 300[6]
	James	20	17.4	53.5	8.4	0	930	853	113	up to 22.6
Total		**20**	**101.6**	**131.4**	**25.7**	**8.6**	**990**	**853**	**118**	**up to 1347.6**

[1] Acreage protected as of 2005. These values would decrease each year until containment dikes are constructed.

[2] These acreages do not include dike acreage (only cell placement area).

[3] 80% low marsh to 20% high marsh would be targeted.

[4] 'Intertidal' includes mudflats, beach, and other intertidal habitats. Distribution would be determined by adaptive management.

[5] This is the maximum extent of SAV acreage reported by VIMS from 1994-2003. VIMS mapping is described in Section 3.1.6.a.

[6] It has not been determined which SAV beds in the Barren Island vicinity are protected by the island and which are protected by the submerged sandbar remaining from the eroded island that extends south from the existing island. A goal of the Phase I modeling/monitoring would be to provide this information. At this time, these values are estimates based on the leeward SAV beds mapped by VIMS since 1994.

Table 6-2: Impacts of Proposed Best Buy Alternatives for James Island and Barren Island				
Resource	**No Action Alternative**	**Barren Alignment A, 45/55 upland/wetland (Barren A)**	**James Alignment 5 + Barren Alignment D, 40/60 upland/wetland (5D)**	**James Alignment 5 + Barren Alignment E, 45/55 upland/wetland (5+protection)**
Physiography, Geology, Groundwater, and Soils	Complete loss of resources as James and Barren Islands continue to erode and subsequently are no longer part of the region's landscape. Eventual possibility of increased erosional losses to mainlands in shadow of James and Barren.	Impacts to physiography by turning open-water into remote Island habitat. No impacts to groundwater or existing soils. Erosion of James Island would continue.	Same impacts as for Barren A. Impacts to geology as sand would be dredged from within footprint and area would be filled with silty material. Additionally, dredging of access channel would have impact on geology in that specific area. No impacts to groundwater or existing soils.	Impacts to physiography by turning open-water into remote Island habitat and adding a stone breakwater to open-water. Same impacts to geology as 5D. No impacts to groundwater or existing soils.

Table 6-2: Impacts of Proposed Best Buy Alternatives for James Island and Barren Island				
Resource	**No Action Alternative**	**Barren Alignment A, 45/55 upland/wetland (Barren A)**	**James Alignment 5 + Barren Alignment D, 40/60 upland/wetland (5D)**	**James Alignment 5 + Barren Alignment E, 45/55 upland/wetland (5+protection)**
Hydrogeology and Hydrodynamics	Hydrodynamics and hydrology would be expected to change as islands erode and eventually are lost. The positive/negative value of these changes would be evaluated through the expected impacts to living resources (this statement holds for all alternatives).	Minimal impacts to hydrodynamics and hydrology at Barren Island: slight changes to current velocity would be expected, and increased wetland connection through constructed wetlands, and tidal guts. Less erosion of the Barren Island shoreline and surrounding shallow areas. Additional protection to Meekins Neck and Upper Hoopers Island. James Island impacts are similar to the 'no action' alternative.	Minimal impacts to hydrodynamics and hydrology of both islands: slight changes to current velocity would be expected, and increased wetland connection through constructed wetlands, and tidal guts. Less erosion of the James Island shoreline and surrounding shallow areas. Protection of Taylors Island from wind and waves. Reduction of sediment suspension and reduction of erosion and accretion around NOBs. Same impacts as for Barren A.	Same impacts to hydrodynamics and hydrology as Barren A and 5D. Potential for more accretion and erosion at southern tip of Barren Island restoration/ protection project possible due to higher current velocities through constricted area. **(con't)**
Water Quality	Continued impacts from inputs of erosional substrates at James and Barren Island.	Barren: Potential for elevated turbidity during construction. Potential for slightly elevated nutrient concentrations during construction. Probable reduction in suspended sediments in water column following construction. Potential increase in DO due to wetland restoration. James Island impacts would be similar to 'no action' alternatives.	Same impacts for James and Barren components as for Barren A. Potential for anoxia in access channel at James Island.	Same impacts as for Barren A and 5D.

Table 6-2: Impacts of Proposed Best Buy Alternatives for James Island and Barren Island (con't)				
Resource	**No Action Alternative**	**Barren Alignment A, 45/55 upland/wetland (Barren A)**	**James Alignment 5 + Barren Alignment D, 40/60 upland/wetland (5D)**	**James Alignment 5 + Barren Alignment E, 45/55 upland/wetland (5+protection)**
Sediment Quality	Adverse impacts would result from continued erosion of James Island and Barren Island.	Impacts to sediment quality by reducing sediment transport and deposition at Barren Island. Adverse impacts would result from continued erosion of James Island.	Same impacts to sediment quality for James and Barren components as for Barren A. Potential for higher metal concentrations in the sediments from material placed in upland cells at James Island.	Same impacts to sediment quality as for Barren A and 5D.
Aquatic Resources	No impacts. Potential for eventual loss of SAV in waters east of Barren Island.	Beneficial impacts from protection of existing SAV and promoting additional growth, which also benefits HAPC. Beneficial impacts to plankton, benthics, and NOBs by reducing erosion. Beneficial impacts to fish and other aquatic organisms by the creation of diversity through wetlands and rock dikes. Beneficial impacts from protection of existing natural shoreline. Adverse impacts would result from burial of shallow water habitat. Adverse impacts would result from replacing shallow water habitat with uplands. Commercial finfish or shellfish abundance, particularly blue crab, may be locally reduced. No impacts expected at James Island.	Similar impacts expected to Barren and James Island as for Barren A, with exception of impacts to commercial fish and shellfish. Negative impacts to commercial finfish and shellfish are expected to be minimal at James Island. Minimal impacts expected at James from burial of shallow water habitat. That is, the shallow water habitat at James is less abundant and diverse when compared to that of Barren Island. Burial of shallow water habitat would impact foraging waterfowl. This habitat would be lost. It is expected foraging waterfowl would be able to find similar habitat in the local area.	Same beneficial impacts as for Barren A. Adverse impacts would result from burial of shallow water habitat at James Island and along the Barren shoreline. Adverse impacts would result from replacing shallow water habitat with uplands at James Island. No impact on commercial finfish or shellfish harvests, however, crabbers may have to relocate some operations.

Table 6-2: Impacts of Proposed Best Buy Alternatives for James Island and Barren Island (con't)				
Resource	**No Action Alternative**	**Barren Alignment A, 45/55 upland/wetland (Barren A)**	**James Alignment 5 + Barren Alignment D, 40/60 upland/wetland (5D)**	**James Alignment 5 + Barren Alignment E, 45/55 upland/wetland (5+protection)**
Terrestrial Habitats (including wetlands), Flora, and Fauna	Adverse impacts would result from continued erosion and loss of habitat at James Island and Barren Island.	Beneficial impacts expected due to habitat protection at Barren. Potential short-term adverse impacts to fauna resulting from noise disturbances during project construction. Adverse impacts would result from continued erosion and loss of habitat at James Island.	Same impacts as for Barren A, but now apply to James also.	Beneficial impacts expected due to habitat protection on James Island. Same impacts to fauna at James Island and Barren Island as Barren A. Potential short-term impacts to habitats and flora along western shore of Barren Island directly adjacent to wetland restoration areas. However, long term beneficial impacts expected due to habitat protection.
Rare, Threatened, Endangered Species	Adverse impacts would result from continued erosion and loss of habitat on James Island and Barren Island.	Beneficial impacts due to protection of rare, threatened, endangered species habitats.	Beneficial impacts due to protection of rare, threatened, endangered species habitats.	Beneficial impacts due to protection of rare, threatened, endangered species habitats.
Air Quality	No impact.	Minimal short-term impacts associated with construction equipment emissions and airborne soil and dust particles at the project site.	Same impacts as expected for Barren A.	Same impacts as expected for Barren A.
Noise	No impact.	Some impacts to local boat traffic and nearest residences during construction.	Same impacts as expected for Barren A.	Same impacts as expected for Barren A.
Light	No impact.	Some impacts to nearest residences during construction.	Same impacts as expected for Barren A.	Same impacts as expected for Barren A.
HTRW	No impact.	No impact.	No impact.	No impact.
Protected Areas	Adverse impacts would result from continued erosion and loss of protected areas on James Island and Barren Island.	Beneficial impacts due to habitat protection. Adverse impacts would result from continued erosion of protected areas on James Island.	Beneficial impacts due to habitat protection.	Beneficial impacts expected due to habitat protection.

Table 6-2: Impacts of Proposed Best Buy Alternatives for James Island and Barren Island (con't)				
Resource	**No Action Alternative**	**Barren Alignment A, 45/55 upland/wetland (Barren A)**	**James Alignment 5 + Barren Alignment D, 40/60 upland/wetland (5D)**	**James Alignment 5 + Barren Alignment E, 45/55 upland/wetland (5+protection)**
Cultural Resources	No impact.	No impacts to submerged sites. Beneficial impacts expected due to protection of any existing cultural resources on island.	No impacts to submerged sites. Beneficial impacts expected due to protection of any existing cultural resources on island.	No impacts to submerged sites. Beneficial impacts expected due to protection of any existing cultural resources on island.
Socioeconomics	No impact.	No adverse economic impacts to finfish and shellfish fisheries expected if displaced fisheries (i.e. poundnets, crab pots) are successfully relocated. Long-term beneficial impacts expected for local economies in Dorchester County due to trade and traffic generated by project, and to State of Maryland resulting from ability to maintain shipping access to Port of Baltimore. No impacts expected to public safety and environmental justice. Reduction of wave height on mainland shoreline in lee of Barren Island would be a significant benefit to those communities.	Same impacts as expected for Barren A.	Same impacts as expected for Barren A.
Aesthetics	No impact.	Minimal impacts expected due to slight change in viewshed and night lighting.	Same impacts as expected for Barren A.	Same impacts as expected for Barren A..
Recreation	No impact.	No adverse impacts to boating expected. Potential beneficial impacts for fishing, wildlife viewing, and other "ecotourism" oriented activities.	No adverse impacts to boating expected. Potential beneficial impacts for fishing, wildlife viewing, and other "ecotourism" oriented activities.	No adverse impacts to boating expected. Potential beneficial impacts for fishing, wildlife viewing, and other "ecotourism" oriented activities.

Table 6-3: James Hydrodynamic Modeling Results – James 5 (ERDC, 2006)

Calculated Maximum Current Speed (ft/sec) at James Island Under Normal Tide Condition		
Location	**Existing**	**James 5**
1	1.97	1.94
2	0.36	0.20
3	0.82	0.59
4	1.08	0.79
5	1.28	1.28
6	1.34	0.66
7	1.28	0.52
8	1.71	0.88
9	1.41	0.20
10	1.38	1.57
11	0.95	0.49
12	1.11	1.80
13	1.18	2.13
14	0.00	0.00
15	0.92	0.72
16	0.79	0.00
NOTE: A ‘0’ velocity indicates the ‘no-current’ (dry) condition.		

Table 6-4: Barren Hydrodynamic Modeling Results – Barren E (ERDC, 2006)

Calculated Maximum Current Speed (ft/sec) at Barren Island Under Normal Tide Condition		
Location	**Existing**	**Barren E**
1	1.15	1.15
2	1.08	0.69
3	0.98	0.75
4	0.85	0.69
5	0.92	0.89
6	1.15	1.18
7	0.98	0.98
8	0.98	0.89
9	0.95	0.92
10	1.15	1.15
11	0.62	0.56
12	1.90	1.87
13	0.82	0.82
14	0.85	0.82
15	0.92	2.03
16	0.56	0.10
17	0.56	0.23

Table 6-5: Likely Time of Year Restrictions

(based on Poplar Island Environmental Restoration Project)

Name / Coordinating Agency	Description of Restrictions
Bald Eagle ***Haliaeetus leucocephalus*** **MDNR & USFWS**	Three zones of activity limitation. Zone 1: Extends 330 feet from nest. Year-round restrictions include any habitat changes such as timber cutting, land clearing, building and road construction. Dec 15-June15-no human activities. June 16 – Dec. 14 - limited activity, restricted hunting & off road vehicles. Zone 2: Extends 660 feet from nest. Restrictions include major habitat changes such as clear cutting, land clearing, building and road construction. Dec. 15-June 15 - no human activities, although some activities are allowed if researchers find that the nesting eagles are tolerant of it. June 16 – Dec. 14, activities such as hunting, fishing, hiking, farming are possible. Aug 16-Nov 16 - timber thinning & maint., buildings and road maintenance is possible. ZONE 3: ¼ MILE RADIUS AROUND NEST. MOST ACTIVITIES ARE POSSIBLE, BUT MANAGEMENT SHOULD INCLUDE PROTECTION OF ROOSTS & FEEDING SITES IN THIS AREA. DEC. 15-JUNE 15– RESTRICTIONS ON TIMBER CUTTING, LAND CLEARING, BUILDING, ROAD & TRAIL CONSTRUCTION
Least Tern ***Sterna antillarum*** **MDNR/ USFWS**	Activity disturbs nesting terns, causing them to abandon their nests. The nests should be avoided and activity limited during nesting and fledging. DNR-designated SSPRA nesting zones limit activity between Apr 15-Jul 31. Created habitat areas are not designated. No formal restrictions. Least tern typically nest in more isolated areas, from May-June. ACTIVITIES THAT COULD RESULT IN A ‘TAKE’ ARE REQUIRED TO BE COORDINATED WITH USFWS, DNR.
Common Tern ***Sterna hirundo*** **MDNR/ USFWS**	Avoid activity near nesting sites during the mid-May to late July nesting season. DNR-designated SSPRA nesting zones limit activity between Apr 15-Aug 15. Created habitat areas are not designated. No formal restrictions. ACTIVITIES THAT COULD RESULT IN A ‘TAKE’ ARE REQUIRED TO BE COORDINATED WITH USFWS, DNR.

Table 6-5: Continued.

Name/ Coordinating Agency	Description of Restrictions
Double Crested Cormorant ***Phalacrocorax auritus*** **MDNR/ USFWS**	No formal restrictions. Limited activity from April 1-Aug 15 applied to Jefferson Island area. Activities that could result in a 'take' are required to be coordinated with USFWS, DNR. DOUBLE CRESTED CORMORANT, WHILE NATIVE, ARE CONSIDERED A NUISANCE SPECIES BY SOME. RECORDS SHOULD BE KEPT OF ACTIVITIES BY THE CORMORANTS THAT MAY RESULT IN HABITAT DESTRUCTION FOR OTHER SPECIES.
Great Blue Heron ***Ardea herodeus*** **MDNR/ USFWS**	Restricted areas set by DNR, USFWS limiting activity during nesting, fledging periods. Feb 15 – Jul 31 – Limited activities are allowed, with specific stipulations. Normal operational activities (light vehicle traffic, personnel access to spillways) are allowed within restricted areas at all times of year. Construction, heavy equipment, earth-moving activities are not allowed during nesting season. Activity within restricted area such as wetland planting, volunteer activities are limited to 6 people at a time, no vehicles. Tours can be conducted, but no people should exit the buses in the restricted areas during the restricted time of year. ACTIVITY SHOULD BE LIMITED TO DAYS WHEN AIR TEMPERATURES ARE LESS THAN 85^{O}F AND GREATER THAN 65 ^{O}F, AND NOT DURING PERIODS OF PRECIPITATION.
Mixed Heronry **Snowy Egret** ***Egretta thula*** **Cattle Egret** ***Bubulcus ibis*** **Little Blue Heron** ***Ardea caerulea*** **MDNR**	No formal restrictions. Similar to great blue heron. FEB 15 – AUG 15 – LIMITED ACTIVITIES ARE ALLOWED, WITH SPECIFIC STIPULATIONS

Table 6-5: Continued.

Name/ Coordinating Agency	Description of Restrictions
Osprey *Pandion haliaetus* **USFWS**	No formal restrictions. Moving nests from inappropriate areas requires a Federal permit from USFWS. Assistance from a Federal agency is required to move the nest. Permits must be renewed annually. PRIOR TO 'WEAVING' OR SITTING ACTIVITIES, STICKS CAN BE REMOVED FROM INAPPROPRIATE AREAS TO INHIBIT NESTING.
Diamondback terrapin, *Malaclemys terrapin* **MDNR**	No formal restrictions. Report sightings to MDNR. LIKELY MID-BAY WOULD ELECT TO BECOME A STATE TERRAPIN STATION TO ASSIST IN THE CONSERVATION OF TERRAPIN BREEDING HABITAT.

Table 6-6: Duration and Timing of Noise Impacts at James Island **(UMCES, 2004b)**

	Construction – sand dredging	Construction – dike construction	Inflow	Crust Management	Habitat Development
Duration	2-3 months per phase	2-3 years	Duration of project life	Duration of project life	Duration of project life
Time of Year		Year round	Seasonal (Sept – Mar)	Year round	Year round
Time of Day	Day and night	Day[1]	Day and night	Day only	Day only

[1] **Construction activities may start early in the morning and end after dusk.**

Table 6-7: Typical Noise Levels and Subjective Impressions **(UMCES, 2004b)**

Source	Decibel Level (dBA)	Subjective Impression
Normal breathing	10	Threshold of hearing
Soft whisper	30	
Library	40	Quiet
Normal conversation	60	
Television audio	70	Moderately loud
Ringing telephone	80	
Snowmobile	100	Very loud
Shouting in ear	110	
Thunder	120	Pain threshold

Table 6-8: Duration and Timing of Noise Impacts at Barren Island **(UMCES, 2004b)**

	Construction
Duration	1.5-2 years
Time of Year	Year round
Time of Day	Day

Table 6-9: Lights used During Operations at PIERP (UMCES, 2004b)

Location	# Lights	Wattage	Type	Height	Shielded?
Personnel pier	6	300 W	Incandescent	10 ft above dock	Yes, Down
Welcome marquis	2	300 W	Incandescent	12 ft	Yes, Down
Transformer at trailer complex	2	300 W	Incandescent	12 ft	Yes, Down
Building complex	6	60 W	Incandescent	7-8 ft	Yes
Transfer switch	1	60 W	Incandescent	5 ft	Yes
Navigation lights – buoys	2	2-4 candela	Incandescent		No
Navigation lights – Cell 6	2	2-4 candela	Incandescent		No

Table 6-10: Lights used During Inflow at PIERP (UMCES, 2004b)

Location	# Lights	Wattage	Type	Height	Shielded
Spillway 1	4	1000 W	Mercury vapor	~12 ft	Yes
Spillway 3	4	1000 W	Mercury vapor	~12 ft	Yes
Spillway 4	4	1000 W	Mercury vapor	~12 ft	Yes

Table 6-11: Summary of State Economic Impacts of James Island Restoration Over Life of Project (UMCES, 2006)

	Planning, Engineering, and Design	Site Development	Dredging	Transport	Placement	Habitat Development	Site Management & Monitoring	Total[1]
I. Direct Impacts[2]								
Year of spending in category	43	4	30	30	30	20	41	NA
Total Spending[2]	$51,996,674	$307,351,699	$177,320,777	$251,828,802	$100,731,521	$81,426,571	$108,390,609	$1,079,046,653
Average Annual Spending[3]	$1,209,225	$76,837,925	$5,910,693	$8,394,293	$3,357,717	$4,071,329	$2,643,673	NA
Average Annual Direct Employment[4]	16	470.4	9.8	41.4	4.4	110.5	41	NA
Total Direct Person-years of Employment	688	1,882	294	1,242	132	2,210	1,681	8,129
II. Average Annual Economic Impacts[5]								
Impact Category								
Annual Jobs (FTEs)[6]	29	1,229	61	130	34	143	67	NA
Annual Labor Income	$1,158,421	$53,467,399	$3,658,416	$4,848,019	$2,075,470	$2,779,627	$2,059,038	NA
Annual Employee Compensation	$1,060,840	$46,551,920	$3,065,953	$4,316,985	$1,741,908	$2,388,109	$1,823,872	NA
Annual Proprietors Income	$97,581	$6,915,479	$592,463	$531,034	$333,562	$391,518	$235,166	NA
Annual Indirect Business Taxes	$70,251	$3,891,233	$321,259	$524,713	$182,491	$255,803	$151,190	NA
Annual Other Property Type Income	$204,256	$13,511,612	$851,186	$1,861,149	$483,542	$1,230,770	$570,207	NA
Annual Value Added	$1,432,928	$70,870,244	$4,830,861	$7,233,881	$2,741,503	$4,266,200	$2,780,435	NA
Annual Business Sales	$2,285,903	$139,134,556	$10,691,139	$16,180,508	$6,074,247	$6,769,795	$4,726,831	NA
III. Total Economic Impacts[7]								
Impact Category								
Person-years per spending category	1,264	4,916	1,842	3,909	1,011	2,862	2,727	18,531
Total Labor Income	$49,812,103	$213,869,596	$109,752,480	$145,440,570	$62,264,100	$55,592,540	$84,420,558	$721,151,947
Total Employee Compensation	$45,616,120	$186,207,680	$91,978,590	$129,509,550	$52,257,240	$47,762,180	$74,778,752	$628,110,112
Total Proprietors Income	$4,195,983	$27,661,916	$17,773,890	$15,931,020	$10,006,860	$7,830,360	$9,641,806	$93,041,835
Total Indirect Business Taxes	$3,020,793	$15,564,932	$9,637,770	$15,741,390	$5,474,730	$5,116,060	$6,198,790	$60,754,465
Total Other Property Type Income	$8,783,008	$54,046,448	$25,535,580	$55,834,470	$14,506,260	$24,615,400	$23,378,487	$206,699,653
Total Value Added	$61,615,904	$283,480,976	$144,925,830	$217,016,430	$82,245,090	$85,324,000	$113,997,835	$988,606,065
Total Business Sales	$98,293,829	$556,538,224	$320,734,170	$485,415,240	$182,227,410	$135,395,900	$193,800,071	$1,972,404,844

[1] Where "NA" appears in the Total column, a simple sum of the row could not be calculated because each average annual value in the row is based upon a different number of years of spending

[2] Direct spending by task over the 40+ year project life was estimated by the US Army Corps of Engineers

[3] Average annual cost per task calculated by dividing total spending in category by number of years of spending in category

[4] Direct employment per task was estimated by UMCES using phone interviews and IMPLAN regional economic modeling results

[5] Average annual economic impacts during each phase
Includes direct, indirect and induced economic impacts of both state and federal spending in Maryland
Direct, indirect and induced impacts of spending were estimated using the IMPLAN regional economic modeling system

[6] These numbers represent the average annual number of full-time equivalent (FTE) jobs in each task for each year of spending in that category. The jobs associated with some tasks will be primarily in early years and the jobs associated with some tasks will be in later years. (See text)

[7] These numbers represent the total impacts over the life of the project, calculated by multiplying the average annual jobs or spending in each category by the number of years of spending in the category. The "Total" column reflects total spending over the life of the project.

Table 6-12: Summary of State Economic Impacts of Barren Island Restoration Over Life of Project (UMCES, 2006)

	Planning, Engineering, and Design	Site Development	Habitat Development	Site Management & Monitoring	Total[1]
I. Direct Impacts[2]					
Year of spending in category	3	2	1	2	NA
Total Spending[2]	$531,300	$29,508,926	$5,157,251	$1,048,344	$36,245,821
Average Annual Spending[3]	$177,100	$14,754,463	$5,157,251	$524,172	NA
Average Annual Direct Employment[4]	2.3	90.3	139.9	8.1	NA
Total Direct Person-years of Employment	7	181	140	16	344

II. Average Annual Economic Impacts[5]					
Impact Category					
Annual Jobs (FTEs)[6]	4	236	183	13	NA
Annual Labor Income	$169,659	$10,266,840	$3,521,021	$408,254	NA
Annual Employee Compensation	$155,368	$8,938,926	$3,025,076	$361,627	NA
Annual Proprietors Income	$14,291	$1,327,914	$495,945	$46,627	NA
Annual Indirect Business Taxes	$10,289	$747,197	$324,032	$29,977	NA
Annual Other Property Type Income	$29,915	$2,594,507	$1,559,046	$113,057	NA
Annual Value Added	$209,863	$13,608,544	$5,404,099	$551,288	NA
Annual Business Sales	$334,788	$26,716,697	$8,575,463	$937,209	NA

III. Total Economic Impacts[7]					
Impact Category					
Person-years per spending category	13	472	183	26	694
Total Labor Income	$508,977	$20,533,680	$3,521,021	$816,508	$25,380,186
Total Employee Compensation	$466,104	$17,877,852	$3,025,076	$723,254	$22,092,286
Total Proprietors Income	$42,873	$2,655,828	$495,945	$93,254	$3,287,900
Total Indirect Business Taxes	$30,867	$1,494,394	$324,032	$59,954	$1,909,247
Total Other Property Type Income	$89,745	$5,189,014	$1,559,046	$226,114	$7,063,919
Total Value Added	$629,589	$27,217,088	$5,404,099	$1,102,576	$34,353,352
Total Business Sales	$1,004,364	$53,433,394	$8,575,463	$1,874,418	$64,887,639

[1] Where "NA" appears in the Total column, a simple sum of the row could not be calculated because each average annual value in the row is based upon a different number of years of spending

[2] Direct spending by task over the 3 year project life was estimated by the US Army Corps of Engineers

[3] Average annual cost per task calculated by dividing total spending in category by number of years of spending in category

[4] Direct employment per task was estimated by UMCES using phone interviews and IMPLAN regional economic modeling results

[5] Average annual economic impacts during each phase and overall
Includes direct, indirect and induced economic impacts of both state and federal spending in Maryland
Direct, indirect and induced impacts of spending were estimated using the IMPLAN regional economic modeling system

[6] These numbers represent the average annual number of full-time equivalent (FTE) jobs in each task for each year of spending in that category. The jobs associated with some tasks will be primarily in early years and the jobs associated with some tasks will be in later

[7] These numbers represent the average annual jobs or spending in each category multiplied by the number of years of spending in the category. The "Total" column reflects total spending over the life of the project.

Table 6-13: Summary of Local (Dorchester County) Economic Impacts of James Island Restoration Over Life of Project (UMCES, 2006)

	Planning, Engineering, and Design	Site Development	Habitat Development	Site Management & Monitoring	Total[1]
I. Direct Impacts[2]					
Year of spending in category	43	4	20	41	NA
Total Spending[2]	$51,996,674	$307,351,699	$81,426,571	$108,390,609	$549,165,553
Average Annual Spending[3]	$1,209,225	$76,837,925	$4,071,329	$2,643,673	NA
Average Annual Direct Employment[4]	8.9	128.3	13.3	44.0	NA
Total Direct Person-years of Employment	383	513	266	1,804	2,966

II. Average Annual Economic Impacts[5]					
Impact Category					
Annual Jobs (FTEs)[6]	15	553	38	59	NA
Annual Labor Income	$497,833	$21,866,143	$1,200,066	$1,323,022	NA
Annual Employee Compensation	$359,119	$14,716,632	$1,010,449	$1,093,782	NA
Annual Proprietors Income	$138,714	$7,149,511	$189,617	$229,240	NA
Annual Indirect Business Taxes	$29,073	$2,051,238	$100,129	$95,129	NA
Annual Other Property Type Income	$278,738	$7,795,198	$448,308	$459,321	NA
Annual Value Added	$805,644	$31,712,579	$1,748,503	$1,877,472	NA
Annual Business Sales	$1,707,124	$104,478,145	$5,878,827	$3,602,449	NA

III. Total Economic Impacts[7]					
Impact Category					
Person-years per spending category	645	2,210	764	2,419	6,038
Total Labor Income	$21,406,819	$87,464,572	$24,001,320	$54,243,902	$187,116,613
Total Employee Compensation	$15,442,117	$58,866,528	$20,208,980	$44,845,062	$139,362,687
Total Proprietors Income	$5,964,702	$28,598,044	$3,792,340	$9,398,840	$47,753,926
Total Indirect Business Taxes	$1,250,139	$8,204,952	$2,002,580	$3,900,289	$15,357,960
Total Other Property Type Income	$11,985,734	$31,180,792	$8,966,160	$18,832,161	$70,964,847
Total Value Added	$34,642,692	$126,850,316	$34,970,060	$76,976,352	$273,439,420
Total Business Sales	$73,406,332	$417,912,580	$117,576,540	$147,700,409	$756,595,861

[1] Where "NA" appears in the Total column, a simple sum of the row could not be calculated because each average annual value in the row is based upon a different number of years of spending

[2] Direct spending by task over the 3 year project life was estimated by the US Army Corps of Engineers

[3] Average annual cost per task calculated by dividing total spending in category by number of years of spending in category

[4] Direct employment per task was estimated by UMCES using phone interviews and IMPLAN regional economic modeling results

[5] Average annual economic impacts during each phase and overall
Includes direct, indirect and induced economic impacts of both state and federal spending in Maryland
Direct, indirect and induced impacts of spending were estimated using the IMPLAN regional economic modeling system

[6] These numbers represent the average annual number of full-time equivalent (FTE) jobs in each task for each year of spending in that category. The jobs associated with some tasks will be primarily in early years and the jobs associated with some tasks will be in later years. (See text)

[7] These numbers represent the average annual jobs or spending in each category multiplied by the number of years of spending in the category. The "Total" column reflects total spending over the life of the project.

Table 6-14: Summary of Local (Dorchester County) Economic Impacts of Barren Island Restoration Over Life of Project (UMCES, 2006)

	Planning, Engineering, and Design	Site Development	Habitat Development	Site Management & Monitoring	Total[1]
I. Direct Impacts[2]					
Year of spending in category	3	2	1	2	NA
Total Spending[2]	$531,300	$29,508,926	$5,157,251	$1,048,344	$36,245,821
Average Annual Spending[3]	$177,100	$14,754,463	$5,157,251	$524,172	NA
Average Annual Direct Employment[4]	1.3	24.6	16.8	8.7	NA
Total Direct Person-years of Employment	4	49	17	17	87

II. Average Annual Economic Impacts[5]					
Impact Category					
Annual Jobs (FTEs)[6]	2	106	48	12	NA
Annual Labor Income	$72,912	$4,198,749	$1,520,153	$262,321	NA
Annual Employee Compensation	$52,596	$2,825,896	$1,279,960	$216,869	NA
Annual Proprietors Income	$20,316	$1,372,853	$240,193	$45,452	NA
Annual Indirect Business Taxes	$4,258	$393,880	$126,835	$18,862	NA
Annual Other Property Type Income	$40,823	$1,496,838	$567,883	$91,072	NA
Annual Value Added	$117,993	$6,089,467	$2,214,871	$372,255	NA
Annual Business Sales	$250,021	$20,061,953	$7,446,853	$714,273	NA

III. Total Economic Impacts[7]					
Impact Category					
Person-years per spending category	7	212	48	23	291
Annual Labor Income	$218,736	$8,397,498	$1,520,153	$524,642	$10,661,029
Annual Employee Compensation	$157,788	$5,651,792	$1,279,960	$433,738	$7,523,278
Annual Proprietors Income	$60,948	$2,745,706	$240,193	$90,904	$3,137,751
Annual Indirect Business Taxes	$12,774	$787,760	$126,835	$37,724	$965,093
Annual Other Property Type Income	$122,469	$2,993,676	$567,883	$182,144	$3,866,172
Annual Value Added	$353,979	$12,178,934	$2,214,871	$744,510	$15,492,294
Annual Business Sales	$750,063	$40,123,906	$7,446,853	$1,428,546	$49,749,368

[1] Where "NA" appears in the Total column, a simple sum of the row could not be calculated because each average annual value in the row is based upon a different number of years of spending

[2] Direct spending by task over the 3 year project life was estimated by the US Army Corps of Engineers

[3] Average annual cost per task calculated by dividing total spending in category by number of years of spending in category

[4] Direct employment per task was estimated by UMCES using phone interviews and IMPLAN regional economic modeling results

[5] Average annual economic impacts during each phase and overall
Includes direct, indirect and induced economic impacts of both state and federal spending in Maryland
Direct, indirect and induced impacts of spending were estimated using the IMPLAN regional economic modeling system

[6] These numbers represent the average annual number of full-time equivalent (FTE) jobs in each task for each year of spending in that category. The jobs associated with some tasks will be primarily in early years and the jobs associated with some tasks will be in later years. (See text)

[7] These numbers represent the average annual jobs or spending in each category multiplied by the number of years of spending in the category. The "Total" column reflects total spending over the life of the project.

Table 6-15: Overlap of 2003 Crabbing Areas with James Island Footprint (UMCES, 2004b)

Month	Area crabbed (ac)	Area of intersection with footprint (ac)	Percent of area crabbed covered by footprint
July	4,516	1,933	43%
August	3,754	1,929	51%
September	1,651	1,358	82%

Table 6-16: Compliance with Applicable Federal Laws, Regulations, and Executive Orders

Federal Statutes	**Level of Compliance**[1]
Archeological and Historic Preservation Act	Full
Clean Air Act	Full
Clean Water Act	Partial
Coastal Barrier Resources Act	N/A
Coastal Zone Management Act	Partial
Comprehensive Environmental Response, Compensation and Liability Act	Full
Endangered Species Act	Full
Estuary Protection Act	Full
Federal Water Project Recreation Act	N/A
Fish and Wildlife Coordination Act	Full
Land and Water Conservation Fund Act	Full
Magnuson-Stevens Act	Full
Marine Mammal Protection Act	Full
National Historic Preservation Act	Full
National Environmental Policy Act	Partial
Resource Conservation and Recovery Act	N/A
Rivers and Harbors Act	Full
Watershed Protection and Flood Prevention Act	Full
Wild and Scenic Rivers Act	N/A
Executive Orders, Memoranda, etc.	
Migratory Bird (E.O. 13186)	Full
Protection and Enhancement of Environmental Quality (E.O. 11514)	Full
Protection and Enhancement of Cultural Environment (E.O. 11593)	Full
Floodplain Management (E.O. 11988)	Full
Protection of Wetlands (E.O. 11990)	Full
Prime and Unique Farmlands (CEQ Memorandum, 11 Aug. 80)	Full
Environmental Justice in Minority and Low-Income Populations (E.O. 12898)	Full
Invasive Species (E.O. 13112)	Full
Protection of Children from Health Risks & Safety Risks (E. O. 13045)	Full

Level of Compliance:
Full Compliance (Full): Having met all requirements of the statute, E.O., or other environmental requirements for the current stage of planning.
Non-Compliance (NC): Violation of a requirement of the statute, E.O., or other environmental requirement.
Not Applicable (N/A): No requirements for the statute, E.O., or other environmental requirement for the current stage of planning.

7 PLAN IMPLEMENTATION

This section provides an overview of the major requirements for project implementation for both the PED and construction phases of the Mid-Bay project. Implementation of the recommended plan described in Chapter 5 requires commitments on the part of USACE-Baltimore District and MPA, the non-Federal sponsor, for the benefits of the plan to be realized. Section 204 of WRDA 1992, as amended by Section 207 of WRDA 1996 authorizes USACE to carry out projects for the protection, restoration, and creation of aquatic and ecologically related habitats (including wetlands) in connection with dredging of authorized navigation projects. This authorization was considered appropriate for the James Island restoration feature of the Mid-Chesapeake Bay Island Ecosystem Restoration project prior to WRDA 2007, when the Section 204/207 cost-sharing was changed to match the ecosystem restoration cost share. Therefore, Section 204 and 207 are no longer advantageous. The protection of Barren Island is an environmental restoration project. Authorization will be requested for the James and Barren Island projects through the General Investigations process following the policies, guidance and cost-sharing for environmental restoration projects. The cost of implementing beneficial use of dredged material projects under Section 207 was originally established to be shared 75% Federal and 25% non-Federal; however, environmental restoration projects implemented under the USACE Construction General program are cost-shared 65% Federal and 35% non-Federal. Construction for both the James and Barren Island components will be funded through USACE's Construction, General account though the costs of maintenance dredging activities up to the Federal Standard (base plan) still must remain funded with Federal Operations and Maintenance appropriations. The project components, James Island and Barren Island, must both be implemented to achieve the full environmental benefits demonstrated during project formulation; however, they do not need to be implemented simultaneously. Due to the larger effort involved in designing the James Island component, it is recommended that separate PED efforts be conducted, and separate project partnership agreements (PPA) be executed.

7.1 PROJECT AUTHORIZATION

In order for construction of the Mid-Chesapeake Bay Island Ecosystem Restoration Project, authorization must come from the United States Congress, typically as part of a WRDA. The process dictates that once the final feasibility report is completed, Headquarters of the USACE prepares a Chief of Engineer's Report. This report provides the Assistant Secretary of the Army for Civil Works (ASA[CW]) with USACE's views, findings and recommendations on project authorization. Once the Assistant Secretary's office has reviewed the report and finds that authorization, implementation, and budgeting of the project is consistent with applicable laws and policies, it is forwarded to the Office of Management and Budget (OMB). OMB supervises and controls the administration of the budget and issues policies for the Executive Branch. After OMB approves the project, the ASA(CW) forwards the Chief's Report to Congress for construction authorization. The House of Representatives Committee on Transportation and Infrastructure and the Senate Committee on Environment and Public Works are responsible for drafting the WRDA bill. Typically, these bills are enacted every two years; however, in the recent past, several years have elapsed between bills. If this project is to be implemented under the next WRDA, the earliest that authorization could be realized is through WRDA 2008, with construction then estimated to begin in 2010 for the Barren Island component, assuming adequate funding. James Island would follow and construction could begin as soon as the PED phase is completed and the PPA is signed, but must happen no later than 2014 in order to be on-line in 2018.

As was mentioned previously, the James Island site could have been authorized under Section 207, which was the appropriate vehicle for beneficial use of dredged material projects. Further, in accordance with Policy Guidance Letter Number 56, dated 10 November 1998, Section 207 allows for authorization of beneficial use of dredged material projects at the discretion of the ASA(CW). Section 2037 of WRDA 2007 changed the Section 207 cost sharing from 75% Federal to 65%. Since Section 207 would require separate authorizations, yet did not offer a benefit to the project sponsor, it was dropped from consideration.

7.2 IDENTIFICATION OF THE NON-FEDERAL SPONSOR

The State of Maryland, Department of Transportation (MDOT) is the non-Federal sponsor for this project. The MPA, under the auspices of the MDOT and acting through its Office of Harbor Development, was involved in all of the coordination related to this study. For the PED and construction phases, the MPA would participate as the non-Federal sponsor. The MPA has indicated their intent to proceed with the next phase of project implementation and to provide the non-Federal cooperation required for project implementation. They are aware of the items of local cooperation described below and are aware of their responsibilities with regard to a potential project. They have participated throughout the study and have demonstrated a commitment to both the outcome of the study and project implementation. As such, a letter of intent has been received from MPA and is included in at the end of this section.

7.3 PROJECT COST-SHARING & IMPLEMENTATION COSTS

7.3.1 Project Cost Estimate

Cost estimates have been developed for the restoration and protection of James and Barren Islands. The estimate includes the costs for PED, construction, construction management, monitoring, and contingencies. The total cost estimate for the recommended plan is $1,564,636,000. The fully-funded cost is $2,805,544,000 over the 52 years of project implementation, from the beginning of Barren Island PED in 2009 to James Island project completion in 2060. As an ecosystem restoration project involving the beneficial use of dredged material, the James Island estimate includes all costs in excess of the Federal Standard, as discussed in Section 7.3.3. The baseline construction cost estimate for the Mid-Chesapeake Bay Island Ecosystem Restoration Project was prepared in accordance with ER 1110-2-1302 using the USACE M-CACES program, and values are at October 2007 price levels. Contingencies for the project components were established in conjunction with the Cost Engineering Center of Expertise in the Walla Walla District using the Crystal Ball method, as detailed in Appendix C. The complete funding schedules for this project are also presented in Appendix C. A comparison of the baseline and fully-funded costs for the total project cost, including the Federal and non-Federal cost-share through FY60 are included in Table 7-1. Tables 7-2 and 7-3 show how these costs are anticipated to be spent over the entire span of project implementation.

7.3.2 Cost-Share for PED Phase

As part of the USACE Civil Works General Investigations process, the determination of costs among various project purposes and implementation authority is necessary. For congressionally authorized projects, Section 210 of WRDA 1995 states that the non-Federal sponsors share will be 25% of the project or separable element implementation costs (PED and construction) (EP 1165-2-502). During feasibility, the non-Federal sponsors share was 50%, all of which was in-kind services. For the PED phase, no in-kind services are permitted. The PED phase for the recommend plan is currently estimated to cost $2,499,000 total, $2,195,000 for James Island and $304,000 for Barren Island. To complete this phase, the Federal cost-share of 75% is $1,874,250 and the non-Federal cost-share of 25% is $624,750. For James Island, the Federal contribution is $1,646,250 and the non-Federal is $548,750, and for Barren Island, the Federal contribution is $228,000 and the non-Federal is $76,000. Since the two project sites will be designed and constructed separately, it is recommended that separate PED agreements be negotiated.

7.3.3 Cost-Share for Project Construction, Operations, and Maintenance

The James Island component is a beneficial use of dredged material, ecosystem restoration project, and will be implemented separately from Barren Island due to the different implementation schedules. Beneficial use of dredged material, ecosystem restoration, projects are funded as navigation construction or operation and maintenance costs up to the level of the Federal Standard. The Federal Standard, or baseline, is defined as the least costly, environmentally acceptable alternative(s) consistent with sound engineering practices and which meet the environmental standards established by the 404(b)(1) evaluation process (See 33 CFR Part 335 et seq.). The Federal Standard for the Southern Approach Channels to the C&D Canal, which are estimated to produce 1.2 mcy of sediment per year, is overboard placement at Pooles Island. For the Chesapeake Bay Approach Channels to the Port of Baltimore, the Federal Standard is overboard placement at the Deep Trough. For James Island, it has been assumed that during development of the site, there will be 30 years of active dredged material placement. The cost of dredging to the Federal Standard is estimated at $824,102,000 over the 30 years at October 2007 price levels. These costs will be funded through the USACE (Baltimore and Philadelphia Districts) Operations and Maintenance program. To capture the costs above this baseline where applicable, non-Federal interests must typically enter into a cooperative agreement in accordance with the requirements of Section 221 of the Flood Control Act of 1970, agreeing to provide assurances as indicated below. When it is determined that there is a Federal interest, projects can be cost-shared beyond the Federal Standard. The cost-sharing for environmental restoration projects is 65% Federal under the authority of Section 210 of WRDA 1996 (PL 104-303). The non-Federal sponsor must provide 35% of the cost associated with construction of the project, including provision of all lands, easements, rights-of-way, relocations, and disposal areas; and pay 100% of the operation, maintenance, repair, rehabilitation and replacement (OMRR&R) costs associated with the project.

Operations and maintenance costs incurred during construction have been estimated and are cost shared as a project cost. These costs cover such activities as maintenance of staging areas, access roads and channels, dike erosion, storm damage, mechanical devises, vegetation mortality, etc. Once construction is complete, or as project components are completed, stabilized and turned over to the sponsor, these O&M costs become OMRR&R costs and are borne 100% by the sponsor. For this report, the assumption has been made for the James Island component that bulkheads, piers and operations facilities could be turned over to the MPA shortly after completion of those features at the beginning of construction of the island. The exterior containment dikes could be turned over after stability is assured and upland and wetland cells could be turned over after they are developed and found to be stable. It should be noted that at the date of this report, no components had yet been turned over to the MPA on Poplar Island. More detailed design during PED may yield better estimates of OMRR&R; however, it will not be until construction that the ultimate determinations of what components can be turned over and when can be made. Based on experience at the PIERP, operations and maintenance costs at the time of project completion are projected to be less than 2 percent of the total project cost.

Recreational project components are cost shared 50/50 between the Federal and non-Federal sponsor. Any recreational component costs in excess of 10% of the project cost are 100% non-Federally funded. Recreation for the Mid-Bay Island project is discussed in Section 4.7.4.b and in Appendix L. The anticipated cost for recreational components is $204,000 and will be shared equally. It is assumed that the cost for the recreational components will be borne in 2057; therefore, the fully funded estimate is $555,492.

Based on October 2007 price levels, the cost for the construction phase for James Island is $1,518,914,000. The Federal share of 65% for construction of the beneficial use of dredged material project and 50% of the recreation costs, less OMRR&R, is $984,359,000 and the non-Federal share, 35% plus 50% of the recreational features plus OMRR&R, is $534,555,000. Under the previous Section 207 cost-share of 75/25, the Federal share would have been $1,135,784,000 and the non-Federal share would have been $383,130. The OMRR&R plan developed for this report assumes that the exterior dikes will be turned over for non-Federal maintenance in 2023. This would allow for 5 years of filling operation to assure the dikes are stable and ready to be turned over. Other features that will likely be turned over during construction include the personnel pier and operations facilities shortly after construction of those components, and habitat cells after they have been developed and stabilized. Total O&M, including OMRR&R, for this project is estimated to be approximately $23,490,000 with OMRR&R accounting for $4,468,000 of that total. The total O&M amounts to less than 2% of the implementation cost. Costs for adaptive management activities at James Island are included in the total project costs. The total first cost for adaptive management is estimated to be $8,725,000 or 0.58% of the total project. During the years in which adaptive management will be practiced, the annual cost is estimated to be $396,000 over 22 years, or 1.28% of the project cost during those years.

Barren Island is an ecosystem restoration project and will be authorized through the standard General Investigations process. Funding for USACE participation in Civil Works environmental restoration projects occurs under the authority of Section 210 of WRDA 1996 (PL 104-303). In this section, the construction cost-sharing that was earlier established by Section 103 of WRDA 1986 was revised to 65% Federal and 35% non-Federal. Based on October 2007 price levels, the cost for the construction phase for Barren Island is $43,654,000. The Federal share, 65%, is $28,375,000 and the non-Federal share, 35%, is $15,279,000.

7.4 PROJECT SCHEDULE

The record of decision (ROD) for the entire plan and ASA(CW) determination on authorization of James Island and Barren Island is expected in 2009. Since the recommended plan for James Island is needed to accept dredged material in 2018, and it is estimated that it will take 6 years to design and construct the James Island project, the schedule and cost estimate shows implementation from FY12 to FY60. Should funding be available, PED for James Island could commence in 2009. Construction could begin in 2011, thereby allowing for lower levels of funding for each year of construction. The plan in this report, however, assumes optimal funding that allows for the project to be on-line in 2018. The Barren Island project's schedule for implementation starts in FY09 and ends in FY15. Details of each project are provided below.

7.4.1 Barren Island

For Barren Island, the PED phase is planned to be completed in FY10. In FY10, a PPA will be executed with the non-Federal sponsor and construction will begin. Construction of Barren Island is expected to be completed by FY12, followed by five years of post-construction monitoring from FY13 through FY17.

7.4.2 James Island

For James Island, the PED phase is shown as being conducted in FY12 and FY13. A PPA will be executed in FY13 or FY14, and dike construction will begin in FY14, continuing through FY17. Dredged material placement is scheduled to begin in FY18, to address projected placement inefficiencies at the existing PIERP. Dredged material placement is estimated to continue until FY57. From FY58 through FY60, site operation and habitat development will be conducted, followed by five years of post-project monitoring, ending in FY65. A summary of project milestones is provided in Table 7-4. This is consistent with the dredged placement recommendations of the Federal DMMP.

7.5 SUMMARY OF RESPONSIBILITIES

The sponsoring agency understands that they will be required to provide assurance of their authority and willingness to provide 25% of the costs in PED, 35% of the incremental project costs above the Federal Standard for James Island and construction of Barren Island, and as further specified below:

a. Provide all lands, easements, and rights-of-way, including suitable borrow and dredged or excavated material disposal areas, and perform or ensure the performance of all relocations determined by the Federal Government to be necessary for the initial construction, operation, and maintenance of the project.

b. Provide all improvements required on lands, easements, and rights-of-way to enable the proper disposal of dredged or excavated material associated with the initial construction, operation, and maintenance of the project. Such improvements may include, but are not necessarily limited to, retaining dikes, wasteweirs, bulkheads, embankments, monitoring features, stilling basins, and dewatering pumps and pipes.

c. Provide, during construction, any additional amounts as are necessary to make its total contribution equal to 35% of incremental project costs above the Federal Standard for James Island components and 35% of project costs for Barren Island components.

d. For so long as the project remains authorized, operate, maintain, repair, replace, and rehabilitate the completed project, or functional portion of the project, at no cost to the Federal Government, in a manner compatible with the project's authorized purposes and in accordance with applicable Federal and state laws and regulations and any specific directions prescribed by the Federal Government.

e. Give the Federal Government a right to enter, at reasonable times and in a reasonable manner, upon property that the non-Federal sponsor, now or hereafter, owns or controls for access to the project for the purpose of inspection, and, if necessary after failure to perform by the non-Federal sponsor, for the purpose of completing, operating, maintaining, repairing, replacing, or rehabilitating the project. No completion, operation, maintenance, repair, replacement, or rehabilitation by the Federal Government shall operate to relieve the non-Federal sponsor of responsibility to meet the non-Federal sponsor's obligations, or to preclude the Federal Government from pursuing any other remedy at law or equity to ensure faithful performance.

f. Hold and save the United States free from all damages arising from the initial construction, periodic nourishment, operation, maintenance, repair, replacement, and rehabilitation of the project and any project-related betterment, except for damages due to the fault or negligence of the United States or its contractors.

g. Keep and maintain books, records, documents, and other evidence pertaining to costs and expenses incurred pursuant to the project in accordance with the standards for financial management systems set forth in the Uniform Administrative Requirements for Grants and Cooperative Agreements to State and Local Governments at 32 CFR Section 33.20.

h. Perform, or cause to be performed, any investigations for hazardous substances as are determined necessary to identify the existence and extent of any hazardous substances regulated under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), PL 96-510, as amended, 42 U.S.C. 9601-9675, that may exist in, on, or under lands, easements, or rights-of-way that the Federal Government determines to be required for the initial construction, periodic nourishment, operation, and maintenance of the project. However, for lands that the Federal Government determines to be subject to the navigation servitude, only the Federal Government shall perform such investigations unless the Federal Government provides the non-Federal sponsor with prior specific written direction, in which case, the non-Federal sponsor shall perform such investigations in accordance with such written direction.

i. Assume complete financial responsibility, as between the Federal Government and the non-Federal sponsor for all necessary cleanup and response costs of any CERCLA regulated materials located in, on, or under lands, easements, or rights-of-way that the

Federal Government determines to be necessary for the initial construction, periodic nourishment, operation, or maintenance of the project.

j. As between the Federal Government and the non-Federal sponsor, the non-Federal sponsor shall be considered the operator of the project for the purpose of CERCLA liability. To the maximum extent practicable, operate, maintain, repair, replace, and rehabilitate the project in a manner that will not cause liability to arise under CERCLA.

k. Comply with the applicable provisions of the Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970, Public Law 91-646, as amended by Title IV of the Surface Transportation and Uniform Relocation Assistance Act of 1987 (Public Law 100-17), and the Uniform Regulations contained in 49 CFR Part 24, in acquiring lands, easements, and rights-of-way, required for the initial construction, periodic nourishment, operation, and maintenance of the project, including those necessary for relocations, borrow materials, and dredged or excavated material disposal, and inform all affected persons of applicable benefits, policies, and procedures in connection with said act.

l. Comply with all applicable Federal and state laws and regulations, including, but not limited to, Section 601 of the Civil Rights Act of 1964, PL 88-352 (42 U. S .C. 2000d), and Department of Defense Directive 5500.11 issued pursuant thereto, as well as Army Regulation 600-7, entitled "Nondiscrimination of the Basis of Handicap in Programs and Activities Assisted or Conducted by the Department of the Army."

m. Provide 25% of that portion of total historic preservation mitigation and data recovery costs that are in excess of one percent of the total amount authorized to be appropriated for this project.

7.6 VIEW OF THE NON-FEDERAL SPONSOR

Construction of the Mid-Chesapeake Island project is projected to begin 2010 for Barren Island and 2014 for James Island. At that time, the non-Federal sponsor must have funding mechanisms in place to provide the local share of projects costs in a timely fashion. The non-Federal sponsor has diligently supported, promoted, and financed multiple studies to identify dredged material placement sites, including this study. The MPA has indicated their intent to proceed with the next phase of project implementation and to provide the non-Federal cooperation required for project implementation. As such, a letter of intent has been received from the non-Federal sponsor and is included in at the end of this section.

The State of Maryland's DMMP Executive Committee recommendations for dredged material from the open bay channels are (DMMP, 2004): 1) conclude the Poplar Island General Re-Evaluation study of expanding, through dike raising and/or lateral expansion, the PIERP in Talbot County, MD; and 2) conclude the Mid-Chesapeake Bay Island Restoration feasibility study of restoring James Island and Barren Island, both located in Dorchester County, MD.

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Martin O'Malley
Governor
Anthony G. Brown
Lieutenant Governor

Maryland Port Commissio
John D. Porcari
Chairman

Atwood Collins, III
Brenda A. Dandy
George C. Doub, III
John G. Gary, Jr.
Michael G. Martino

F. Brooks Royster, III
Executive Director

May 14, 2007

Colonel Peter W. Mueller
District Engineer
US Army Engineer District, Baltimore
P.O. Box 1715
Baltimore, MD 21203-1715

Re: Statement in Support of the Mid-Chesapeake Bay Island Ecosystem Restoration Project

Dear Colonel Mueller:

The Mid-Chesapeake Bay Islands project is critical to the continued success of Maryland's Port of Baltimore. The Maryland Department of Transportation, Maryland Port Administration is solidly in support of this project.

The Port of Baltimore is doing well, increasing tonnage across the many types of cargo handled at the Port, but its growing prosperity could soon be impacted by a lack of dredged material placement capacity to keep its channels clear. More cargo at the Port enhances economic benefits to local communities, the State of Maryland and the consolidated Baltimore/Washington Metropolitan Area, a trend that will likely be interrupted unless new placement options for Bay channels are included in the Water Resources Development Act (WRDA) of 2007.

Maryland's Port of Baltimore is a major economic engine for the state, responsible in 2005 for $1.9 billion in direct business revenues and $2.4 billion in personal wage and salary income. The Port generates approximately 42,300 jobs in Maryland.

The total value of foreign cargo moving through the Port in 2005 was $35.8 billion – an all time record. General cargo handled at state terminals exceeded 8 million tons, setting a new tonnage record for the fourth year in a row. Container tonnage was up by 4%. There were over 2,100 vessel arrivals at the Port in 2005, an increase of 2.6% over 2004.

Approximately 4.7 million cubic yards (mcy) of material must be dredged in Maryland waters each year to maintain authorized channel dimensions and enable safe and efficient passage of all vessels. Some vessels transiting the system are loaded to within 2.5 to 3 feet of the channel bottom. Efficient annual maintenance of Port of Baltimore channels is an absolute necessity for safe and efficient ship transits.

Maryland Port Administration, 2310 Broening Highway, Baltimore, MD 21224, 800.638.7519, TTY: 800.201.7165, www.MarylandPorts.com

Maryland's existing placement sites currently provide more than adequate capacity to accept the annual dredging requirement, but this will soon change significantly. The Hart-Miller Island (HMI) site will close at the end of 2009. By the end of 2010, the Pooles Island Open Water Site will close and wetlands development at the Paul S. Sarbanes Ecosystem Restoration Project at Poplar Island (Poplar Island) will reduce its annual capacity by half. Poplar Island is expected to be filled by 2014, without the expansion project. With the expansion project, Poplar Island would be able to accept the total annual maintenance dredging requirement in Bay channels (3.2 mcy) until 2017, after which its annual capacity will likely be reduced. To ensure efficient management of dredged material, an additional site would need to come on line by 2016 to avoid overfilling and reducing the total placement capacity of the Poplar Island Expansion project. The current dredged material placement shortfall through 2025 for the Chesapeake Bay channels is 40 million cubic yards.

Failure to diligently maintain channels will result in a loss of cargo, jobs, and revenue for Maryland and for local communities and jurisdictions as well. Recognizing the potential severity of this approaching problem, the Maryland General Assembly passed the Dredged Material Management Act of 2001. The Act mandated development of a program to provide 20 years of dredged material placement and reuse capacity for the Port of Baltimore. It also stipulated **beneficial use** of dredged material as a top priority.

In response to the Act, existing programs were restructured and refocused to become the current Dredged Material Management Program (DMMP). In the DMMP, communities, citizens, regulatory and resource management agencies and other identified vested interests such as the maritime industry are first involved at the program's conceptual level, and continue throughout project selection, design, construction and operation. The State's DMMP is closely coordinated with the U.S. Army Corps of Engineers. For Chesapeake Bay channels, the State's DMMP and the Corps of Engineers have recommended the Poplar Island expansion and Mid-Chesapeake Bay Island projects. These are island restoration, **beneficial use** options.

Since its beginning in 2001, this coordinated Port/Corps/citizens effort has conducted a series of reconnaissance and feasibility studies of potential placement and reuse options for material dredged from Baltimore Harbor and Chesapeake Bay Channels. Studies of options for Chesapeake Bay dredged material have been conducted jointly by the U.S. Army Corps of Engineers and the Maryland Port Administration. It is an intensively collaborative effort at all levels.

The Mid-Chesapeake Bay Island Restoration project is an environmentally responsible project which will enhance ecosystem viability in the Chesapeake Bay while providing critical support to state and regional economic vitality. The project will construct 2,072 acres of remote island habitat at James Island, which will provide 90 to 95 mcy of dredged material placement capacity. Approximately 72 acres of island habitat will be created at Barren Island. These habitats will be created using material dredged from Maryland's Chesapeake Bay channels. Island habitat has been consistently disappearing from the Chesapeake Bay, and the opportunity to restore this habitat while supporting the continued economic success of the Port of Baltimore and the Baltimore/Washington region is a winning proposition from all perspectives.

The Maryland Department of Transportation, Maryland Port Administration is solidly in support of the Mid-Chesapeake Bay Island Ecosystem Restoration project. If you should have any questions concerning our support, please do not hesitate to contact us.

Sincerely,

Frank L. Hamons
Deputy Director for Harbor Development
The Maryland Department of Transportation
Maryland Port Administration

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SECTION 7

TABLES

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Table 7-1: Summary of the Federal and Non-Federal Contribution to the Mid-Chesapeake Bay Island Ecosystem Restoration Project **(October 2007 price levels)**				
	Federal** **($1000)**	**Non-Federal**** **($1,000)**	**Total First Cost** **($1,000)**	**Fully Funded** **($1,000)**
James Island (FY12-60)***	$971,893	$523,327	$1,495,220	$2,711,250
PED	$1,340	$447	$1,786	$2,195
O&M (less OMRR&R)	$12,364	$6,658	$19,022	$34,484
OMRR&R*		$4,468	$4,468	$9,168
Recreation	$102	$102	$204	$555
Total Costs for James	*$985,699*	*$535,002*	*$1,520,700*	*$2,757,653*
Barren Island	$28,268	$15,153	$43,421	$47,324
PED	$212	$70	$282	$304
LERRD	$0	$69	$69	$79
O&M	$107	$57	$164	$183
Total Costs for Barren	*$28,587*	*$15,349*	*$43,936*	*$47,891*
Total Project Cost	**$1,014,286**	**$550,351**	**$1,564,636**	**$2,805,544**

* Note: OMRR&R is a 100% non-Federal expense and refers to O&M on completed project components that have been turned over to the Sponsor

** Note: Cost sharing for the James Island project component is calculated at 65% Federal and 35% non-Federal in accordance with WRDA 2007. PED costs remain 75% Federal and 25% non-Federal. Recreation is shared 50/50. LERRD is a non-Federal responsibility but is credited toward the 35% cost share.

*** Note: Assumes that dredging costs for an average of 3.2 Mcy over 30 years to the Federal Standard are funded through the Operations and Maintenance Program. Project costs as shown are incremental costs above the Federal Standard (Pooles Island for 1.2 Mcy and Deep Trough for 2.0 Mcy per year on average).

Rows or columns may not sum due to rounding.

Table 7-2: Mid-Chesapeake Bay Island Restoration Project Cost for James Island by Federal Fiscal Year (October 2007)

Fiscal Year	Project Cost	Contingency	O&M	O&M Contingency	Total O&M	OMRR&R (non-Fed)	OMRR&R Contingency	Total OMRR&R	Total Project Cost
2012	$780,680	$156,136	$0	$0	$0			$0	$936,816
2013	$707,680	$141,536	$0	$0	$0			$0	$849,216
2014	$79,442,723	$15,888,545	$0	$0	$0			$0	$95,331,268
2015	$119,773,229	$23,954,646	$0	$0	$0			$0	$143,727,875
2016	$78,831,712	$15,766,342	$0	$0	$0			$0	$94,598,054
2017	$38,656,966	$7,731,393	$0	$0	$0			$0	$46,388,359
2018	$27,307,646	$5,461,529	$423,652	$76,257	$499,909			$0	$33,269,084
2019	$2,436,748	$487,350	$423,652	$76,257	$499,909			$0	$3,424,007
2020	$27,398,663	$5,479,733	$423,652	$76,257	$499,909			$0	$33,378,305
2021	$2,528,145	$505,629	$423,652	$76,257	$499,909			$0	$3,533,683
2022	$27,476,174	$5,495,235	$586,825	$105,629	$692,454			$0	$33,663,863
2023	$2,605,656	$521,131	$567,285	$102,111	$669,396	**$69,372**	**$12,487**	**$81,859**	$3,796,183
2024	$2,267,891	$453,578	$567,285	$102,111	$669,396	**$69,372**	**$12,487**	**$81,859**	$3,390,865
2025	$2,099,119	$419,824	$567,285	$102,111	$669,396	**$69,372**	**$12,487**	**$81,859**	$3,188,339
2026	$2,099,119	$419,824	$567,285	$102,111	$669,396	**$69,372**	**$12,487**	**$81,859**	$3,188,339
2027	$23,963,752	$4,792,750	$567,285	$102,111	$669,396	**$69,372**	**$12,487**	**$81,859**	$29,425,898
2028	$27,711,110	$5,542,222	$586,561	$105,581	$692,142	**$69,372**	**$12,487**	**$81,859**	$33,945,474
2029	$30,233,450	$6,046,690	$977,297	$175,913	$1,153,210	**$69,372**	**$12,487**	**$81,859**	$37,433,350
2030	$30,577,787	$6,115,557	$404,112	$72,740	$476,852	**$69,372**	**$12,487**	**$81,859**	$37,170,196
2031	$30,577,787	$6,115,557	$404,112	$72,740	$476,852	**$69,372**	**$12,487**	**$81,859**	$37,170,196
2032	$30,577,787	$6,115,557	$411,317	$74,037	$485,354	**$69,372**	**$12,487**	**$81,859**	$37,178,698
2033	$30,577,787	$6,115,557	$567,285	$102,111	$669,396	**$69,372**	**$12,487**	**$81,859**	$37,362,740
2034	$30,577,787	$6,115,557	$625,477	$112,586	$738,063	**$139,333**	**$25,080**	**$164,413**	$37,431,407
2035	$30,539,564	$6,107,913	$593,941	$106,909	$700,850	**$139,333**	**$25,080**	**$164,413**	$37,348,327
2036	$27,780,283	$5,556,057	$613,218	$110,379	$723,595	**$139,333**	**$25,080**	**$164,413**	$34,059,935
2037	$28,201,634	$5,640,327	$1,011,157	$182,008	$1,193,165	**$139,333**	**$25,080**	**$164,413**	$35,035,126
2038	$28,239,807	$5,647,961	$593,941	$106,909	$700,850	**$139,333**	**$25,080**	**$164,413**	$34,588,618
2039	$30,970,750	$6,194,150	$586,736	$105,612	$692,348	**$139,333**	**$25,080**	**$164,413**	$37,857,248
2040	$30,879,387	$6,175,877	$474,405	$85,393	$559,798	**$191,796**	**$34,523**	**$226,319**	$37,615,062

Table 7-2: Mid-Chesapeake Bay Island Restoration Project Cost for James Island by Federal Fiscal Year (October 2007)

Fiscal Year	Project Cost	Contingency	O&M	O&M Contingency	Total O&M	OMRR&R (non-Fed)	OMRR&R Contingency	Total OMRR&R	Total Project Cost
2041	$30,774,037	$6,154,807	$372,576	$67,064	$439,640	**$69,372**	**$12,487**	**$81,859**	$37,368,484
2042	$30,696,526	$6,139,305	$372,576	$67,064	$439,640	**$69,372**	**$12,487**	**$81,859**	$37,275,471
2043	$30,605,129	$6,121,026	$348,894	$62,801	$411,695	**$69,372**	**$12,487**	**$81,859**	$37,137,850
2044	$30,513,805	$6,102,761	$426,362	$76,745	$503,107	**$139,333**	**$25,080**	**$164,413**	$37,119,673
2045	$30,513,805	$6,102,761	$867,940	$156,229	$1,024,169	**$191,796**	**$34,523**	**$226,319**	$37,640,735
2046	$27,561,879	$5,512,376	$407,086	$73,275	$480,361	**$139,333**	**$25,080**	**$164,413**	$33,554,616
2047	$27,561,879	$5,512,376	$407,086	$73,275	$480,361	**$139,333**	**$25,080**	**$164,413**	$33,554,616
2048	$27,561,879	$5,512,376	$331,687	$59,704	$391,391	**$184,739**	**$33,253**	**$217,992**	$33,465,646
2049	$27,215,942	$5,443,188	$288,049	$51,849	$339,898	**$132,276**	**$23,810**	**$156,086**	$32,999,028
2050	$27,215,942	$5,443,188	$288,049	$51,849	$339,898	**$132,276**	**$23,810**	**$156,086**	$32,999,028
2051	$27,215,942	$5,443,188	$229,858	$41,374	$271,232	**$62,315**	**$11,217**	**$73,532**	$32,930,362
2052	$27,215,942	$5,443,188	$249,133	$44,844	$293,977	**$62,315**	**$11,217**	**$73,532**	$32,953,107
2053	$25,317,389	$5,063,478	$690,712	$124,328	$815,040	**$114,778**	**$20,660**	**$135,438**	$31,195,907
2054	$5,395,525	$1,079,105	$229,858	$41,374	$271,232	**$62,315**	**$11,217**	**$73,532**	$6,745,862
2055	$5,395,525	$1,079,105	$229,858	$41,374	$271,232	**$62,315**	**$11,217**	**$73,532**	$6,745,862
2056	$18,222,306	$3,644,461	$280,130	$50,423	$330,553	**$114,778**	**$20,660**	**$135,438**	$22,197,320
2057	$18,222,306	$3,644,461	$229,858	$41,374	$271,232	**$62,315**	**$11,217**	**$73,532**	$22,137,999
2058	$1,549,397	$309,879	$229,858	$41,374	$271,232	**$62,315**	**$11,217**	**$73,532**	$2,130,508
2059	$1,549,397	$309,879	$229,858	$41,374	$271,232	**$62,315**	**$11,217**	**$73,532**	$2,130,508
2060	$1,549,397	$309,879	$229,858	$41,374	$271,232	**$62,315**	**$11,217**	**$73,532**	$2,130,508
Total	**$1,247,674,772**	**$249,534,954**			**$23,489,907**			**$4,467,679**	**$1,520,699,621**

Table 7-3: Mid-Chesapeake Bay Island Restoration Project Cost for Barren Island by Federal Fiscal Year (October 2007)						
Fiscal Year	**Project Cost**	**Contingency**	**O&M**	**O&M Contingency**	**Total O&M**	**Total Project Cost**
2009	$248,250	$49,650	$0	$0	$0	$297,000
2010	$15,714,135	$3,142,827	$0	$0	$0	$18,856,962
2011	$16,221,753	$3,244,351	$0	$0	$0	$19,466,104
2012	$4,599,119	$552,614	$139,211	$25,058	$164,269	$5,316,002
Total	**$36,783,257**	**$6,989,442**			**$164,269**	**$43,936,968**

Table 7-4: Mid-Chesapeake Bay Island Restoration Project Schedule		
Fiscal Year (Federal)	**James Island**	**Barren Island**
FY09	• ROD • Execute PED agreement • WRDA authorization	
FY10		• Complete PED • Negotiate/execute PPA • Initiate construction
FY11		• Continue construction
FY12	PED activities	• Complete construction
FY13	• Complete PED • Execute PPA	• Project monitoring
FY14	• Initiate dike construction	• Project monitoring
FY15	• Continue dike construction	• Project monitoring
FY16	• Continue dike construction	• Project monitoring
FY17	• Continue dike construction	• Project monitoring
FY18-FY57	• Initiate and continue dredged material placement • Site operation & habitat development	
FY58-FY60	• Site operation & habitat development	
FY61-FY65	• Project monitoring	

8 ADAPTIVE MANAGEMENT AND MONITORING

The project partners will manage the proposed projects at James Island and Barren Island to achieve their island restoration and protection goals by utilizing adaptive management and traditional task management methods. Recurring environmental monitoring studies will also be conducted to measure the achievement of the project goals and to assure that the project is complying with environmental standards. Tasks related to island restoration or island restoration and protection goals will be managed using adaptive management methods. Tasks such as general design, construction, and maintenance will be managed using more traditional task management methods. Adaptive Management practices are currently being used for the Paul S. Sarbanes Ecosystem Restoration Project at Poplar Island (PIERP), which is a project very similar to the proposed island restoration at James Island, and the Adaptive Management structure for PIERP can serve as the model for the recommended plan. The following AMP was developed based on the Poplar Island model. Engineering criteria will be revisited as the site specific design progresses. Environmental monitoring studies will be conducted to document trends in the environmental conditions surrounding the projects.

8.1 MANAGEMENT STRUCTURE

The project partners, USACE-Baltimore District and the MPA, will form the Ecosystem Restoration Project Coordination Team to lead the management of the project. A Site Development Team, Site Operations Team, and Adaptive Management Team will support the Project Coordination Team, and are responsible for daily tasks. Figure 8.1 illustrates the PIERP management structure, which is likely to serve as the model for the Mid-Chesapeake Bay Island restoration project.

The primary responsibility of the Adaptive Management Team will be to draft and execute management plans and guidance documents related to the habitat restoration and environmental monitoring components of the project. In addition to members from USACE and MPA, the Adaptive Management Team will include representatives from the MES, and other involved contractors. A network of teams and working groups will support the decision-making process for the project. A Working Group will be formed to provide technical advice and support to the project partners and Adaptive Management Team. In addition, Subgroups such as the Habitat Subgroup and Monitoring Subgroup can advise the Working Group, as shown in Figure 8.1. The work groups and subgroups will be include members from State and Federal resource agencies. The responsibility of the Work Group and Subgroups will be to provide technical support to the Adaptive Management Team and project partners, and also to review and comment habitat restoration practices for the project.

A network of documents will also be used to manage the proposed project. Figure 8.2 illustrates the relationship between the key environmental documents for PIERP. The same environmental documents will likely be required for the Mid-Chesapeake Bay Island Restoration Project. The Habitat Development Framework (HDF) is the primary document supporting the island habitat restoration. It provides the basic design goals and guidelines for each of the habitat types proposed for restoration: low marsh, high marsh, habitat islands, upland/wetland transition zones, tidal creeks, ponds, upland scrub shrub, and upland forested habitat. The island restoration project at James Island will be divided into discrete cells and subcells for purposes of dredged material placement and habitat restoration. A Cell Development Plan will be created to outline the habitat restoration process in each cell. The island restoration/protection project at Barren Island may not be divided into cells; however, a plan that fills the same role as the Cell Development Plan may be developed for the Barren Island restoration/protection project if necessary. A Monitoring Framework will be prepared for the James Island and Barren Island projects in consultation with Federal and state agencies. The Monitoring Framework will outline the study methods used to document progress on the habitat restoration goals. The Monitoring Framework will be discussed further in Section 8.3.

8.2 ADAPTIVE MANAGEMENT

The AMP developed for this project will provide a framework for managing the proposed island restoration and island restoration/protection projects at James Island and Barren Island. The habitat restoration goals of the proposed projects at James Island and Barren Island are outlined in Section 2.3.2. Adaptive Management is a continuous process, where initial goals are set, and progress is measured and assessed regularly. Once the progress toward the goals is evaluated, the methods of achieving them are revised as necessary. This process will repeat at regular intervals (annually) until the island restoration project at James Island and the island restoration/protection project at Barren Island are complete. Due to its versatility, adaptive management is very applicable to ecosystem restoration projects.

The MPA and USACE utilize Adaptive Management methods at PIERP, and a draft AMP for the James Island and Barren Island project is based on the same principles as the PIERP AMP. The AMP for the island restoration project at James Island and the restoration/protection project at Barren Island is attached in Appendix F. An AMP includes the following key elements:

- Goals and objectives for the final project outcome
- Measurable end points upon which to evaluate progress toward those goals, including acceptable bounds of success around those endpoints
- Methods for measuring progress toward those end points
- A schedule for reviewing the measurements and assessing progress
- A mechanism for developing corrective actions when progress is outside of the acceptable bounds,
- A mechanism for implementing those corrections, and
- A mechanism for incorporating the lessons learned from those assessments into a revised management plan, which could include revising the goals and objectives and/or the end points (USACE, 2004c).

8.2.1 Adaptive Management Components

The AMP has two components: Restoration and Cell Development. The Restoration Component relates to habitat restoration and the outcome of the restoration once development is complete and the habitat has matured. The Cell Development Component of the AMP generally relates to habitat development within each cell, and tends to consist of shorter term activities than the Restoration Component. The details of dredged material placement, developing channels, achieving correct elevations, and final planting of vegetation are detailed in the Cell Development Component.

The habitat restoration goal of the Mid-Chesapeake Bay Island project is to create approximately 2070 ac of island habitat at James Island and provide shoreline protection with the opportunity to create additional wetlands at Barren Island. The habitat at James Island will consist of 55% wetlands and 45% uplands. Section 2.0 of this EIS provides ten subgoals for the Restoration Component:

- Restore and enhance marsh, aquatic, and terrestrial island habitat for fish, reptiles, amphibians, birds, and mammals;
- Protect existing island ecosystems, including sheltered embayments;
- Minimize impacts to existing fisheries nursery, feeding, and protective habitats;
- Increase wetlands acreage in the Chesapeake Bay watershed;
- Decrease local erosion and turbidity;
- Promote conditions to establish and enhance submerged aquatic vegetation;
- Promote conditions that support oyster recolonization;
- Minimize impacts to rare, threatened, and endangered species and their habitat;
- Minimize impacts to existing commercial fisheries;
- Minimize establishment of invasive species to maximum extent possible;
- Optimize the capacity for placement of dredged material (3.2 mcy/y).

These subgoals were developed by the inter-agency Mid-Chesapeake Bay Island Project Delivery Team (PDT). The AMP breaks down the subgoals into the adaptive management elements: objectives, attributes, and criteria (targets and acceptable bounds). The full Restoration Component of the Mid-Chesapeake Bay Island AMP is included in Appendix F.

Section 2.0 of this EIS provides one subgoal for the Cell Development Component of the AMP. Additional subgoals are expected to be added to the AMP as project development progresses. The Cell Development subgoal is to optimize the capacity for placement of dredged material (3.2 mcy/y).

Additional cell development sub-goals will be defined as the HDF is developed and individual cells begin accepting material. Objectives, attributes, and criteria will be assigned to describe each of the Cell Development subgoals. The objectives contained in the Cell Development Component relate to operating goals, including placement and dewatering of dredged materials, or details of cell construction for habitat restoration, such as hydrology, substrate, vegetation, and elevation. It should be noted that the objectives and attributes contained in the Cell Development Component are typically specific to a certain cell. These cell specific objectives and attributes are derived from the general objectives and attributes that would be provided in the Restoration Component. A detailed Cell Development Component for the Mid-Chesapeake Bay Island Restoration Project is located in Appendix F as part of the AMP.

8.2.2 Adaptive Management Plan Review Process

The Adaptive Management Team will annually review the AMP with the assistance of the Working Group and Habitat Subgroup; however, the project partners can review specific objectives, criteria, or monitoring plans more frequently in response to project needs. During the review process, the Adaptive Management Team, Working Group, and Habitat Subgroup assess the monitoring data for each criterion, and evaluate the progress toward achieving the habitat objectives. Favorable monitoring results and acceptable progress may lead the Adaptive Management Team to leave the AMP unrevised. Conversely, the AMP can be revised in the following ways to correct unsatisfactory progress or monitoring results:

- Revise the AMP level (subgoal, objective, attribute, criterion) to make it more realistic
- Revise the monitoring plan to better determine why progress is not occurring.
- Revise the design and/or operation to try to recover or redirect progress toward the goal or objective.
- Revise the design and/or operation to reflect a new or revised goal or objective.
- Revise the Habitat Development Framework.
- Revise the Monitoring Framework.
- Revise individual cell development plans.

It is likely that the review process during the initial years of the project will concentrate on the Cell Development Component of the AMP. At this time there may be few completed habitat areas to evaluate or monitor, and the Restoration Component may only have to be revised if an objective is determined to be unachievable. Monitoring for the long-term restoration goals outlined in the Restoration Component will begin once that habitat has been created at the project. Details of monitoring objectives, methods, and schedules will be included in a Monitoring Framework.

Historic records should be maintained to document the changes that have occurred to objectives, attributes, criteria, and the reasons those revisions were made in the evolving AMP. The records should include:

- Data used in the assessment (i.e., current conditions at the time of the assessment),
- Evaluations of those data versus the criteria,
- Recommended changes,
- Implemented changes or reasons for not implementing specific recommended changes.

8.3 MONITORING ELEMENTS

As noted in Section 8.2, a Monitoring Framework will be developed to provide a multi-disciplinary monitoring plan that meets the regulatory agency, resource agency and construction compliance requirements for the recommended plan. Agencies providing expertise and information on monitoring elements will likely include NMFS, USFWS, the National Biological Survey, MDNR (including the Maryland Geologic Survey), MDE, MES, USEPA and USACE-Baltimore District. Additionally, academic institutions such as the University of Maryland are expected to provide expertise on monitoring.

It is expected that the environmental monitoring framework for the James Island restoration project and the Barren Island restoration/protection project will contain studies to monitor discharge water quality, receiving water quality, SAV presence, sediment quality, benthic community, nekton, birds, and other wildlife. "Pre-construction" environmental monitoring studies will be conducted to determine the baseline environmental conditions in the project vicinity or in ecologically similar reference areas prior to project construction. "Post-construction" environmental monitoring will begin after the proposed projects are constructed, and document environmental conditions or changes in the project vicinity. Due to the similarity between the two projects the proposed monitoring studies are based on the PIERP Monitoring Framework. The monitoring objectives, hypothesis, and brief descriptions for each of the expected recommended plan monitoring elements are described below.

8.3.1 Sediment Quality Monitoring

Objective-The objective of sediment quality monitoring will be to monitor physical parameters and the concentrations of metals and other chemicals in sediment outside of the proposed projects at James Island and Barren Island. Presence of contaminants could be indicators of accompanying effects to benthic infauna, and potential bioaccumulation through the food chain. Additional sediment quality monitoring within the wetlands of the proposed project can provide operational input on ecological function and the need for soil conditioning to increase pH and reduce metals mobilization in the uplands.

Hypothesis- Project conditions will not change the metals behavior in wetlands or the sediments around the proposed projects at James Island and Barren Island when compared to regional background sediments.

Brief Description- Baseline sediment sample collection should be performed for this element before construction begins. Pre-construction baseline monitoring and post-construction monitoring should be performed; followed by periodic monitoring. Sediment analysis should include, but are not limited to, grain size analysis and determining metals, nutrients, pesticides, dioxin/furan congener, PCB congener, and polynuclear aromatic hydrocarbons (PAHs) content. Samples should be collected from the same points as the benthic monitoring and water quality monitoring stations. Annual evaluations will determine whether monitoring should continue.

8.3.2 Wetland Vegetation Monitoring

Objective-Wetland vegetation monitoring will measure and evaluate differences in plant community species composition, densities, or production among the restored marshes at the projects and those of nearby reference marshes. Wetland vegetation monitoring will also measure and evaluate differences in plant community species composition, densities, or production associated with age (seral stage) of restored marshes; and measure and evaluate differences in plant species composition or zonation associated with age (seral stage) or topographic changes of restored marshes. This monitoring will provide operational input on survival of plant species and methods to increase planting success.

Hypotheses

1. There are no differences in plant community species composition, densities or production among the restored wetlands and nearby reference wetlands.

2. There are no differences in plant community species composition, densities or production associated with age (seral stage of the restored wetlands).

3. There are no differences in plant species composition or zonation associated with age (seral stage) or topographic changes of restored wetlands.

Brief Description-Vegetation surveys and collections will be performed at the end of the growing season during a baseline year on marked plots of known size in reference wetlands and at existing vegetated areas on the remnant islands. Plant shoot densities, plant survival, above and below ground biomass survival and large-scale vegetation delineation and survival estimates will be performed. Sediment movement and vegetation zonation will also be examined through topographic measurement along transects, aerial photography and comparison of surveys. The monitoring will occur after planting of a wetlands area, and will be repeated in conjunction with reference marsh monitoring periodically after that.

8.3.3 Water Quality Monitoring

Objective-Water quality monitoring will characterize water quality in the project area to evaluate whether long-term water quality changes have resulted from the project.

Hypothesis-There will be no significant long-term change in water quality at James Island or Barren Island. (A short-term change from discharge is expected.)

Brief Description-Water quality stations will be monitored to test for the same parameters as are tested in the Chesapeake Bay Program. Pre-construction baseline water quality monitoring will be performed, and post construction monitoring will be performed frequently after completion of the dike. Evaluations will be made annually on whether the monitoring should be continued.

8.3.4 Turbidity Monitoring

Objective-Turbidity monitoring may be requested by state or Federal agencies during construction.

Hypothesis-Turbidity levels outside of a defined mixing zone will remain in compliance with the Water Quality Certification limitations during construction activities.

Brief Description-Turbidity monitoring was required during construction of PIERP and may be required during construction of the recommended plan at James Island and Barren Island. For PIERP construction, compliance limits were set at 50 NTU as a monthly average and 150 NTU as a daily maximum outside of an established mixing zone. Initial monitoring may be conducted very frequently (two out of three days), and then be reduced after compliance with the limits is established.

8.3.5 Benthics Monitoring

Objective-Benthics monitoring will characterize the benthic community in the project area at James Island and Barren Island. The characterization will verify re-establishment of the community, provide information on epibenthic colonization on the dike, and assure there is no accumulation of contaminants in the tissue of benthic organisms due to project conditions.

Hypotheses

- There will be achievement of the benthic restoration goal (an abundance and diversity goal for benthic systems developed as part of the Chesapeake Bay Program) in the vicinity of James Island and Barren Island after dike and breakwater construction.

- There will be no accumulation of contaminants in benthic tissue as a result of project conditions.

- The project will promote an epibenthic community on the exterior dikes and finger dikes. This will enhance the habitat restoration impacts of the project and may offset the loss of the snag field to the recreational fishery.

Brief Description-Baseline benthic monitoring will be performed prior to project construction, and community composition, abundance and diversity will be measured and recorded. After the dike or breakwater is constructed, the benthic stations will be monitored periodically. Epibenthic stations should be included on the dike or breakwater to evaluate epibenthic colonization. Evaluations will be made annually on whether monitoring should be continued.

Benthic tissue samples should also be collected when the benthic sampling occurs. The tissue samples will be analyzed for a complete scan of organic contaminants and metals. These samples will be collected in the baseline year, then periodically after construction and dredged material placement have begun. Benthic tissue stations should also be located within the created wetlands at the projects, to measure contaminant concentrations in the tissue of the organisms most likely to be affected by any mobilization of metals from the dewatering of the uplands. Evaluations will be made after the results from each sampling event are known on whether monitoring should be continued.

8.3.6 Fisheries Use of Exterior Proximal Waters Monitoring

Objective- Fisheries (or nekton) monitoring will measure and evaluate differences in fish and decapod populations and densities. This monitoring will be conducted before and after island restoration or island restoration/protection construction.

Hypotheses

1. There is an enhancement in fish or decapod species composition or density in the vicinity of James Island and Barren Island area prior to project construction compared to after project construction.

2. There is an enhancement in faunal species composition or density in areas immediately adjacent to the outside of the dike prior to project construction compared to after project construction.

Brief Description-The waters in the vicinity of James Island and Barren Island and areas on the reference islands east of the island footprint will be sampled using trawls, gill nets, throw traps and crab pots. This monitoring will provide baseline data on fish and decapod utilization. Species composition, abundance and size will be recorded. This monitoring should be performed periodically after pre-construction baseline and initial post-construction monitoring are performed. Evaluations will be made annually to determine if monitoring should be continued.

8.3.7 Wetlands Use by Fish Monitoring

Objective-Fish utilization monitoring will measure and evaluate differences in decapod and fish densities and community species composition over time in the restored marshes, reference marshes, and the remnants of James Island and Barren Island.

Hypotheses
1. There are greater decapod or fish densities, or community species composition among the restored wetlands at the project compared to those of James Island or Barren Island prior to restoration.

2. There are greater decapod, or fish densities or community species composition among restored wetlands compared to nearby reference wetlands.

3. There are greater decapod, or fish densities or community species composition associated with age (seral stage) of restored wetlands.

Brief Description-Fish, shrimp and crab use of the wetlands will be sampled in reference marshes, restored marshes and marshes on the James Island and Barren Island remnants. Species, size and abundance data will be recorded. This monitoring should be performed periodically after pre-construction baseline and initial post-construction monitoring are performed. Evaluations will be made annually to determine if monitoring should be continued.

8.3.8 Wetlands Use by Wildlife Monitoring

Objective-Evaluating species and numbers of migratory water birds nesting on the restoration and protection projects will be a primary goal for wildlife utilization monitoring. The monitoring will also compare densities and species composition of migratory waterbirds on the restored marshes; evaluate differences in wildlife utilization with the seral age of the restored marsh; and evaluate use of the island by terrapin. Wildlife utilization monitoring should also document any types of fauna encountered on the project.

Hypotheses
1. The species and numbers of migratory waterbirds nesting on the existing James Island or Barren Island remnants are increased when comparing pre- vs. post-project conditions.

2. Densities and species composition of migratory waterbirds using (feeding, roosting) the wetlands are greater among restored wetlands or James Island and Barren Island remnants.

3. Age (or seral stage) or restored sites has a positive influence on their relative attractiveness as nesting sites (uplands) or feeding sites (wetlands) to migratory waterbirds.

4. Use of restored habitat by nesting terrapins is increased from use at either James Island or Barren Island.

Brief Description- Monitoring of wildlife utilization of wetlands utilization should note all wildlife observed during the survey and the habitat the species were observed in. A particular goal of wetlands utilization monitoring will be to document the number of species and species densities of migratory waterbirds and terrapins on the island restoration and restoration/protection projects compared to the James Island and Barren Island remnants. Nest counts will be conducted in the spring, and key indicator species may be used. Details regarding avian and terrapin monitoring are further discussed below. This monitoring should be performed periodically after pre-construction baseline monitoring in a reference marsh and initial post-construction monitoring are performed. Evaluations will be made annually to determine if monitoring should be continued.

8.3.9 Shellfish Bed Sedimentation Monitoring

Objective-Shellfish bed sedimentation monitoring will provide information on the change in sedimentation rates on charted oyster bars nearest to James Island and Barren Island.

Hypothesis-There is a decrease in sedimentation rates on the charted oyster bars during construction of the island restoration project at James Island and the island restoration/protection project at Barren Island when compared to sedimentation rates in reference areas unaffected by construction.

Brief Description-There are two methods available for NOB sedimentation monitoring. The first method will establish sample locations within those NOBs that have the potential to be affected by project construction; control sampling locations will be established in the same NOBs outside of the area of potential influence. Sediment cores will be collected and analyzed regularly to determine if sedimentation is occurring and to what degree. In addition, divers may visually examine the sites and measure the sediment accumulation if possible. This will be performed one month prior to and once a month during dike construction on the closest NOBs. Sedimentation monitoring may also be performed by side scan sonar. Pre-construction and post-construction surveys of the NOBs that have potential to be affected by project construction will be performed to evaluate if sedimentation has occurred and to what extent. Evaluations will be made annually to determine if monitoring should be continued.

8.3.10 Interior Water Quality/Algae Monitoring

Objective-Interior water quality and algae monitoring will characterize water quality and identify the types of algae inside the proposed projects at James Island and Barren Island. The monitoring will allow for evaluation of potential trends in water quality changes that may result from the conditions produced by dredged material placement.

Hypotheses-Water quality within the proposed projects will remain safe for discharge, and use by birds and other wildlife.

Brief Description-Samples will be collected from water within the James Island restoration project and analyzed for algae content. The water quality parameters of turbidity, pH, temperature, salinity, DO, and conductivity will be measured in each cell at the time the sampling. Nutrient samples will be taken at the same time for ammonium and phosphate analysis. Water samples will be analyzed for algae down to the lowest practical taxonomic level. Evaluations will be made annually to determine if monitoring should be continued.

8.3.11 Terrapin Monitoring

Objective-Terrapin monitoring will quantify the use of nesting and juvenile habitat by diamondback terrapins on the proposed projects, including the responses to change in habitat availability throughout the progression of the project. The monitoring will also determine hatchling viability, recruitment rates, and sex ratio to evaluate the suitability of the restored habitat for terrapin nesting. Terrapin monitoring will determine if the project is affecting terrapin population dynamics by increasing the amount of juvenile and nesting habitat in the area.

Hypotheses

1. There will be an increase in the number of terrapin nests or the habitat used from year to year.

2. Nest and hatchling survivorship and sex ratio will be improved in the restored habitats than on reference sites.

3. There will be an increase in terrapin population size from the restored habitats, particularly from the time of dredged material placement, throughout wetland development, and after completion of restoration.

Brief Description-Terrapin nesting habitat at the James Island restoration project and the Barren Island restoration/protection project will be monitored daily during the nesting season. Terrapin nesting activities on James Island and Barren Island may also be monitored as a reference site. Nest locations will be documented, and then excavated to determine clutch size. Each nest will be monitored daily for nest survivorship and all resulting hatchlings will be marked and released. Nest temperatures will be recorded using miniature temperature loggers placed in a subset of the nests to determine hatchling sex ratio. Terrapin population size will be determined using mark-recapture release techniques. Hatchlings will be marked using binary coded wire tags. All juvenile and adult turtles captured will be marked with an externally visible, numbered, monel tag and passive integrated transponder (PIT) tag. Body size measurement will be used to determine population structure and to evaluate the impact of the project on population dynamics. Finally, based on the conclusion of the terrapin monitoring, recommendations will be suggested to increase the suitability and availability of terrapin habitat. Evaluations will be made annually to determine if monitoring should be continued.

8.3.12 Submerged Aquatic Vegetation (SAV) Monitoring

Objective-Submerged Aquatic Vegetation (SAV) monitoring will evaluate the location and health of submerged aquatic vegetation (SAV) in the vicinity of the James Island restoration project and the Barren Island restoration/protection project.

Hypothesis-SAV growth around James Island restoration project and the Barren Island restoration and protection project will increase due to improved environmental conditions.

Brief Description-Annual SAV surveys will be conducted to determine density, location, and species of SAV beds. Personnel will survey SAV along selected transects using modified rakes. SAV species will be identified, and the bed densities will be calculated using the amount recovered on the rakes. Locations and extent of the SAV beds will be documented. Results of the SAV surveys will be compared to Eastern Shore reference sites, and monitoring frequencies will be evaluated annually.

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SECTION 8

FIGURES

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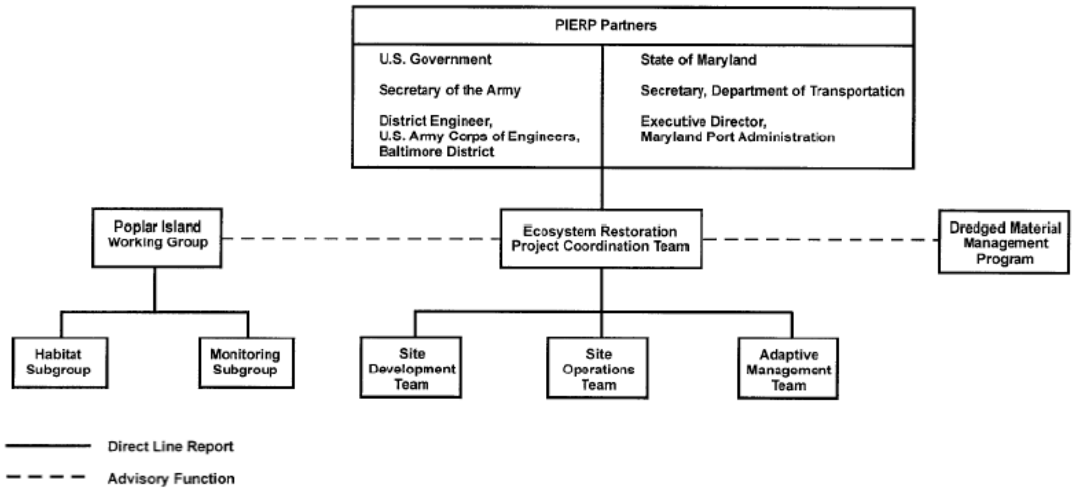

Figure 8-1: Example of Project Management Team Structure for PIERP (USACE, 2004c)

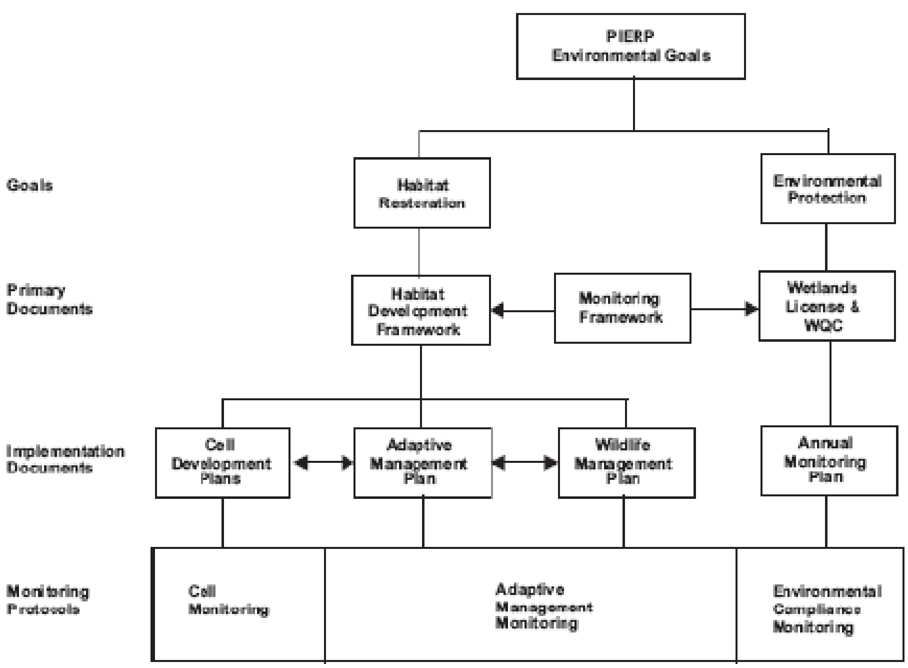

Figure 8-2: Example of Interrelationships of Key Environmental Planning Documents for PIERP (USACE, 2004)

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9 PUBLIC INVOLVEMENT AND AGENCY COORDINATION

The purpose of public participation and agency coordination in the NEPA process is to ensure the productive use of inputs from, private citizens, public interest groups, and government agencies to improve the quality of the environmental decision-making as part of the project (Canter, 1996). CEQ regulations (Title 40 CFR, Chapter V and Part 1506.6) require the incorporation of public participation into multiple phases of the NEPA process, including project scoping and the review process of the recommended plan in the EIS. Components of the public involvement program, as defined in 40 CFR, include at a minimum:

- Making diligent efforts to involve the public in preparing and implementing NEPA procedures;
- Providing public notice of hearings, public meetings, and the availability of environmental documents;
- Holding or sponsoring public hearings or public meetings whenever appropriate;
- Soliciting appropriate information from the public;
- Explaining where interested persons can obtain information, including status reports and other elements of the NEPA process; and
- Providing NEPA documents to the public as stated in the Freedom of Information Act.

Consideration of the views and information of all interested persons promotes open communication and enables better decision-making. Agencies, organizations, and members of the public with a potential interest in the proposed action, including minority, low-income, and disadvantaged groups, were urged to participate in the decision-making process. Public involvement and agency coordination were integrated into each stage of project development. The stages of the project development were: (1) identifying issues and project scoping, (2) conducting additional studies to define existing conditions, (3) providing public update meetings, (4) comparing alternatives, (5) developing the recommended plan, (6) conducting and preparing an impact evaluation and the draft EIS (Environmental Impact Statement), (7) responding to comments on the draft EIS, and (8) preparing the final EIS and completing the record of decision (ROD). Public participation and outreach efforts for each stage of the project are discussed in more detail in the following sections, and documented in Appendix G.

Following the closure of the comment period on the draft EIS, USACE assessed and considered all comments received. This final EIS (FEIS) has been prepared, to include discussions on how the comments were assessed and considered. Responses to all comments received during the draft EIS comment period are documented in Appendix M.

The FEIS circulated to (1) Federal agencies which have jurisdiction by law or special expertise with respect to any environmental impact involved and any appropriate Federal, state or local agency authorized to develop and enforce environmental standards; (2) any person, organization or agency requesting a copy; and (3) to those providing substantive comments on the draft document. Following the circulation of the FEIS and the timing requirements specified in 40 CFR 1506.10, a decision on the proposed action will be made and documented in a record of decision (ROD). The ROD will (1) state what the decision is; (2) identify alternatives considered in reaching its decision, specifying the alternative or alternatives which were considered to be environmentally preferable; (3) identify and discuss factors including any essential consideration of national policy, which were balanced in making the decision; and (4) state whether all practicable means to avoid or minimize environmental harm from the alternative selected have been adopted, and if not, why they were not adopted.

9.1 PUBLIC AND ANGENCY PARTICIPANTS

The public involved in the project included a diverse group of organizations and individuals, ranging from large government agencies to local watermen making their living on the Chesapeake Bay in the vicinity of James and Barren Islands. Participants varied in their degree and type of involvement with the project; however, in general, participants belonged to five identifiable groups:

- <u>Agency Representatives</u> – have been involved since project was initiated and are expected to maintain an active role throughout the life of the project. This group is part of an ongoing collaborative process with the project team. Representatives from MDNR, NOAA, MES, USFWS, NMFS, MDE, USGS, and SHPO were consulted during this process.

- <u>Local Government</u> – are intermittently active in the public involvement program at times when their concerns and interests become issues in the study. Representatives from Dorchester County – Department of Public Works (DPW), County Council, Department of Tourism, and County Manager and a representative from the Star Democrat Newspaper are included in this group.

- <u>Defined Groups</u> – are actively involved in the public involvement program and attend meetings on a regular basis. This group is primarily made of representatives from the CAC, BEWG, the Maryland Charter Boat Captains Association, the Maryland Saltwater Sport Fishermen's Association (MSSA), the Dorchester Shoreline Erosion Group, and the Maryland Watermen's Association (MWA).

- <u>Private Citizens</u> – followed the study progress by attending public meetings, kept informed about the project status, and made comments when necessary. This group was comprised of local watermen from Talbot, Anne Arundel, and Dorchester Counties, private residents, and local business owners.

- <u>Other Individuals</u> – Individuals who followed news of the project, but did not attend meetings or take an active part in other aspects of the public involvement process. These individuals did not take part in public involvement activities or demonstrate interest in the project, but might, nevertheless, be affected by it.

Identification of these five groups allowed for public meeting content to be targeted to a specific audience interested in the project to ensure proper coordination and communication between USACE and the public.

9.2 PUBLIC INVOLVEMENT

The public involvement program was initiated at the beginning of the NEPA process to provide opportunities for public participation during each stage of the project development. The notice of intent (NOI) was published in the Federal Register on January 17, 2003 (Vol. 68, No. 12, pp 2532-2533.) The NOI was the first public notice of the project and the first attempt to involve the public in the project process. The NOI provided a description of the need for the study; outlined project objectives; discussed the islands being considered and the screening process that would be used to select an island for restoration; and also solicited public comment on the proposed project. The following sections describe the chronology of public involvement activities and events, including informal meetings, scoping meetings, public information meetings, public hearings, and other communication activities with public.

9.2.1 Identifying Issues and Project Scoping

The first stage of the public involvement and agency coordination program was to identify the issues and impacts associated with the project by establishing the scope of the EIS. Meetings in the project initiation or scoping stage provided an opportunity to inform the public and government agencies about the proposed project; gather information from a multitude of sources; and discuss the potential project, ideas, issues, and concerns for consideration during the NEPA process. Forums for soliciting public input included public scoping meetings and informal interest group meetings.

The Mid-Chesapeake Bay Island Restoration Study was initiated by a meeting with the non-Federal sponsor (MPA). The Feasibility Cost Sharing Agreement (FCSA) was executed on November 13, 2002 and the kick-off meeting was held on December 10, 2002. The kick-off meeting was attended by representatives from USACE, MPA, and MES.

The *Newsletter* (Appendix G) was mailed to over 900 individuals and emailed to over 200 individuals, including citizens and interested parties at agencies and organizations. The mailing list used to distribute the *Newsletter* was primarily based on the list of stakeholders, government and agency representatives, and interested private individuals identified as recipients for project information for Poplar Island Environmental Restoration Project (PIERP). Federal, state, and local government agencies were also invited to participate in the public scoping meetings and given the opportunity to formally respond with their ideas and concerns to the *Study Initiation Letter* (Appendix G).

In January 2003, the project scoping process was initiated and three public scoping meetings of equal content were held to inform the public of the Mid-Chesapeake Bay Island Study. Public scoping meetings were held at the Dorchester County Public Library on 20 February 2003, Anne Arundel Community College on 25 February 2003 and at Somerset County Commissioner's Office on 13 March 2003. The public meetings were advertised in three local newspapers [*The Daily Banner* (Dorchester County), the *Star Democrat* (Easton), and the *Somerset Herald* (Somerset County)], announced in the Mid-Chesapeake Island Bay Newsletter, posted on the USACE website, and announced in fliers posted in the local area (Table 9-1). At the public scoping meetings, USACE and MPA presented the study background, need, and proposed components; presented the study schedule; and solicited public comments. At each public meeting, a question and answer session was conducted and comment cards were distributed to encourage attendees to express their opinions, make comments, or ask questions about the project in writing. Meeting minutes and a copy of the presentation for both public scoping meetings are included in Appendix G. Significant issues that were brought forward during the scoping process are summarized below. These issues were addressed by the study team in appropriate sections of this report.

- The need for shoreline protection in Dorchester County to reduce erosion;
- The size of the James Island restoration and aesthetic consideration;
- Job opportunities that a large USACE project could provide;
- Support for the project, and the desire to expedite USACE planning and construction process;
- Potential impacts such as erosion and induced flooding at Taylor's Island due to possible changes in currents;
- Impacts to commercial and recreational fishing;
- Impacts to navigation;
- Impacts to bay bottom; and
- Impacts to aquatic resources.

Following the public scoping meetings, several informal meetings were held with local groups with particular interest in the project. Meetings were held between March 2003 and May 2005, and were attended by representatives from the study team, including USACE and MPA. Meeting participants included a group of regional watermen, and members of the Coastal Conservation Association, the MSSA, the Maryland Charter Boat Captains Association, and the MWA (Table 9-1). The study team provided preliminary information including the project need and status of plan formulation. At each meeting, participants were encouraged to voice opinions and concerns about the project and/or submit comments in writing or by email.

The input from the scoping process was incorporated into the plan formulation of project alternatives and the identification of additional studies necessary to adequately document the existing conditions of the proposed project area.

9.2.2 Conducting Additional Studies to Define Existing Conditions

The next stage was to define existing conditions in the vicinity of James and Barren Islands. The purpose of the investigations was to document the existing environmental conditions on and adjacent to the Island remnants as part of the feasibility study. Both aquatic and terrestrial samplings were conducted. Aquatic surveys included water quality and nutrient analyses, sediment quality and geotechnical characterizations, benthic invertebrate surveys, ichthyoplankton and zooplankton surveys, fisheries surveys (bottom trawl, gillnet, beach seine, and pop net gear types), SAV surveys, soft-shell and razor clam surveys, crab pot surveys, and pound net surveys. Terrestrial and wildlife surveys included terrain type and vegetation characterizations, plus avian, wildlife, horseshoe crab, and diamondback terrapin surveys.

Barren Island environmental conditions studies were prepared for the MPA under contract to MES. To conduct a comprehensive assessment of the existing environmental conditions at Barren Island, field sampling events were completed on a seasonal basis in the summer and fall of 2002 and the winter and spring 2003. Aquatic investigations were also completed at various times at Barren Island from May 2003 to March 2004.

James Island and the adjacent waters of the Mid-Chesapeake Bay were investigated during fall 2001, summer and fall 2002 and winter, spring and summer 2003 with one supplemental survey in winter 2004. All studies were conducted under contract to MES for the MPA.

Results of the Environmental Condition Studies for Barren and James Islands are documented in Feasibility-Level Environmental Condition Studies for a Potential Island Restoration Project at Barren Island (MPA, 2005a) and James Island (MPA, 2005b), respectively, and summarized in Section 3.

9.2.3 Public Update Meetings

A meeting was held with local watermen and landowners at the Hoopers Island Volunteer Fire Department on March 10, 2004, after James and Barren Islands had been chosen for detailed plan formulation. A primary objective of the public outreach program was to solicit comments from local watermen that work in the vicinity of Barren and James Islands. This meeting was specifically targeted to address the concerns of local watermen and identify prime commercial fishing areas. The waterman's meeting was advertised in three local newspapers [the *Star Democrat* (Easton), the *Record Observer* (Talbot County), and the *Maryland Waterman's Gazette*] and announced by fliers posted in the local area (Table 9-2). As a result of these meetings, the study team discussed a request by local watermen to preserve a channel between James and Taylor Islands. The watermen identified prime areas used for crabbing and fishing, location of gill nets and pop nets, and outlined island alignments they preferred. A second meeting was held with local watermen and landowners at the Hoopers Island Volunteer Fire Department on May 5, 2005. Interested parties were notified about the meeting by postcard. The purpose of the meeting was to present the recommended plan to the local watermen and landowners, and solicit their comments regarding the plan.

9.2.4 Comparing Alternatives

A comparison of alternatives was completed to identify a recommended plan. Environmental benefits and cost were used to compare alternatives. In order to quantify environmental benefits, it was necessary to obtain additional information on island ecosystem habitat and identify the ecological communities utilizing island habitat. A workgroup was developed to gather the ecological data and determine the environmental benefits for each alternative. Members of the workgroup included representatives from state and Federal agencies, plus private consulting firms, and were chosen based on their expertise of island habitat or a specific ecological community.

9.2.5 Development of the Recommended Plan

The decision to choose an alternative (recommended plan) is completed at this stage and the public involvement activities included: (1) informing the public of the decision and why it was chosen, (2) resolving public conflicts, and (3) soliciting feedback concerning the final decision for the proposed action. Public participation is necessary in the preparation of the EIS and includes reviews and comment periods of the draft document. The USACE reviews, considers, and responds to public comments. These comments become input and will be formally reported and addressed in the FEIS.

9.2.6 Public Meetings

Following the release of the Draft EIS in August 2006, public meetings were held in October 2006 to discuss the recommended plan and solicit comments from the public and relevant resource agencies (Table 9-1). Two public meetings identical in format and content were held at two locations. The first meeting was held at the Dorchester County Public Library, Central Branch, in Cambridge, MD on October 11, 2006 and the second meeting was held at the Taylors Island Volunteer Fire Company in Taylors Islands, MD on October 12, 2006. The public meetings were advertised in twelve local newspapers [the *Baltimore Sun*, *The Examiner* (Baltimore), *The Capital* (Annapolis), the *Star Democrat* (Easton), the *Record Observer* (Talbot County), the *Dorchester Star* (Dorchester County), the *Bay Times* (Kent and Queen Anne's County), the *Maryland Waterman's Gazette*, the *Bay Weekly*, the *Daily Times* (Salisbury), the *Daily Banner* (Dorchester County), and the *Maryland Gazette*], broadcast as public service announcements [WSCL, WSDL, and WESM], announced in the Notice of Availability (Appendix G), and advertised by fliers placed in the local area (Table 9-2). At the public meetings, the USACE and MPA presented a summary of the findings published in the Draft EIS, discussed the public comment period, and solicited formal public statements that were recorded by a professional stenographer. At each public meeting, an informal question and answer session followed the formal statements and comment cards were distributed to encourage attendees to express their opinions, make comments, or ask questions about the project in writing. Attendance sheets, handouts, a copy of the presentation for both public meetings, and transcripts of the meeting minutes including the formal statements are included in Appendix G. A brief summary of written comments received regarding the Draft EIS is provided in Table 9-3, and brief summary of oral comments is provided in Table 9-4.

9.2.7 Preparation of the Final EIS and Record of Decision

A short discussion of the consideration of public comments and concerns in the decision and throughout the NEPA process will be included in the ROD. This discussion highlights the major opinions of the Federal, state, and local government agencies as well as local citizens, including watermen and private residents, and document USACE responses to these comments.

9.3 RELATIONSHIP TO PLANNING PROCESS

The stages of the public involvement program described above were designed to correspond with the major study phases of the project and the NEPA process. This plan allowed the integration of the results of the public involvement program with the planning process at every level. This process encouraged an interaction among the project players that was critical in building and maintaining public support for the project. At each stage of the project, the information collected during the previous public involvement stage was reviewed and considered by the project team and incorporated into the project design, when possible.

9.4 OFFICIAL SUPPORT FOR MID-CHESAPEAKE BAY ISLANDS

In addition to the regular coordination with and participation by agencies, organizations, and the public, government officials have strongly supported the project. Letters from the County Council of Dorchester County offices are described below.

13 March 2003 Letter from County Council of Dorchester County, MD supporting the use of dredged material for island restoration in Dorchester County.

13 April 2005 Letter received from County Council of Dorchester County providing support for restoration projects at James and Barren Islands. The Council expressed concern that James and Barren Islands are eroding rapidly and encouraged USACE to expedite these projects.

14 May 2007 Letter of intent received from Maryland Department of Transportation, Maryland Port Administration, non-Federal sponsor. MPA expressed their solid support for this environmentally responsible project, and the economic impact that would result if new placement options are not available.

9.5 AGENCY COORDINATION AND SUPPORT

Strong and consistent agency coordination and support was a hallmark of the Mid-Chesapeake Bay Islands Restoration Project. Long-term agency coordination in the early plan formulation stages was consistent during the entire EIS process. Agencies playing key roles in the project development included NMFS, MDNR, NOAA, USFWS, USEPA, MES, MPA, SHPO, and MDE. These agencies have communicated on a regular basis during all stages. Although not an actively involved as a member of the PDT, coordination also extended to the following: Dorchester Soil Conservation District, Department of the Navy, Maryland State Highway Administration (SHA), U.S. Dept. of Housing and Urban Development, Maryland Dept. of Housing and Community Development, Chesapeake Bay Yacht Club Association, MGS, Maryland Historical Trust, Maryland Environmental Trust, U.S. Dept. of Commerce, Chesapeake Bay Critical Area Commission, USGS, Federal Emergency Management Agency (FEMA), USEPA, Maryland Conservation Council, MSSA, Maryland Charter Boat Association, National Park Service (NPS), MWA, Coastal Conservation Association (CCA), Maryland Critical Areas Commission (CAC), and U.S. Department of Agriculture (USDA).

Agency participation was important in developing early conceptual plans for the island restoration and agencies will continue to play an active role in finalizing the feasibility study, project design, implementation, and monitoring. Agency coordination activities ranged from formal written communication among agencies to assistance with presentations and participation at public meetings and workshops. Major required coordination included:

(1) Fish and Wildlife Coordination Act requires coordination with the USFWS, NMFS, and state resource agencies,
(2) Endangered Species Act requires coordination with USFWS and NMFS,
(3) Magnuson-Stevens Act, as amended, requires coordination with NMFS on EFH,
(4) National Historic Preservation Act requires coordination with SHPO,

(5) Prime and Unique Farmlands requires coordination with the NRCS, and
(6) Clean Water Act and Clean Air Act require coordination with MDE.

The involvement of a number of sponsors, contractors, and agencies in the collaborative approach to development of the project required sharing coordination letters and other communications as appropriate. For this reason, letters were often sent to one participant and forwarded to others. Agency involvement included formal and informal coordination correspondence, review and comment activities. Extensive informal coordination also took place in the form of natural resource management agency participation in Plan Formulation Work Group meetings, efforts to address questions raised during phone conversations, and impromptu discussions as working group members met during normal work activities. A number of formal letters expressing agency support for the project were received by USACE-Baltimore District. Copies of the support and comment letters as well as pertinent memoranda are included in Appendix E-Attachment D. Following is a summary of key agency and official correspondence and the response or resolution of any issues.

31 December 2002 Transmittal of NOI to Federal Register from USACE

17 January 2003 Publication of NOI in Federal Register (Vol. 68, No. 12, pgs 2532-2533)

31 January 2003 Study initiation letter from USACE to Maryland Department of Planning, Chesapeake Bay Program, U.S. Dept. of Housing and Urban Development, Maryland Dept. of Housing and Community Development, MDNR, Chesapeake Bay Yacht Club Association, MGS, Maryland Historical Trust, Maryland Environmental Trust, U.S. Dept. of Commerce, Chesapeake Bay Critical Area Commission, USGS, MDE, NOAA, FEMA, USEPA, SHA, NMFS, Maryland Conservation Council, MSSA, MES, Maryland Charter Boat Association, NPS, MWA, CCA, USDA, and USFWS. The letter provided preliminary project information and the time and location of the public scoping meetings.

19 February 2003 Letter from Maryland Department of Planning notifying USACE that the project application had been received and submitted for intergovernmental review. MDP requested immediate completion of a 'Project Survey' and completion of a 'Project Status Form' once notification of a decision regarding approval had been made. The letter additionally stated, 'All MIRC requirements have been met in accordance with Code of Maryland Regulations (COMAR 14.24.04) and this concludes the review process.'

28 February 2003 Letter to USACE from Dorchester County Resource Preservation and Development Corporation endorsing project goal and encouraging selection of a site or sites in Dorchester County.

11 March 2003 Letter to USACE from Maryland Department of Housing and Community Development in response to study initiation letter sent January 31, 2003. Maryland Historical Trust suggests USACE secure the services of a qualified cultural resource management team to identify historic properties and requested consultation of further cultural resources actions taken for the project.

11 March 2003 Letter to USACE from Environmental Concern Inc. requesting that Hambleton Island, Broad Creek be included in the Mid-Chesapeake Bay Island, Maryland Environmental Restoration Feasibility Study. *USACE response*: Hambleton Island was considered for restoration, but did not meet two screening criteria. (1) Hambleton Island was historically less than 200 ac and was therefore not determined to be a cost-effective alternative by the Federal DMMP. (2) Restoration at Hambleton Island did not minimize hydraulic impacts to environmentally sensitive areas. See Section 4.2.1 and Table 4-1 for further details.

20 March 2003 Letter to USACE from USEPA in response to study initiation letter sent January 31, 2003. USEPA encourages habitat creation that improves the productivity of the Chesapeake Bay, provides buffers, and provides reductions in sediments and nutrients that enter the Chesapeake Bay. USEPA stated that actions need to be taken to minimize sediment resuspension when using dredged material to restore habitat. An increase to near shore suspended sediment problems needs to be avoided. Benthic habitats need to be considered and studies need to be included to evaluate the impacts the use of dredged material may have on water quality.

24 June 2004 Coordination letter from USACE to Julie Crocker at NMFS requesting information on the presence of Federally protected species in the vicinity of James and/or Barren Island listed by Section 7 of the Endangered Species Act (ESA).

24 June 2004 Coordination letter from USACE to Tom McCabe at USFWS requesting information on the presence of Federally protected species in the vicinity of James and/or Barren Island listed by Section 7 of the Endangered Species Act (ESA).

26 June 2004 Letter received by MES from the Maryland Department of Housing and Community Development. Letter communicated their review of the two volumes, *Underwater Archaeological Surveys in the vicinity of James and Barren Islands in the Chesapeake Bay, Maryland*.

2 July 2004 Coordination letter from USACE to John Nichols at NMFS initiating coordination for compliance with the provisions of the Magnuson-Stevens Fishery Conservation and Management Act, as amended and requesting information to support an Essential Fish Habitat (EFH) assessment.

2 July 2004 Letter to Department of the Navy requesting information on activities and permitted use of Restricted Area 334.200, south and southwest of Barren Island.

20 July 2004 Response to coordination letter sent June 24, 2004 to NMFS. Letter identified Federally endangered species of concern in the project area as shortnose sturgeon (*Acipenser brefirostrum*) and several species of sea turtles- leatherback (*Dermochelys coriacea*), loggerhead (*Caretta caretta*), Kemp's ridley (*Lepidochelys kempi*), and green sea turtles (*Chelonia mydas*). NMFS requested further Section 7 consultation once project details are developed.

21 September 2004 Letter from Navy listed permitted use of Restricted Area 334.200 and included a request for USACE to include provisions in project plans to avoid the disruption of Naval flight operations due to the possible arrival of nesting colonial waterbirds. Requested further notification if recreational or residential development that could threaten flight operations is added to project plans. *USACE response*: There are no recreation plans for Barren Island as this is USFWS property. Recreation typical of pre-project conditions is expected. Potential recreational features at James Island would not interfere with naval operations.

26 October 2004 Coordination letter from USACE to Glenn Therres, MDNR, requesting information on the presence of state listed rare, threatened, or endangered species in the vicinity of James and/or Barren Island.

26 November 2004 Response to coordination letter sent October 26, 2004 to MDNR. Letter provided information on state threatened and endangered species under the jurisdiction of MDNR.

1 December 2004 Response to coordination letter sent June 24, 2004 to USFWS. Letter provided information on Federally protected species under the jurisdiction of USFWS.

11 January 2005 Phone conversation with Ms. Regina Esslinger of CAC. Purpose of phone call was to follow up on the initial coordination letter sent to MCAC on January 31, 2003. Ms. Esslinger requested project information to satisfy a review by the MCAC.

14 January 2005 Phone conversation with Ms. Tricia Kimmel, MDNR, regarding sea turtle presence in the Chesapeake Bay. Ms. Kimmel identified two sources of information, (1) stranding data, and (2) incidental takes in commercial pound nets. Ms. Kimmel agreed to forward to USACE available reports and data on sea turtle stranding and incidental takes.

20 January 2005 Phone conversation with Mr. John Nichols, NMFS. Mr. Nichols stated that the EFH analysis for the project should be based on the Choptank River designations.

26 January 2005 Phone conversation with Mr. Martin Kaehny, USFWS. Purpose of phone conversation was to discuss the actions USACE was formulating for Barren Island and to solicit USFWS opinion on these actions. Mr. Kaehny identified that USFWS's main concern is to protect the remaining acreage of Barren Island and is supportive of the actions USACE is proposing.

28 January 2005 Phone conversation with Mr. Mike Naylor, MDNR, regarding SAV beds in vicinity of James and Barren Islands. Mr. Naylor stated that the oldest SAV records available for the project area are aerial photographs from the 1940s/1950s and agreed to provide an electronic file of the photographs.

17 February 2005 Phone conversation with George Harman, MDE. The purpose of the phone conversation was to discuss the term 'mixing zone' and how it pertained to any necessary water quality certification for the proposed project.

17 February 2005 Phone conversation with Mr. John Nichols, NMFS, to clarify the species to focus on for EFH analysis. Mr. Nichols confirmed that adult and juvenile bluefish, adult and juvenile summer flounder, and juvenile red drum were the species of concern.

18 March 2005 Letter and information packet sent to Ms. Regina Esslinger of the Critical Areas Commission to initiate review of the recommended plan.

23 March 2005 Letter from CAC to MPA expressing their support that Poplar Island Expansion and Mid-Chesapeake Bay Islands be included in WRDA 2005.

4 April 2005 Contacted Lori Byrne, MDNR, requesting information about the Eastern narrow-mouthed toad, a state-listed endangered species. This species was identified by site during wildlife surveys on Barren Island.

5 April 2005 Contacted Glenn Therres, MDNR, regarding the presence of bald eagles at James Island. He stated nest DO-99-11 was no longer present. The only existing nest is DO-02-02.

15 April 2005 Letter received from NMFS stating review of General Re-Evaluation Report and Supplemental EIS for the Poplar Island Environmental Restoration Project. Letter specified that recommendations for the proposed mix of uplands, wetlands, and open water habitat in Poplar Island Expansion are specific to Poplar Island, and should not supersede the policy of 50% wetland to 50% uplands on future Island restoration project, such as James Island. Further, this policy should not prevent future projects from including features that will provide secondary benefits to fish inhabiting waters adjacent to the project.

21 April 2005 Phone conversation with George Ruddy, USFWS, regarding whether James and Barren Island are covered by the Coastal Barrier Resources Act. Mr. Ruddy clarified that Barren Island is categorized as an ‘otherwise protected area’ and as such is not subject to the restrictions of the Coastal Barrier Resources Act. James Island is not in the Coastal Barrier system.

21 April 2005 Letter received from Cindy Beck of the Dorchester Shoreline Erosion Group thanking Scott Johnson for giving on update on the project to the Group.

5 May 2005 Phone conversation with Glenn Therres, MDNR, regarding rare, threatened, and endangered state species. Mr. Therres stated that as far as DNR is aware, the eastern narrow-mouthed toad does not inhabit Barren Island. It is believed the appropriate habitat on Barren for this species has been lost. Mr. Therres further stated that time of year restrictions are applicable to the heron rookery on the southern tip of Barren Island.

5 May 2005 EFH assessment prepared by USACE-Baltimore District sent to John Nichols, NMFS, for review. (Assessment available in Appendix E, Attachment A).

17 May 2005 Endangered Species Act Section 7(a)(2) assessment prepared by USACE-Baltimore District sent to Mr. John Wolflin of USFWS and Ms. Julie Crocker of NMFS, for review. (Assessment available in Appendix E, Attachment C).

19 May 2005 Phone conversation with Dave Ludwig, Blasland, Bouck and Lee, Inc. (BBL), regarding their spring 2003 identification of the presence of the Eastern narrow-mouthed toad by its call at Barren Island. Mr. Ludwig was confident that the toad is present in a freshwater marsh on the north end of Barren, east of airport road.

19 May 2005 Email correspondence with Lori Byrne, MDNR, to inform MDNR of BBL’s identification of the Eastern narrow-mouthed toad at Barren Island.

20 May 2005 Memo received from John Nichols, NMFS detailing NMFS issues and concerns for the proposed project, Fish and Wildlife Coordination Act comments, and Essential Fish Habitat comments. NMFS views the selection of James and Barren Islands for restoration as essentially one project, and supports the size of James Island and the proposal to limit sand borrow activities to areas within the footprint of the proposed James Island alignment. NMFS proposes additional peripheral features be incorporated with James Island plans to benefit fish resources such as diversifying the shoreline, and the addition of small coves, specifically at the northeast tip and at the southern tip of the island. NMFS recommends that the entire east shoreline of the project be bordered by tidal marsh cells that will facilitate eventual removal of exterior dikes from these cells. NMFS acknowledges their support for wetland restoration at Blackwater NWR and the consideration of using James Island as a staging area.

23 May 2005 Email request from Lori Byrne for the Spring 2003 Barren Island Field Survey Report. Ms. Byrne stated the MDNR ecologists intend to verify the BBL Eastern narrow-mouthed sighting. At the time, Ms. Byrne is unsure of how a positive verification will impact the proposed project.

23 May 2005 Phone conversation with Brian Hug, MDE, regarding Clean Air Act compliance. Mr. Hug stated that Dorchester County is not in non-attainment zones for either ozone or particulate matter (2.5). Therefore, no further consultation needs to take place.

24 May 2005 Phone conversation with Dorchester Soil Conservation District. It was confirmed that both James and Barren Island contain prime farmland soils. A letter will be sent requesting determination that the project will have no impact on the prime farmlands. Full compliance with the Prime and Unique Farmlands Executive Order (CEQ Memorandum, 11 August 1980) is expected.

24 May 2005 Fish and Wildlife Coordination Act report received from USFWS. The report summarizes the main environmental issues of the project and sets forth the USFWS's official position on the recommended plan. The report states that the USFWS enthusiastically supports the proposed plans for both James and Barren Islands. (Report available in Appendix E).

8 June 2005 Letter sent to Jim Newcomb of the Dorchester Soil Conservation District requesting a determination that the proposed project at James and Barren Islands is not likely to adversely affect the soils designated as prime farmlands on James and Barren Islands.

17 June 2005 Letter received from USFWS in response to ESA coordination letter sent by USACE 17 May 2005. USFWS concurs with the conclusion of the USACE biological assessment that the proposed action will have no adverse effect on Federally listed RTE. To protect the bald eagle nest at James Island, a time-of-year restriction on placement of dredged material will be implemented for the project area that extends into the protection zone (zone #3) of the eagle nest during the nesting season (December 15-June 15) to avoid disturbance.

27 June 2005 Letter received from Dorchester Soil Conservation District in response to Prime and Unique Farmland coordination letter sent by USACE 8 June

2005. The Dorchester Soil Conservation District sees no adverse effects on the prime farmland soils remaining on James and Barren Island. The agency also expressed the opinion that without any intervention these Islands will be completely lost and foresees only positive benefits by protection and expanding the acreage that currently exists.

26 July 2005 Letter received from Frank Spitz to Senator Paul Sarbanes supporting the inclusion of Mid-Bay and Poplar Expansion projects in the next WRDA.

22 August 2005 Letter received from NMFS providing concurrence with USACE's determination that the proposed project is not likely to adversely affect any threatened or endangered species listed under NMFS jurisdiction. No further consultation pursuant to Section 7 of the ESA is required.

29 August 2005 Phone conversation with John Nichols, NMFS. Mr. Nichols requested that in lieu of a written response specific to the Mid-Bay EFH assessment, the 20 May 2005 letter be used to serve as his response.

1 September 2005 Letter received from CAC in response to the letter and information provided to them on 18 March 2005. Present letter requested a copy of the feasibility report and environmental impact statement when they are issued. These documents will be used to advise USACE of any additional information needed to initiate formal Commission review and approval process. Due to different ownership, the Barren Island portion of the proposal will be considered under COMAR 27.02.05 (State Agency Actions Resulting in Development on State-Owned Lands) while work at James Island will likely be considered under COMAR 27.02.04 (State or Local Agency Actions Resulting in Major Developments on Private Lands or Lands Owned by Local Jurisdictions).

30 August 2006 Transmittal of NOA to Federal Register from USACE

8 September 2006 Publication of NOA in Federal Register (Vol. 71, No. 174, pgs 53090-53091)

15 September 2006 Publication of Correction to NOA in Federal Register (Vol. 71, No. 179, pg 54552)

25 September 2006 Letter received from Dorchester Soil Conservation District in support of Mid-Chesapeake Bay Island Restoration. The District feels that the process of rebuilding the natural barriers to shoreline erosion would greatly benefit Dorchester County and its residents, as well as restore an endangered ecosystem. The District would like to be kept in mind as a resource and supportive partner in the project's efforts.

March and April 2008 Email correspondence with Matthew Perry (USGS), David Kidwell (NOAA), and Doug Forsell (USFWS) regarding waterfowl use of open water areas in James and Barren Island vicinities.

March and April 2008 Email correspondence with John Nichols (NOAA NMFS) regarding fishery use of open water areas in James and Barren Island vicinities.

9.6 OTHER COMMUNICATION ACTIVITIES

The USACE and MPA have informed local citizens, county government, and watermen by solicitation of their opinions through a variety of means, including public meetings; special interest group meetings; bi-monthly CAC, BEWG and Federal DMMP meetings; a newsletter; information on the USACE Website, advertisement of public participation in local newspapers including the *Daily Banner* (Dorchester County), the *Star Democrat* (Easton), and the *Somerset Herald* (Somerset County), and the *Maryland Watermen's Gazette*; and placing fliers in local businesses.

9.7 PRESS COVERAGE

The *Daily Banner* featured an article highlighting a USACE presentation to the Dorchester County Council on June 24, 2004 (Appendix G, Attachment F).

Additional articles pertaining to the Mid-Chesapeake Bay Island Ecosystem Restoration Project are included in Appendix G, Attachment F as well. Those articles are: *Dredge Material could be used on Barren or James Island* featured in the *Dorchester Editor* on July 22, 2002; *Massive U.S. Budget Bill Brings Windfall for Area Projects* featured in the *Washington Post* on February 20, 2003; *Search Narrows for Next Bay Dredge Dump Site Army Corps of Engineers Still Considering Eight Shore Islands for Restoration Project* from the *Capital News Service* on February 21, 2003; *Island Hunting Continues* from the *Capital News Service* on February 24, 2003; *Feds Eye Way to Save Bay Islands* featured in the *Somerset Herald* on March 22, 2003; *The Rise and Fall of Bay's Level Determines Islands' Empires* in the *Bay Journal* in April, 2003; *Three Dorchester Islands Under Consideration by Port Administration for State Dredging Project* in the *Dorchester Editor* on April 20, 2003; *Most of What Now Exists of Eroding James Island is Memories* in the *Bay Journal* in September 2003; an announcement in the *The Rotoscope*, published by the Cambridge Rotary Club on April 11, 2005; *Dredging Up Answers to Vanishing Islands* in the *Baltimore Sun*, November 13, 2006; and *Maryland considers using dredged silt to repair 2Chesapeake islands* in the December 2006 *Bay Journal*.

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SECTION 9

TABLES

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Table 9-1: Public Involvement Meeting Dates And Locations

Name of Meeting	Date	Location Of Meeting
Public Scoping Meeting	20 February 2003	Dorchester County Public Library
Public Scoping Meeting	25 February 2003	Anne Arundel Community College
Public Scoping Meeting	13 March 2003	Somerset County Commissioner's Office
BEWG Meeting (held bimonthly; meeting dates provided where Barren and/or James were specifically discussed)	13 February 2003 5 March 2003 1 July 2003	MPA Point Breeze
Federal DMMP Management Committee	20 May 2004	MPA World Trade Center
Federal DMMP CAC Meeting	Bi-monthly 9 June 2004	MPA Point Breeze
Dorchester County Resource Preservation and Development Corporation, Inc.	21 February 2004	St. Mary's of the Sea Parish Hall, Golden Hill, MD
Regional Watermen's Meeting	3 March 2004	Tilghman Island Elementary School Library
Watermen's Public Meeting	10 March 2004	Hoopers Island Volunteer Fire Department
CCA Executive Board Meeting	26 April 2004	Annapolis, MD
MSSA Executive Board Meeting	1 June 2004	Glen Burnie, MD
MSSA (Carroll County Chapter)	15 June 2004	Carroll County, MD
MWA Executive Board	16 August 2004	MWA, Annapolis, MD
MSSA (Essex-Middle River Chapter)	17 August 2004	1909 Old Eastern Avenue, Essex, MD
Tilghman Island Day	16 October 2004	Tilghman Island, MD
Maryland Charter Boat Captain's Meeting	19 October 2004	Deale, MD – Skipper's Restaurant
Regional Watermen's Meeting	16 November 2004	Tilghman Island Elementary School Library
Cambridge Rotary Club Meeting	7 April 2005	Cambridge, MD
Dorchester County Shoreline Erosion Group Meeting	16 April 2005	Taylors Island Volunteer Fire Department
Watermen's Public Meeting	5 May 2005	Hoopers Island Volunteer Fire Department
Public Meeting	11 October 2006	Dorchester County Public Library
Public Meeting	12 October 2006	Taylors Island Volunteer Fire Company

Table 9-2: Publication Dates For Public Meeting Announcements

Public Meeting	Newspaper Name	Type of Advertisement	Day of the Week	Date of Publication
Notice for Public Scoping Meetings – 18, 20, 25 February 2003	The Daily Banner	Legal Notice	Wednesday	2/5/03
	Star Democrat	Legal Notice	Sunday	1/26/03
Notice for Public Scoping Meetings – 13 March 2003	Somerset Herald	Legal Notice	Wednesday	3/12/03
Notice for Public Meetings – 11, 12 October 2006	Baltimore Sun	Display Ad	Friday	9/22/06
	The Examiner	Display Ad	Friday	9/22/06
	The Capital	Display Ad	Friday	9/22/06
	Star Democrat	Display Ad	Friday	9/22/06
	Record Observer	Display Ad	Friday	9/22/06 10/6/06
	Dorchester Star	Legal Notice Display Ad	Friday	9/22/06
	Bay Times	Display Ad	Wednesday	9/27/06
	Maryland Waterman's Gazette	Legal Notice	Friday	October Issue
	Bay Weekly	Display Ad	Thursday	9/21/06
	Daily Times	Display Ad	Friday	9/22/06
	Daily Banner	Display Ad	Friday	9/22/06
	Maryland Gazette	Display Ad	Saturday	9/23/06

Table 9-3: Summary of Written Comments Received Regarding Draft EIS

Affiliation	Name	Date	Comment Summary
Federal Government Comments			
USFWS	Michael Chezik	October 17, 2006	States the DEIS adequately describes the project effects for which the Department has jurisdiction or special expertise. Points out inaccuracies in the text regarding endangered species, erosion rates, Bay salinity, tides, wetland/upland ratio, and historical acreages.
USEPA, Region III	William Arguto	October 23, 2006	Supportive of restoration efforts for James Island and Barren Island. Recommends that Blackwater National Wildlife Refuge also be considered for future restoration and management efforts. EPA gives the DEIS a rating of LO, Lack of Objections.
State Agency Comments			
MDA	Gloria Minnick	September 27 and 29, 2006	The DEIS is found to be within the MDA's plans, programs, and objectives.
MDE	Joane D. Mueller	September 28, 2006	Any above ground or underground petroleum storage tanks that may be utilized must be installed and maintained in accordance with applicable State and Federal laws and regulations.
MES	Charles Madison	October 2, 2006	DEIS is found to be within the MES' plans, programs, and objectives. The Service defers to regulatory agencies for regulatory concurrence.
MDNR	Ray Dintaman	October 31, 2006	MDNR has concerns about the project's proximity to NOBs. Recommended additional discussion regarding the relationship of the historic footprint to the proposed footprint of James Island. Efforts to avoid impacts to sensitive species in the project area should continue. Consideration should be given to the incorporation of small bird islands.
MHT	Elizabeth Cole	November 8, 2006	MHT has determined that there are no historic properties affected by this undertaking.

Table 9-3 Continued

10 Local Agency Comments			
Harford County Health Department	Susan Kelly	November 1, 2006	Recommends checking option #2 with the qualifying statement that the dredging process adheres to state of the art technology and the dredge material is monitored to minimize hazardous and toxic conditions.
11 Group and Association Comments			
Dorchester Citizens for Planned Growth	Fred Pomeroy	October 17, 2006	The group is in support of the project due to its potential to help reverse the loss of wetlands, which has negatively impacted marine resources in recent years. The group sees the project as a means to promoting sustainable economic development in Dorchester County and a complement to Blackwater National Wildlife Refuge. The group requests that efforts be made to enlist local residents in the construction work force. The group notes the success of the Poplar Island project and its benefits and believes the potential for the Mid-Bay Island project is at least as great.
Maryland Chapter of the Sierra Club	Margaret Carter	October 23, 2006	Recognize great amount of effort required to produce DEIS. Found DEIS to be lacking with regards to the tradeoffs between recreating habitat and destroying existing habitat, and for this reason is not an effective decision-making document.
12 Public Comments			
Citizen	Frank Bentz, Jr.	October 6, 2006	Supportive of project. In favor of all steps that might protect Hoopers Island. Would like to see Barren Island project started first as it protects more private property than James Island.
Citizen	Anna Cutter	October 18, 2006	Supportive of project; praise for public meeting held at Taylors Island.

Table 9-3 Continued

Affiliation	**Name**	**Date**	**Comment Summary**
Citizen	John Cutter	October 18,2006	Supportive of project and its benefits to environment, wildlife, and residents of neighboring communities.
Citizen	Arthur Boccuti	October 20, 2006	Indicates that the shoreline along Ragged Point Rd. is eroding. Adds that the road washes out regularly and is in constant need of repair. Supportive of project.
Citizens	Mark and Linda Wilson	October 22, 2006	Supportive of project. Suggest that every effort be made to proceed with the proposed new project as soon as possible and that a real effort be made to employ watermen and other local people on the project.

Table 9-4: Summary of Oral Comments Received During October 2006 Public Meetings

Affiliation	Name	Date	Comment Summary
Maryland Port Administration	Stephen Storms	October 12, 2006	The Port of Baltimore fully supports this project to provide continued efficient management of this dredged material. The Port Administration has indicated their intent to proceed with the next phase of project implementation and to provide the non-federal cooperation required for the project implementation.
Dorchester County Shoreline Erosion Group	Joe Coyne	October 11, 2006	Supportive of project and its potential to make significant contributions to the health of the Chesapeake Bay.
Maryland General Assembly	Jeannie Haddaway	October 11, 2006	Stressed importance of the Port of Baltimore to Eastern Shore businesses and economy. Encouraged USACE to work with watermen to address concerns of watermen regarding displaced bottom.
Dorchester County Seafood Harvesters Association	Larry Powley	October 11, 2006	Barren Island restoration would benefit Bay grasses. Encouraged employment of local watermen.
Dorchester County Seafood Harvesters Association	Ben Parks	October 11, 2006	Has not received any calls in opposition to the project.
Dorchester County Shoreline Erosion Group	Bruce Coulson	October 11, 2006	Supportive of project and long-term economic benefits. Recommended that other members of the public visit Poplar Island to get an idea of what the project might look like.

Table 9-4 Continued

Affiliation	Name	Date	Comment Summary
Dorchester County Resident	Art Bocutti	October 11, 2006	Supportive of project.
Dorchester County Resident	Fred Pomeroy	October 11, 2006	Supportive of project and long-term economic and recreational benefits.
Maryland General Assembly	Addie Eckardt	October 12, 2006	Supportive of project; will continue to support as long as she has support of community.
Maryland General Assembly	Jeannie Haddaway	October 12, 2006	Stressed importance of Port of Baltimore to the Eastern Shore. Urged public to visit Poplar Island to see a model of how project might work.
Dorchester County Council	Jay Newcomb	October 12, 2006	Supportive of project; stated that most watermen seem to be supportive.
Dorchester Shoreline Erosion Group	Joe Coyne	October 12, 2006	Supportive of recommendation that Barren Island and James Island be restored.
Maryland Port Administration	Stephen Storms	October 12, 2006	The Port of Baltimore fully supports this project to provide continued efficient management of this dredged material. The Port Administration has indicated their intent to proceed with the next phase of the project implementation and to provide the non-Federal cooperation required for project implementation.
Dorchester Shoreline Erosion Group	Bruce Coulson	October 12, 2006	Supportive of project and its environmental and economic benefits. Stressed importance of Port to Eastern Shore businesses.
Taylors Island Resident	Ellie Polley	October 12, 2006	Supportive of project.

Table 9-4 Continued

Affiliation	Name	Date	Comment Summary
Dorchester County Seafood and Oyster Association	Ben Parks	October 12, 2006	Supportive of project. Stressed problem of erosion with regard to oyster bars. Is important to protect existing oyster and SAV resources.
Blackwater National Wildlife Refuge	Glenn Carowan	October 12, 2006	Supportive of project; will continue to work with various partners on this project.

10 RECOMMENDATIONS

I have reviewed and evaluated, in light of the overall public interest, the documents concerning the proposed action, as well as the stated views of other interested agencies and concerned public related to the implementation of Mid-Chesapeake Bay island restoration and protection at Barren and James Islands. I have reviewed alternative plans at each island location to restore island ecosystem habitat, to provide additional dredged material capacity, and to support other project enhancements. USACE-Baltimore District received the authority to pursue the study under the resolution of the Senate Committee on Environment and Public Works on June 5, 1997 which allows the USACE to improve water resources in the interest of navigation, flood control, hurricane protection, erosion control, ecosystem restoration, wetlands protection, and other allied purposes in watersheds of the Eastern Shore, Maryland and Delaware.

As part of the plan formulation, I have given consideration to the relevant aspects of public and agency interest, including environmental, social, economic, and engineering concerns. The restoration of island habitat in the Mid-Chesapeake Bay was one of three actions specifically recommended by USACE-Baltimore District's *Dredged Material Management Plan (DMMP) and Tiered Environmental Impact Statement* (September 2005) to meet the projected dredged material shortfall. The report projected that the Port of Baltimore community would face a dredged material placement shortfall starting in 2009, related to the statutory closure of the Hart-Miller Island Containment Facility in 2009, the closure of the Pooles Island open water sites in 2010, and other restrictions imposed by the State of Maryland on open water placement.

A lack of placement capacity would prohibit necessary maintenance and modification of the Baltimore Harbor and Channels and the Inland Waterway Delaware River to Chesapeake Bay, Chesapeake and Delaware (C&D) Canal Federal navigation projects, which would have an adverse impact on the regional and national economy.

Offshore remote islands are a critical ecosystem component in the Chesapeake Bay watershed that is being lost to land subsidence, rising sea level, and wave action. Isolation, lack of human disturbance, and fewer predators make islands desirable as nesting and resting sites for a diverse avian community including colonial waterbirds, some of which are endangered species. The remaining island beaches also provide nesting habitat for Diamondback terrapins and mating habitat for horseshoe crabs. The island wetlands are a critically needed resource and benefit numerous finfish and macroinvertebrates such as blue crabs. Within the study area, there has been a loss of more than ten thousand five hundred acres of remote island habitat. Further, the erosion of these island habitats contributes sediment and nutrients to shallow water habitat, likely impacting SAV resources, and leads to the eventual loss of physical barriers that provide shelter from wave and storm forces for SAV beds. The recommended plan would improve the environment by restoring critical habitat that would benefit a diverse assemblage of species, contributing to the connectivity of the island chain, and contributing to water quality improvements and SAV protection.

The recommended plan proposed herein represents a cost-effective and environmentally beneficial plan to meet the goal of restoring and protecting valuable but threatened Mid-Chesapeake Bay Island ecosystems through the beneficial use of dredged material. The plan will provide for approximately 90 to 95 million cubic yards of dredged material placement capacity at James Island and restore 2,144 acres of essential remote island habitat at both James and Barren Islands. The total project impact area is 2,172 acres, including the breakwater and sill construction at Barren Island. In addition, the recommended plan provides added protection of existing island habitat by minimizing erosion of the existing remnant islands.

Impacts to environmental and cultural resources and quality of human environment have been evaluated and are documented herein as required by the NEPA of 1969. The recommended plan is in full compliance with the NEPA of 1969, the Clean Water Act of 1972 (as amended), the Endangered Species Act of 1973, the Fish and Wildlife Coordination Act of 1958 (as amended), the Clean Air Act of 1972 (as amended), and Section 106 of the National Historic Preservation Act (NHPA) of 1966.

On the basis of these evaluations, and with the support of various resource agencies, I recommend that USACE, along with the project sponsor, Maryland Port Administration implement the recommended plan as described in this report. Restoration of James Island and protection of existing remnants would consist of creating a 2,072-acre fill area, subdivided to provide approximately 55% tidal wetland habitats and 45% upland island habitats. Dredged material to construct the proposed wetland and upland habitat area at James Island will be dredged from the following Federal navigation channels in the Chesapeake Bay: the Craighill Entrance Channel; the Craighill Channel; the Craighill Angle, the Craighill Upper Range; the Cutoff Angle; the Brewerton Channel Eastern Extension; the Tolchester Channel, the Swan Point Channel, and Inland Waterway from Delaware River to Chesapeake Bay; and Federal channels in the local area.

Restoration and protection at Barren Island would incorporate the use of sills to protect the current acreage of the Island and the SAV/shallow water habitat off the eastern shore of Barren Island. Sills constructed along the current shoreline would be backfilled with dredged material to create wetland habitat. Approximately, 72 acres of wetlands will be created by backfilling on the north and west, respectively. The material that would be used to backfill behind the breakwaters at Barren Island will be from the Federal channels in the Honga River. If it is determined that the SAV habitat to the south and southeast require further protection, a maximum of 3,350 feet of structure is proposed at a maximum height of plus 6 feet MLLW.

The recommended plan would prevent disruption of the growth of the Port of Baltimore due to a lack of dredged material placement capacity to keep its channels clear. Maryland's Port of Baltimore is a major economic engine for the State of Maryland. In 2006, the Port of Baltimore was responsible for $1.9 billion in direct business revenues and $3.6 billion in personal wage and salary income. The Port generates approximately 50,200 jobs in Maryland. Total foreign tonnage moving through the Port in 2007 was 30.8 million tons. The total value of the foreign cargo was $41.9 billion. General cargo handled at state terminals exceeded 8.7 million tons, which was the sixth straight record year.

The total project cost (October 2007 price level) for the Mid-Chesapeake Bay Island Restoration recommended plan is estimated at $1,564,636,000. The fully funded cost is $2,805,544,000. This cost does not include the cost to maintain the channels listed above to the Federal Standard, which will continue to be funded though appropriations under the Federal Operations and Maintenance budget. The Federal cost-shared portion (generally 65% for both the James Island and Barren Island components) is $1,014,286,000. The fully funded Federal share is $1,817,759,000. The non-Federal cost-shared portion (generally 35% for the James Island and Barren Island components) is $550,351,000. The fully funded non-Federal share is $987,783,000. These costs include the PED phases, which are shared 75/25, recreation features at James Island that are cost-shared 50/50 and assumption of some OMRR&R activities during construction, which is a 100% non-Federal cost. The State of Maryland, as represented by the MPA is the non-Federal sponsor of the Mid-Chesapeake Bay Island Restoration project. Note that prior to changes in Section 207 of WRDA 1996 brought about by Section 2037 of WRDA 2007, the James Island component would have been shared generally 75% Federal and 25% non-Federal.

The recommendations contained herein reflect the information that is currently available at this time and current USACE policies governing the formulation of individual projects. The recommendations do not reflect program budgeting priorities inherent in the formulation of a national Civil Works construction program nor the perspective of higher-level reviews within the Executive Branch. Consequently, the recommendations may be modified before they are transmitted to Congress as proposals for authorization and implementation funding. However, prior to transmittal to Congress, the non-Federal sponsor, interested state and Federal agencies, and other parties will be advised of any modifications and will be afforded an opportunity to comment further.

PETER W. MUELLER
COL, Corps of Engineers
District Engineer

11 GLOSSARY

(***** denotes definitions which are quoted verbatim from guidelines, such as definitions at 40 CFR 230.3 and/or other parts)

A-Weighted Decibel (dBA): An overall frequency-weighted sound level in decibels, which approximates the frequency response of the human ear.

Abundance: Mean number of individual organisms.

Acid volatile sulfide (AVS): The sulfides removed from sediment by cold acid extraction, consisting mainly of H_2S and FeS. AVS is a predictive tool for divalent metal sediment toxicity.

Acute: An effect having a sudden onset, lasting a short time.

Acute water quality criteria: A water quality criteria recommendation for the highest in-water concentration of a chemical or effluent to which organisms can be exposed for a brief period of time without causing an acute effect.

Algae: Simple rootless plants that grow in bodies of water (e.g. estuaries) at rates in relative proportion to the amounts of nutrients (e.g. nitrogen and phosphorus) available in water.

Ammonium: (NH4+) chemical compound that is a source of nitrogen for plants and microorganisms.

Amphipod: Small crustacean belonging to phylum Arthropoda.

Anadromous: Fish that spend most of their life in salt water but migrate into freshwater tributaries to spawn (i.e. shad, sturgeon).

Analyte: A single chemical constituent.

Analytical fraction: A group of chemical constituents that is measured using a single analytical method or instrument.

Anoxia/Anoxic: Without dissolved oxygen or in oxygen deficit. Dissolved oxygen concentrations of 0 mg/l (MDE 1994).

Anthropogenic: Influenced by the activities of humans.

Archipelago: Group or string of islands.

Astronomical tide: The periodic rising and falling of the water that result from the gravitational attraction of the Moon and Sun and other astronomical bodies acting upon the rotating Earth.

Bathymetry: The physical characteristics, including depth, contour, and shape of the bottom of a body of water, such as oceans, seas, bays and lakes.

Bay Bridge: WM Preston Lane Jr. Memorial Bridge. Located between Kent Island and Cape St. Clair, Maryland.

Benthic: Living in, on, or in close association with the bottom of a body of water.

Benthic macroinvertebrates: Macroinvertebrates are large, generally soft-bodied organisms that lack backbones. Macroinvertebrates may have hard exoskeletons. Benthic macroinvertebrates live in or on the bottom sediment in aquatic environments.

Benthos: Collective term for aquatic plants and animals living in or on the bottom sediments of a body of water.

Bioaccumulation: The accumulation of chemical constituents in the tissue of organisms through any route, including respiration, ingestion, or direct contact with chemical constituents in water, sediment, pore water, or dredged material.

Bioavailable: In a form that is readily consumed or assimilated by organisms. Some metals and chemical constituents bind to particulates and are not available for uptake by organisms.

Biochemical oxygen demand (BOD): A measure of the quantity of oxygen used by microorganisms in the oxidation of organic matter.

Biological Diversity: The variety of life in all its forms, levels and combinations including ecosystem diversity, species diversity and genetic diversity.

Biotic: Life and living organisms.

Bivalve: An organism that has a two-part shell (e.g., clams, mussels, oysters).

Bloom: A large population increase of phytoplankton that remains within a defined part of the water column.

Body burden: The concentration of a chemical constituent that accumulates in the tissue of an organism.

Borrow area: Area from which material (e.g., sand, soil, etc.) is taken for use in another location.

Brackish: Somewhat salty water, as in an estuary.
Breakwater: A structure protecting a shore area, harbor, anchorage, or basin from waves.

Bulk sediment chemistry: Results of chemical analyses of whole sediments (in terms of wet or dry weight), without normalization (e.g., to organic carbon, grain-size, acid volatile sulfide).

Catadromous: Fish that live in freshwater and migrate to saltwater to spawn (i.e. American eel).

Chain of custody: Documentation that describes the date and time of collection for each environmental sample (sediment, water, or tissue), and the date and time of transfer of each environmental sample to the analytical or ecotoxicological laboratory.

Chemical constituents: Chemical substances associated with or contained in or on dredged material.

Chemical oxygen demand (COD): A measure of the oxygen required to oxidize all compounds in water, both organic and inorganic.

Chlorophyll *a*: A photosynthetic pigment found in plants, including phytoplankton. A measure of this is frequently utilized as an estimate of plant or phytoplankton standing crop.

Chronic: An effect involving a stimulus that is lingering or which continues for a long time.

Chronic water quality criteria: A water quality criteria recommendation for the highest in-water concentration of a chemical or effluent to which organisms can be exposed indefinitely without causing unacceptable effects.

Clay: An extremely small fragment of rock or mineral with a diameter less than 0.0039 millimeter; a physical property measured in sediment grain size analysis.

Coast: A strip of land of indefinite width that extends from the shoreline inland to the first major change in terrain features.

Coastal plain: The level land with soils composed of sediments transported downstream of the piedmont and fall line, where tidal influence is felt in the rivers.

Coastline: Line separating the coast and the shore, or, more commonly, the boundary between land and water.

Cohesive sediment: Sediment containing a significant proportion of clays, the electromagnetic properties of which cause the sediment to bind together.

Comparability: The confidence with which one data set can be compared to others and the expression of results consistent with other organizations reporting similar data. Comparability of procedures also implies using methodologies that produce results comparable in terms of precision and bias.

Congener: A member of a family of chemical compounds sharing similar structure and characteristics.

***Contaminant:** A chemical or biological substance in a form that can be incorporated into, onto, or be ingested by and that harms aquatic organisms, consumers of aquatic organisms, or users of the aquatic environment.

Copepod: Minute aquatic crustaceans having elongated bodies and forked tails belonging to the subclass Copepoda.

Core sample: Rock, sediment, or soil that is extracted by coring or drilling and used for analysis.

Coterminous: Having a boundary in common; contiguous

County Subdivision: The division or redivision of a lot, tract, or parcel of land by any means into two or more lots, tracts, or parcels including the changing of lot lines for the purpose.

Crab pot: An approximately one cubic yard cage used commercially and recreationally to trap blue crabs.

Crustaceans: The class of aquatic Arthropods including copepods, isopods, amphipods, barnacles, shrimp, and crabs which are characterized by having jointed appendage and gills.

Current: A flow of water, typically generated by wave action, tidal fluctuations, or winds.

Decapod: Ten-legged crustacean such as crab, lobster, or shrimp of order Decapoda.

Decibel: A unit less measure of sound on a logarithmic scale, which indicates the squared ratio of sound pressure amplitude to reference sound pressure amplitude. The reference pressure is 20 micropascals.

Deep water: Water deep enough that the bottom bathymetry does not affect waves (greater than –12 ft MLLW).

Demersal species: Fish that live on or near the ocean bottom.

Depth: The vertical distance from a specified tidal datum to the sea floor.

Designated use: An element of a water quality standard, expressed as a narrative statement, describing an appropriate intended human and/or aquatic life objective for a water body. Designated uses for a water body may include: recreation, shellfishing, water supply and/or aquatic life habitat.

Diatoms: Microscopic algae with plate like structures composed of silica. Diatoms are considered a good food source for zooplankton.

Dike: An embankment constructed (typically using soil and rock) to contain dredged material or to serve as a protective barrier.

Dioxin: A family of carcinogenic hydrocarbons.

Direct Economic Impact: Economic activity occurring as a direct result of initial project spending

Dissolved organic carbon (DOC): The fraction of carbon bound in organic compounds in water that is made up of particles smaller than 0.45mm, which is separated out from total organic carbon by filtration.

Dissolved oxygen (DO): Microscopic bubbles of oxygen that are mixed in the water and occur between water molecules. Dissolved oxygen is necessary for healthy lakes, rivers, and estuaries. Most aquatic plants and animals need oxygen to survive. Fish will drown in water when the dissolved oxygen levels get too low. The absence of dissolved oxygen in water is a sign of possible pollution.

District: A U.S. Army Corps of Engineers administrative area.

Diversity: A measure of the number of species coexisting in a community.

***Dredged material:** Material that is excavated or dredged from waters of the United States.

Ebb tide: A falling tide.

Effluent: The discharge to a body of water from a defined source, generally consisting of a mixture of waste and water from industrial or municipal facilities.

Environmental Impact Statement (EIS): Required by NEPA for actions that could result in significant environmental impacts or for projects that are not eligible for an Environmental Assessment (EA) and Finding of No Significant Impact (FONSI). Results in a Record of Decision from the District Commander, Army Corps of Engineers (USACE).

Emergent: Plants whose roots are in shallow water but whose stems and leaves rise above the surface of the water.

Emissions: Refers to pollution being released or discharged into the air from natural or man-made sources. Pollutants may be released directly into the air from a structural device (i.e., smokestack, chimney, exhaust pipe) or indirectly via volatilization or dispersal (i.e., aerosol spraying).

Endemic species - A species that is restricted in its distribution to a particular locality or region.

Environmental Assessment (EA): A document required by NEPA, which provides sufficient information to the District Commander, USACE on potential environmental effects of the proposed action and its alternatives to determine if an EIS or FONSI is required.

Epibenthic: The area on top of the sea floor. Epibenthic organisms may be freely moving or sessile (permanently attached to a surface).

Epifaunal: Plants, animals and bacteria that are attached to the hard bottom or substrate (for example, to rocks or debris); are capable of movement; or that live on the sediment surface.

Epiphyte: A plant that lives on the surface of other plants but does not derive water or nourishment from them.

Equilibrium species: Organisms that dominate communities in habitats.

Estuary: Semi-enclosed coastal body of water which has free connection with the open sea, and which within freshwater and seawater mix.

Eutrophic: Describes an aquatic system with high nutrient concentrations. These high nutrient concentrations are generally from anthropogenic sources. These nutrient concentrations fuel algal growth. This algae eventually dies and decomposes, with reduces the amount of dissolved oxygen in the water.

Eutrophication: The fertilization of surface waters by nutrients that were previously scarce. Human activities are greatly accelerating the process. The most visible consequence is the proliferation of algae. The increased growth of algae and aquatic weeds can degrade water quality.

Evaluation: The process of judging data in order to reach a decision.

Exposure: The period of time during which an organism is exposed to a laboratory test concentration or field condition.

Fecundity: The capacity of an individual or a species produce offspring.

Federal Standard: The dredged material placement alternative(s) identified by the U.S. Army Corps of Engineers that represent the least costly, environmentally acceptable alternative(s) consistent with sound engineering practices and which meet the environmental standards established by the 404(b)(1) evaluation process. [See Engle et al. (1988) and 33 CFR 335-338].

Fetch: The area in which seas (waves) are generated by wind having a fairly constant direction and speed.

Flood tide: A rising tide.

Furan: A family of colorless, volatile organic compounds.

Generalist species: A species having a broad range of ecological niches, tolerant.

Geotextile: A permeable synthetic fabric, which may be woven or non-woven that is used as a filter in construction projects.

Glare: Light emitted at intensity great enough to reduce a viewer's ability to see, and in extreme cases causing momentary blindness.

Grab sampling: The collection of surficial sediments (the top 4-8 inches) using a sampling device with a jaw that grabs a bite of sediment.

Grain-size effects: Mortality or other effects in laboratory whole sediment bioassays due to sediment granulometry, not chemical toxicity. [It is clearly best to use test organisms which are not likely to react to grain-size, but if this is not reasonably possible, then testing must account for any grain-size effects.]

High tide (high water): Maximum elevation reached by each rising tide.

Higher high water: The higher of the two high waters of any tidal day.

Hindcasting, Wave: The use of historic synoptic wind charts to calculate characteristics of waves that occurred at some time past.

Hurricane: An intense tropical cyclone in which winds tend to spiral inward toward a core of low pressure. Maximum surface wind velocities equal or exceed 75 mph for several minutes or longer at some point.

Hypoxia/Anoxia: Deficiencies in the concentration of dissolved oxygen in aquatic systems.

Hypoxic/Hypoxia: Having dissolved oxygen concentrations less than 4 to 5 mg/L (MDE, 1994).

Impaired waters list (or impairments): Impaired waters are waters that do not meet State water quality standards. Under the Clean Water Act, section 303(d), States, territories and authorized tribes are required to develop lists of impaired waters. The law requires that these jurisdictions establish priority rankings for waters on the lists and develop TMDLs for these waters.

Indirect Economic Impact: Multiplier effects associated with purchases and sales by businesses that supply inputs to businesses that are directly impacted by project spending.

Induced Economic Impact: The effect of increased consumer-level spending in a region as a result of direct and indirect economic impacts.

Infauna: Aquatic organisms that live in the substrate of a body of water, especially in a soft bottom or reef.

In-situ**:** Latin term meaning ‘in place’, especially in natural or original position. In research, this typically refers to data collection or analysis that occurs at the location where sampling occurs, in contrast to measurements conducted in a laboratory.

Intertidal: The area of shore located between high and low tides.

Invertebrates: Animals which lack a backbone and include such as squids, octopuses, lobsters, or shrimps, crabs, shellfishes, sea urchins and starfishes.

Juvenile: Strictly speaking, a juvenile is any of a species which is not yet sexually mature. In the context of many finfish surveys, however, it is most often used interchangeably with young-of-year (YOY).

Keystone species: A predator at the top of a food web, or discrete sub-web, capable of consuming organisms of more than one trophic level beneath it.

Land use - The way land is developed and used in terms of the kinds of anthropogenic activities that occur (e.g. agriculture, residential areas, and industrial areas).

Lethal: Causing death.

Light attenuation - Absorption, scattering, or reflection of light by water, chlorophyll a, dissolved substances, or particulate matter. Light attenuation reduces the amount of light available to submerged aquatic vegetation.

Light Trespass: Light that shines beyond the boundaries of the property on which it is located and onto areas where it is unwanted or interferes with land use.

Lipids: Any of a diverse class of compounds found in all living cells, insoluble in water but soluble in organic solvents, and which include fats and oils.

Low tide: Minimum elevation reached by each falling tide.

Lower low water: The lower of the two low waters of any tidal day.

Macroinvertebrate: Organisms greater than 0.5 mm, possessing no internal skeleton.

Macroplankton: Planktonic organisms that are 200-2,000 micrometers in size.

Maintenance dredging: Dredging necessary to keep the channels serving the Port at their nominal authorized depth and width.

Mean abundance: Number of organisms per area.

Mean sea level: The average height of the surface of the sea for all stages of the tide over a 19-year tidal epoch.

Mean (Higher High, High, Low, Lower Low) Water: Average height of the (higher high, high, low, lower low) waters over a 19-year period.

Mesohaline: Moderately brackish water with low range salinities (from 5-18 parts per thousand).

Method detection limit (MDL): The minimum concentration of a substance which can be identified, measured, and reported with 99 percent confidence that the analyte concentration is greater than zero.

Migratory: Describing groups of organisms which move from one habitat to another on a regular or seasonal basis.

Mixing factor: Amount of dilution required to achieve compliance with water quality criteria; the mixing factor is determined by dividing the criterion by the concentration detected in the full-strength sample (elutriate).

Nearshore zone: An indefinite zone extending seaward from the shoreline well beyond the breaker zone.

Nekton: Organisms with swimming abilities that permit them to move actively through the water column and to move against currents (i.e. fish, crabs).

New work dredging: Dredging needed to widen and deepen channels below existing conditions.

Nitrate: Salt or ester of nitric acid (NO_3^-). It is an essential nutrient for phytoplankton growth, and its low surface water concentrations typically limit phytoplankton productivity. It is typically limiting in estuaries, it is not limiting in freshwaters.

Nitrite: Salt or ester of nitrous acid (NO_2^-).

Noise: Sound that is loud, unpleasant, unexpected, or otherwise undesirable.

Non-cohesive sediment: Coarse-grained sediment (sand) containing minimal clays.

Non-detect: A chemical constituent that is not detected or measured above the method detection limit in an analytical test.

Non-point sources: A diffuse source of pollution that cannot be attributed to a clearly identifiable, specific physical location or a defined discharge channel. This includes the nutrients that runoff the ground from any land use - croplands, feedlots, lawns, parking lots, streets, forests, etc. - and enter waterways. It also includes nutrients that enter through air pollution, through the groundwater, or from septic systems.

Nutrients: Compounds of nitrogen and phosphorus dissolved in water, which are essential to both plants and animals. Too much nitrogen and phosphorus act as pollutants and can lead to unwanted consequences - primarily algae blooms that cloud the water and rob it of oxygen critical to most forms of aquatic life. Sewage treatment plants, industries, vehicle exhaust, acid rain, and runoff from agricultural, residential and urban areas are sources of nutrients entering the Chesapeake Bay.

Open water placement: Placement of dredged material in rivers, lakes, or estuaries via pipeline or release from hopper dredges or barges.

Opportunistic species: Generally small organisms that are short-lived and reproduce rapidly. They generally dominate communities in disturbed or stressed habitats.

Organophosphorus pesticide: Similar in structure to some compounds acting as nerve gases. These were developed as more selective and less persistent alternatives to organochlorine pesticides such as DDT.

Overtopping: Water carried over the top of a coastal structure because of wave run-up exceeding the crest height

Particulate matter: Matter composed of particles that are not bound together (e.g., sand or dust).

Pelagic: The open ocean, excluding the ocean bottom and shore.

Pelagic Species: Fish species that live at or near the water's surface.

pH: A measure of acidity or alkalinity on a scale of 0 (acidic) to 14 (basic), with 7 being neutral.

Phaeophytin: Degraded product of chlorophyll *a*. The amount of this compound in the water is utilized to estimate the amount of phytoplankton in the surface water.

Phosphate: The anion (PO_4-) or a salt of phosphoric acid. Essential to the metabolism of living organisms because inorganic phosphate is required for the synthesis of ATP. Plants and microorganisms take up phosphorus mainly in the form of phosphates, and various phosphates are used as fertilizers. Excess phosphate washed into streams and lakes contributes to eutrophication and formation of algal blooms.

Photic zone: Layer of a body of water that receives ample sunlight for photosynthesis.

Phytoplankton: Microscopic plants (primary producers) found throughout aquatic systems. Plankton are usually very small organisms that cannot move independently of water currents. Phytoplankton are any plankton that are capable of making food via photosynthesis.

Piscivorous: Animals that primarily eat fish.

Plankton: Small or microscopic algae and organisms associated with surface water and the water column.

Plume: A space containing a substance or characteristic released from a point source.
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Polynuclear aromatic hydrocarbons (PAH): A group of over 100 different chemicals that are formed during the incomplete burning of coal, oil and gas, garbage, or other organic substances like tobacco or charbroiled meat. Some PAHs are manufactured. These pure PAHs usually exist as colorless, white, or pale yellow-green solids.

Polychlorinated biphenyl (PCB): A large group of toxic synthetic lipid-soluble chlorinated hydrocarbons that are used in various industrial processes and that have become persistent environmental contaminants that can be concentrated in food chains.

Pound Net: A long net strung between stakes and arranged in such a manner to direct fish into a netted enclosure.

Primary producers: Organisms, such as algae, that convert solar energy to organic substances through the molecule, chlorophyll. Primary producers serve as a food source for higher organisms.

Primary productivity: The amount of organic matter fixed by the autotrophic organisms in an ecosystem per unit time.

Probable effect level (PEL): An estimate of the concentration of a potentially toxic substance in the sediment above which the substance is likely to cause adverse effects to aquatic organisms.

Pycnocline: A layer of water across which the density changes rapidly, due to salinity or temperature. An example from an estuary would be a pycnocline separating deep, more saline cooler water and shallow, fresher warmer water.

Quality assurance (QA): The total integrated program for assuring the reliability of data. A system for integrating the quality planning, quality control, quality assessment, and quality improvement efforts to meet user requirements and defined standards of quality with a stated level of confidence.

Quality Control (QC): The overall system of technical activities for obtaining prescribed standards of performance in the monitoring and measurement process to meet user requirements.

Quiescent: Marked by inactivity, tranquil.

Recruitment: The addition, by means of reproduction, of new individuals to the population.

Reference sediment: A whole sediment, collected near an area of concern, which is used as a point of comparison to assess sediment conditions exclusive of the material(s) or activities of interest. The reference sediment may be used as an indicator of localized sediment conditions exclusive of the specific pollutant of concern. Such sediment would be collected near the site of concern and would represent background concentrations.

Reference site: The location from which reference sediment is obtained.

Region: U.S. Environmental Protection Agency administrative area.

Regulations: Administrative rules published in the Code of Federal Regulations (CFR) or Code of Maryland Regulations (COMAR).

Revetment: A facing of stone, concrete, etc., built to prevent erosion by wave action or currents.

Rip-rap: A layer of large stone or broken rock that is placed on an embankment for erosion control and protection.

Rookery: A breeding place for colonial birds.

Rotifers: Microscopic members of the Phylum Rotifera, many of which are planktonic.

Run up: The rush of water up a structure, associated with the breaking of a wave. The amount of run-up is measured according to the vertical height above still water level that the rush of water reaches.

Salinity regime: A portion of an estuary distinguished by the amount of tidal influence and salinity of the water. The major salinity regimes are, from least saline to most saline:

- **Tidal Fresh –** Describes waters with salinity between 0 and 0.5 parts per thousand (ppt). These areas are at the extreme reach of tidal influence.
- **Oligohaline –** Describes waters with salinity between 0.5 and 5 ppt. These areas are typically in the upper portion of an estuary.
- **Mesohaline –** Describes waters with salinity between 5 and 18 ppt (brackish). These areas are typically in the middle portion of an estuary.
- **Polyhaline –** Describes waters with salinity between 18 and 30 ppt (brackish). These areas are typically in the lower portion of an estuary, where the ocean and estuary meet.

Sampling reach: Refers to a channel, placement site, or reference area where samples were collected.

Sand: Fine-grained sediment particles that have a diameters between 2.00 and 0.0625 millimeters.

Sediment: Matter that settles and accumulates on the bottom of a body of water or waterway.

Sedimentation: The separation of suspended particles from water by gravity.

Sediment quality guidelines (SQG): Concentrations of chemical constituents in sediments that are used in order to differentiate sediments of little concern from those predicted to have adverse biological effects.

Semidiurnal tide: A tide with two high and two low waters in a tidal day.

Secchi disk: A white and black disc used to gauge depth of light penetration in the water column.

Shallow water: Water of such depth that surface waves are noticeably affected by bottom topography.

Shallow water habitat (SWH): Areas generally less than six ft in depth.

Shannon Diversity Index: Typically used to show the hierarchical species diversity and one of the parameters used to calculate the B-IBI. Formula is: H'=(ni/N)log(ni/N) where ni = number of individuals of a given species and N = total number of individuals in each sample (Brower and Zar 1984).

Shoal: An area of submerged accumulation of sediments in shallow or deep water.

Shore: The narrow strip of land in immediate contact with the sea.

Shoreline: The intersection of a specified plane of water with the shore or beach (typically taken as mean high water or mean higher high water).

Silt: A fine-grained sediment particle that ha a diameter of less than 0.0625 millimeter and greater than 0.0039; a physical property measured in sediment grain size analysis.

Soil classification: An arbitrary division of a continuous scale of grain sizes. Soil classification also reflects if the soil is capable of supporting plant life.

Sound: A vibratory disturbance created by a vibrating object, which, when transmitted by longitudinal pressure waves through a medium such as air, is capable of being detected by a receiving mechanism, such as the human ear or a microphone.

Standard operating procedure (SOP): A written document which details an operation, analysis, or action whose mechanisms are thoroughly prescribed and which is commonly accepted as the method for performing certain routine or repetitive tasks.

Storm surge: A rise above normal water level on the open coast due to the action of wind stress on the water surface or atmospheric pressure differentials associated with storm events.

Stratification: Vertical arrangement in layers, e.g. distinct temperature bands within a water body.

Supernatant: Liquid floating on the surface of sediments or precipitate.

Surf zone: The area of breaking waves.

Swell: Wind-generated waves that have traveled out of their generating area.

Stoplog: A low-head damn structure that controls the flow of water.

Submerged aquatic vegetation (SAV): Vascular plants that grow completely underwater are referred to as SAV. Light penetration, turbidity, water depth, salinity (mesohaline species require 5 to 18 ppt), and nutrient availability influence the distribution, growth and viability of SAV. SAV normally occurs in water depths to 10 feet, although SAV is more likely to be found in depths of three to five feet or less in the Chesapeake Bay because of increased turbidity levels (Batiuk et. al, 1992).

Substrate: A surface on which organisms live and grow. The substrate may simply provide structural support, or may provide water and nutrients. A substrate may be inorganic, such as rock or soil, or it may be organic, such as wood.

Target detection limit (TDL): A performance goal set by consensus between the lowest, technically feasible, detection limit for routine analytical methods and available regulatory criteria and guidelines for evaluating dredged material. The target detection limit is, therefore, equal to or greater than the lowest amount of a chemical that can be reliably detected based on the variability of the blank response of routine analytical methods. However, the reliability of a chemical measurement generally increases as the concentration increases. Analytical costs may also be lower at higher detection limits. For these reasons, a target detection limit is typically set at not less than 10 times lower than available dredged material guidelines.

Tests/testing: Specific procedures which generate biological, chemical, and/or physical data to be used in evaluations. The data are usually quantitative, but may be qualitative (e.g., taste, odor, organism behavior). Testing for discharges of dredged material in waters of the United States is specified in 40 CFR 230.60 and 230.61 and is implemented through the procedures in this manual.

Thermocline: A layer across which the temperature changes dramatically. Commonly, warmer surface water is separated from the cooler deep water. This temperature gradient results in the formation of a density barrier.

Threshold Effects Level (TEL): Concentrations below which a contaminant will rarely induce adverse biological effects.

Tiered approach: A structured, hierarchical procedure for determining data needs relative to decision-making, which involves a series of tiers or levels of intensity of investigation. Typically, tiered testing involves a decreased uncertainty and increased available information with increasing tiers. This approach is intended to ensure the maintenance and protection of environmental quality, as well as the optimal use of resources. Specifically, least effort is required in situations where clear determination can be made of whether (or not) unacceptable adverse impacts are likely to occur based on available information. Most effort is required where clear determinations cannot be made with available information.

Tidal datum: The plane or level to which soundings, elevations, or tide heights are referred.

Tidal day: The time of the rotation of the Earth with respect to the Moon, or the interval between two successive upper transits of the Moon over the meridian of a place, approximately 24.84 solar days.

Tidal range: The difference in height between consecutive high and low waters.

TMDLs: "Total Maximum Daily Load" or TMDL. A TMDL defines the pollutant load that a water body can assimilate without causing violations of water quality standards, and allocates the loading between contributing point sources and non-point source categories.

Topography: The configuration of a surface, including its relief and the positions of its streams, roads, buildings, etc.

Total dissolved nitrogen (TDN): Measures both the inorganic and organic forms of the dissolved nitrogen, which includes nitrate, nitrite, and ammonia.

Total dissolved phosphate (TDP): Measures both the inorganic and organic forms of the dissolved phosphorus.

Total organic carbon (TOC): The sum of all organic carbon compounds in water.

Total suspended solids (TSS): Organic and inorganic particles that are suspended in water; includes sand, silt, and clay particles as well as biological material.

Tributyltin: Compounds that belong to a group known as the organotins. TBT's are manufactured compounds that have no counterparts in nature. They are extremely toxic over a broad spectrum

Trophic level: Layer in the food chain wherein one group of organisms serves as the source of nutrition of another group of animals.

Tropical storm: A tropical cyclone with maximum winds less than 75 mph.

Turbidity: Cloudiness in the water column created by suspended particles, algae, or other materials; high turbidity reduces the amount of light that penetrates into the water column and, therefore, high turbidity can be harmful to aquatic life.

Void ratio: The volume of voids in a soil divided by the volume of solids

Volatile organic compound: An organic compound that evaporates readily at atmospheric temperatures.

Water quality certification: A state certification, pursuant to Section 401 of the Clean Water Act, that the proposed discharge of dredged material will comply with the applicable provisions of Sections 301, 303, 306, and 307 of the Clean Water Act and relevant State laws.

Water quality criteria: A constituent concentration or narrative statement representing a quality of water that supports a particular use. When criteria are met, water quality will generally protect the designated area. See acute water quality criteria, chronic water quality criteria.

Water quality standard: A law or regulation that consists of the beneficial designated use or uses of a water body, the numeric and narrative water quality criteria that are necessary to protect the use or uses of that particular water body, and an anti-degradation statement.

Wave climate: The combination of waves of different heights, periods, and directions.

Wave crest: The highest point on a wave.

Wave direction: The direction from which a wave approaches.

Wave height: The vertical distance between a crest and the preceding trough.

Wave length: The horizontal distance between similar points on two successive waves measured perpendicular to the wave crests.

Wave period: The time for a wave crest to traverse a distance equal to one wavelength.

Watch List: A state ranking for rare to uncommon species. The numbers of occurrences are typically in the range of 21 to 100 in Maryland. Species designated S3 are not actively tracked by the Wildlife and Heritage Division, species designated S3.1 are actively tracked due to global significance.

Weight-of-evidence: Data to support a hypothesis or determination.

Wind Tide: The deviation from still-water level surface elevation caused by the transport of surface water by winds.

Year class: Most fish species in temperate waters (like those found in the Chesapeake Bay and offshore Virginia) reproduce during a relatively short (one or two month) period each year. That period may be different for each species. Fisheries scientists refer to all of the fish of any species hatched during one annual spawning period as a year class. For mathematical purposes, fishery analysts often treat members of the year class as if all fish were hatched on one day.

Young-of-the-year: All of the fish of a species younger than one year of age. Usually scientists assign an arbitrary "birth date" to all fish of a species hatched over a two or three month period in one year. The fish are then assigned to Age 1 status on that birth date. By convention, this is usually January 1.

Zooplankton: A community of floating, often microscopic animals that inhabit aquatic environments. Unlike phytoplankton, zooplankton cannot produce their own food, and so are consumers.

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