# APPENDIX N
# ANNOTATED BIBLIOGRAPHY OF TECHNICAL REPORTS FOR PIERP

GENERAL REEVALUATION REPORT (GRR) AND
SUPPLEMENTAL ENVIRONMENTAL IMPACT STATEMENT (SEIS)
FOR THE
POPLAR ISLAND ENVIRONMENTAL RESTORATION PROJECT

CHESAPEAKE BAY, TALBOT COUNTY, MARYLAND

## Management Reports

**EA Engineering, Science, and Technology (EA). 2004. *Poplar Island Environmental Restoration Project. Project Management Plan*. Prepared for USACE-Baltimore and Maryland Port Administration. June.**

This Project Management Plan (PMP) provides the management framework for executing the Poplar Island Environmental Restoration Project. The PMP identifies the management teams responsible for successful execution of the project, outlines the management approach for completing the project, describes the process for documenting project progress, establishes lines of communication important to project teamwork, discusses safety and quality control requirements, and includes project schedule and cost information. The PMP includes copies of important project-related documents, such as partner agreements, the record of decision from the 1996 Feasibility Report/Environmental Impact Statement, project fact sheets, management plans, and monitoring plans.

**EA Engineering, Science, and Technology (EA). 2004. *Poplar Island Environmental Restoration Project. Adaptive Management Plan*. Prepared for USACE-Baltimore and Maryland Port Administration. July.**

The adaptive management plan provides the framework for managing the habitat restoration goal of the PIERP. Adaptive management is the dynamic process of setting a management plan, periodically reviewing progress towards executing the plan, and revising the plan, if necessary, to reflect actual experience gained in the implementation. The adaptive management process is an iterative process – set initial goals, measure progress, assess progress, and revise goals if necessary – then repeat the process over and over again until the project is complete.

The Adaptive Management Plan for the PIERP has two components: restoration and cell development. The long term goals and objectives of the restoration component are used to establish the more detailed, short-term goals and objectives of the cell development component. Experience gained from monitoring and assessing the objectives in the cell development component is used, as necessary, to adjust the goals or objectives in the restoration component.

The habitat restoration goal for PIERP is to create approximately 1,140 acres of remote island habitat, half uplands and half tidal marsh. The cell development goal is to develop cells to meet dredging needs and achieve habitat requirements.

**U.S. Army Corps of Engineers (USACE). 2001. *Baltimore Harbor and Channels Dredged Material Management Plan. Preliminary Assessment.* July.**

The purpose of dredged material management plan (DMMP) preliminary assessment was to determine whether there was sufficient dredged material placement capacity to accommodate 20 years of maintenance and new work dredging. Results of the preliminary assessment indicated that the dredged material placement capacity at existing sites – Hart-Miller Dredged Material Containment Facility, Cox Creek Confined Disposal Facility, Pooles Island Open Water Placement Sites, and the PIERP – will run out within the 20-year timeframe of the DMMP, therefore a dredged material management plan was recommended.

**U.S. Army Corps of Engineers (USACE). 2005. *Draft Baltimore Harbor and Channels Dredged Material Management Plan and Tiered Environmental Impact Statement.* Prepared by Weston Solutions, Inc. February. Draft.**

The DMMP is a planning document that ensures maintenance-dredging activities are performed in an environmentally acceptable manner, use sound engineering techniques, and are economically warranted. The plan addresses a full range of placement alternatives to ensure that sufficient placement capacity is identified for the next 20 years. The Baltimore District's DMMP covers the dredging of the channels from the mouth of the Chesapeake Bay in Virginia to and including the Port of Baltimore and the southern approach channels to the C&D Canal as far north as the Sassafras River.

The Federal DMMP addresses navigation and dredging needs, annual placement capabilities, existing capacity of placement areas, placement site management practices, environmental compliance requirements, potential beneficial use of materials and an assessment of the economic viability of continued maintenance. The DMMP identified, evaluated, screened, prioritized, and ultimately optimized such alternatives resulting in the recommendation of a specific viable 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 geographic area, as placement of material from these sources will affect the size and capacity of placement areas required for the Federal project.

Six alternatives were selected as the recommended plan to meet the 20-year dredged material capacity needs of the Port of Baltimore, and were evaluated in the Programmatic DMMP and Tiered EIS Evaluation (USACE, 2005a). Four of the six alternatives were applicable to dredged material placement for the Upper Chesapeake Bay Approach Channels to the Port of Baltimore:

- PIERP Expansion
- Optimized use of existing dredged material management sites in Maryland, including PIERP, Pooles Island Open Water Site, Hart-Miller Dredged Material Containment Facility, and Cox Creek Confined Disposal Facility.

- Large Island Restoration – Middle Chesapeake Bay
- Wetland Restoration – Dorchester County

The other two alternatives evaluated in the Federal DMMP were continued use of open water placement sites in Virginia for dredged material from the three Federal navigation channels located in the Virginia portion of the Chesapeake Bay, and multiple confined disposal facilities in the Patapsco River for Baltimore Harbor dredged material.

**Gahagan & Bryant Associates, Inc. (GBA). 2003. *Poplar Island Habitat Restoration Project. Poplar Island Modification Reconnaissance Study.* Prepared for Maryland Environmental Service. January.**

This study summarized the dredging and site engineering aspects of studies related to the modification of the existing PIERP, and presented six conceptual lateral alignments that would provide additional wetland and upland habitats at Poplar Island. For each of the six conceptual alignments dike design, site construction and operation assumptions, and the associated costs were evaluated.

## PIERP Geotechnical and Surface Sediment Studies

**E2CR, Inc. 2002. *Geotechnical Reconnaissance Study for Poplar Island Modifications, Chesapeake Bay, Maryland*. Prepared for Moffatt Nichol Engineers. Final. November.**

The study, part of the PIERP reconnaissance study, evaluated the subsurface conditions for the six conceptual lateral alignments, the suitability of the foundation soils for supporting the dike, and the availability of suitable sand borrow to construct the dikes. A total of 56 soil borings were drilled to depths of 30 feet to 70 feet. Foundation soils were found to vary considerably from very soft clay to silty sands to preconsolidated silty clays. The silty sands and preconsolidated silty clays are suitable for supporting the dike, but the very soft clay areas will have to either be avoided or be undercut and backfilled with sand. A sufficient quantity of suitable sand borrow material was identified within the vicinity of the PIERP.

**EA Engineering, Science and Technology (EA). 2002. *Poplar Island Environmental Restoration Project. Phase I Exterior Monitoring Pre-Placement Sediment Quality Analysis*. Prepared for USACE-Baltimore. October.**

This report presents the results of physical and chemical analyses of sediments from nine monitoring locations and two reference locations in the vicinity of Poplar Island. Three replicate grab samples were collected from each of the 11 locations. Results of the physical analyses indicate that sediment composition in Poplar Harbor has changed since the 1995/1996 pre-construction baseline survey, with an increased percentage of fine-grained materials. Results of the trace metals analyses indicate that metal concentrations are comparable to background levels

measured in sediments from other areas of the northern Chesapeake Bay. None of the detected organic concentrations exceeded published sediment quality guideline values for marine sediments.

**EA Engineering, Science and Technology (EA). 2004. *Poplar Island Environmental Restoration Project Exterior Monitoring. Post-Placement (2003) Sediment Quality Characterization.* December.**

This report presents the results of physical and chemical analyses from ten monitoring locations, two reference locations, and 16 sediment quality locations in the vicinity of Poplar Island. These data were compared to baseline chemical concentrations in sediment (collected prior to dredged material placement and discharge of effluent) to access the impact, if any, of the operation of the Poplar Island Environmental Restoration Project on the surrounding environment. Concentrations of chemical constituents detected in the sediment sampled in the post-placement (2003) were low and generally comparable to results from the pre-placement (2001) study.

**Hill, J.M., J. Park, and W. Panageotou. 1997. *Poplar Island Baseline Survey: Sediment Quality Monitoring*. Maryland Geological Survey File Report 97-3. Prepared for \ Maryland Environmental Service. April.**

Samples were collected from a total of 27 locations (WQ1 through WQ9, WQR1 and WQR2, SQ1 through SQ16) to establish the regional sedimentary background near the PIERP, prior to the dike construction in October 1995 and July 1996. Samples were analyzed for metals, grain size, total carbon, total nitrogen, total phosphorus, total sulfur, bulk density, and moisture content The objectives of monitoring program are to monitor physical parameters and the concentration of metals and other chemicals in the sediment that could be indicators of accompanying effects to the benthic infauna and potential bioaccumulation through the food chain and to provide operational input on wetland function and the need for soil conditioning to increase pH and reduce metal mobilization in the uplands. Sediments collected during the baseline study were predominantly sand, reflecting the high-energy environment of the area. Finer sediments collected from some of the locations were attributed to erosion from the remnant islands. Metal concentrations were low, and typical of sandy environments in this region of the Bay.

**Hill, J.M., and G. Wikel. 2001. *Poplar Island: Sediment Quality Monitoring*. Maryland Geological Survey File Report 01-4. Prepared for Maryland Environmental Service. September.**

Sediment samples were collected from 11 locations (WQ1 through WQ9, WQR1 and WQR2), and analyzed for metals, grain size, total carbon, total nitrogen, total phosphorus, total sulfur, bulk density, and moisture content. Results of the trace metal analyses indicate that metal concentrations at the PIERP were comparable to background levels measured in sediments from other areas of the northern Chesapeake Bay. In addition, carbon, nitrogen, phosphorus, and sulfur concentrations were nearly equivalent to those reported in other studies for this region of the Bay.

**Hill, J.M., and G. Wikel. 2002. *Poplar Island: Sediment Quality Monitoring (2002)*. Maryland Geological Survey File Report. Prepared for Maryland Environmental Service. June.**

Sediment samples were collected from 11 locations (WQ1 through WQ9, WQR1 and WQR2), and analyzed for metals, grain size, total carbon, total nitrogen, total phosphorus, total sulfur, bulk density, and moisture content. Results of the study indicate that the metals concentration at the PIERP was low compared to the other areas of the Chesapeake Bay, primarily as a result of the coarse grained sands at the PIERP. The study also found that the distribution of the metals had changed since the construction of the PIERP. Poplar Harbor is now protected by the dike from wave action and serves as a sediment trap for fine-grained particulates. Changes in the detected metal concentrations were not attributed to anthropogenic inputs, but to changes in the local hydrodynamics and sedimentation pattern resulting from dike construction. Concentrations of detected metals at each of the PIERP monitoring locations were low, and comparable to concentrations in regional background sediments.

**Hill, J.M. 2004. *Poplar Island Sediment Quality Monitoring (2003) April 2003 and October 2003: Effects of Hurricane Isabel*. Maryland Geological Society, Coastal and Estuarine Geology Open File Report. June. Draft.**

One sample from each of the ten monitoring locations and the two reference locations, plus sediments collected from 16 sediment quality locations (SQ1 through SQ16) were analyzed for the following: metals, grain size, total carbon, total nitrogen, total phosphorus, total sulfur, bulk density, and moisture content. This sampling indicated the accumulation of fine sediments in the area between the PIERP, Coaches and Jefferson Islands, consistent with the lower velocity environment that resulted from dike construction.

Tropical Storm Isabel came through the Chesapeake Bay area on September 18, 2003, and the record high storm surge caused two breaches in the containment dikes of the PIERP. An additional sediment survey was conducted at exterior monitoring locations (WQ1 through WQ10, WQR1 and WQR2, and SQ1 through SQ16) to assess the impact, if any, Hurricane Isabel had on the sediments in the vicinity of the PIERP. The sampling indicated that there were two primary areas of change – an increase in sand deposition southeast of the PIERP and a slight shift to finer grained sediments northeast of the PIERP. The higher sand proportions were attributed to increased scour as a result of high current velocities from the tropical storm, and the fine grained sediment deposition was attributed to a localized thin veneer of sediments from the breach in Cell 1. However, the breaches resulting from Tropical Storm Isabel did not significantly alter the exterior sedimentary environment.

**Hill, J.M. 2005. *Poplar Island Sediment Quality Monitoring (2004) June 2004.* Maryland Geological Society, Coastal and Estuarine Geology Open File Report. February.**

One sample from each of the ten monitoring locations and the two reference locations, plus sediments collected from 16 sediment quality locations (SQ1 through SQ16) were analyzed for metals, grain size, total carbon, total nitrogen, total phosphorus, total sulfur, bulk density, and

moisture content. Results indicated that metals concentrations were within baseline levels for the area, based on previous studies conducted in the vicinity of Poplar Island. The effects of Tropical Storm Isabel on trace element behavior have been erased, although some effects on the grain size distribution remain. Sediment samples collected in 2004 indicated that the changes to the sedimentary environment from Tropical Storm Isabel are reverting to pre-storm conditions, and that deposition of fine-grained sediments at northern locations adjacent to the PIERP is continuing.

## Approach Channel Sediment Studies

**EA Engineering, Science, and Technology. 2005.** ***Poplar Island Expansion Study White Paper - Assessment of the Potential for Placement of Dredged Material from the C&D Approach Channels and Small Navigation Projects at Poplar Island. Chesapeake Bay, Maryland*****. Prepared for USACE-Baltimore District. January.**

The purpose of the white paper was to evaluate the potential for PIERP to accept dredged material from additional federal navigation channels, specifically the C&D Canal Approach Channels, as well as other small navigation projects (including Federal, State, and local channels), and to summarize current sediment quality guidance that could be used to develop sediment quality recommendations for placement at Poplar Island. Dredged material from federal navigation channels within Baltimore Harbor (west of the North Point-Rock Point line) was not considered for placement at Poplar Island. Issues presented in the white paper were intended to serve as a starting point for discussions with State and Federal resource agencies about establishing acceptance standards for dredged material from small Federal, State, and local navigation projects at Poplar Island. Any proposal to include dredged material from additional channels would require additional authorization and would require an amendment to the existing Project Cooperation Agreement (PCA) with the non-Federal sponsor (Maryland Port Administration).

A comparison of the bulk sediment chemistry results indicates that the sediment quality in the C&D Canal Approach Channels is comparable to the quality of the sediment from the upper Chesapeake Bay channels currently being placed at Poplar Island. Based on these results, the physical and chemical characteristics of the dredged material from the C&D Canal Approach Channels are consistent with the dredged material authorized and already placed at Poplar Island from the upper Chesapeake Bay channels.

Also included in the white was a discussion of the following data quality objectives that could be used to develop sediment quality guidelines for Poplar Island: (1) Deciding the number of samples required to accurately represent dredged material chemical and physical characteristics; (2) Establishing target detection limits (TDLs) to ensure data quality and comparability; (3) Identifying the location of a standard reference site; (4) Determining which sediment quality guidelines (SQGs) should be used to evaluate the data; (5) Establishing ranges of concentrations for compliance and placement.

**EA Engineering, Science, and Technology, Inc. 2000.** ***Evaluation of Dredged Material: Upper Chesapeake Bay Approach Channels to the Port of Baltimore*****. Prepared for USACE-Baltimore. Draft. December.**

This report provides information from testing upper Chesapeake Bay shipping channel sediments and background sediments using the Inland Testing Manual (ITM) guidelines. Twelve channel segments proposed for dredging to maintain their existing authorized depths were sampled in 1999. Testing included site water, sediment, elutriate, bioassay, and bioaccumulation (tissue) testing for 151 target chemical analytes. The results of these comparisons indicated that, while there were variations in reported concentrations, no substantial differences were found between the channel sediments to be dredged and sediments found throughout the upper Bay in areas outside the channels. Based on the results of the ITM testing, open water placement would not necessarily be eliminated from consideration for sediments dredged from the Upper Chesapeake Bay Approach Channels to the Port of Baltimore.

**EA Engineering, Science, and Technology. 2003.** ***FY02 Evaluation of Dredged Material: Upper Chesapeake Bay Approach Channels to the Port of Baltimore and Baltimore Harbor Channels.*** **Prepared for USACE-Baltimore Draft. May.**

Maintenance of the Upper Chesapeake Bay approach channels to the Port of Baltimore and the Harbor Channels within the Port of Baltimore requires annual dredging in channel areas where shoaling has occurred, and the subsequent placement of the resulting dredged sediments. An evaluation of the dredged material is required prior to dredging and placement to ensure that the materials are appropriate for available placement options. The USEPA Region III and the Poplar Island Environmental Impact Statement recommend that testing of project sediments should be repeated at intervals not to exceed three years during the life of the project, and that testing should be conducted according to guidance provided in the Inland Testing Manual (USEPA/USACE 1998). This report represents the third of a series of studies (FY1995, FY1998, and FY2002) conducted to collect data to document existing physical and chemical characteristics of the approach channel and harbor channel sediments. A total of 26 locations in the harbor channels, 27 locations in the approach channels, and 3 reference locations in the Upper Chesapeake Bay were sampled. The testing program included bulk sediment analysis and effluent elutriate testing. Results of the sediment testing indicated that the physical composition of the channel sediments was predominately comprised of silts and clays, and that concentrations of chemical analytes detected in the Upper Chesapeake Bay Approach Channel sediments was comparable to concentrations detected in previous studies and throughout the upper Chesapeake Bay region.

## Water Quality Studies

**EA Engineering, Science, and Technology (EA). 2002. *Poplar Island Environmental Restoration Project: Phase I Exterior Monitoring Pre-Placement Exterior Water Quality Analysis.* Prepared for USACE-Baltimore. October.**

This report presents the results of chemical and nutrient analyses of exterior water from nine monitoring locations and two reference locations in the vicinity of Poplar Island. Results of the pre-placement chemical analyses indicate that organic constituents and trace metals were present at low concentrations in samples from all of the exterior monitoring and reference locations. Nutrient results in the 2001 pre-placement study were comparable to concentrations reported by the Chesapeake Bay Program.

**EA Engineering, Science and Technology (EA). 2004. *Poplar Island Environmental Restoration Project Exterior Monitoring. Post-Placement (2003) Water Quality Evaluation*. April**.

This report documents the existing levels of chemical constituents and nutrients in the exterior water, and compares current chemical concentrations to pre-placement (2001) water quality data collected prior to the inflow of dredged material. Additionally, monthly nutrient monitoring in the water surrounding Poplar Island was conducted to identify the typical seasonal variations in the nutrient concentrations, to compare the nutrient concentrations at PIERP to regional levels over the same time period, and to identify changes to water quality, if any, resulting from the operations at Poplar Island. Exterior water samples were collected from ten monitoring locations and two reference locations. Organic constituents, trace metals, and nutrient concentrations were comparable to reference locations and CBP sampling locations. TSS concentrations are elevated during some months in Poplar Harbor when compared to reference locations and the CBP monitoring location data.

## Benthic, Epibenthic, and Tissue Studies

**EA Engineering, Science and Technology (EA). 2002. *Poplar Island Environmental Restoration Project, Phase I Exterior Monitoring: Pre-Placement Benthic Community Report.* Prepared for USACE-Baltimore. October.**

This report provides pre-placement data collected in October 2000 that characterizes both the infaunal benthic community and the epibenthic community at Poplar Island prior to dredged material placement and discharge of effluent. Benthic infaunal communities were sampled at nine monitoring locations and two reference locations in the vicinity of Poplar Island. The epibenthic community at Poplar Island was sampled at two locations (north face and northwest face) on the submerged exterior dike rocks. The Fall 2000 (post-dike construction) B-IBI values

were lower than the pre-construction values that were calculated in September 1995, with the exception of one reference location. This study was the first to sample the epibenthic community. Results indicated that epibenthic organisms are abundant on the exterior dike and likely provide a food source for juvenile fish.

**EA Engineering, Science and Technology (EA). 2004.** ***Poplar Island Environmental Restoration Project Exterior Monitoring. Post-Placement (2002) Benthic and Epi-Benthic Community Report.*** **March.**

This report provides post-placement data collected in October 2002 that characterizes both the infaunal benthic community and the epibenthic community at Poplar Island following dredged material placement into upland and wetland cells and discharge of effluent into Poplar Harbor. The objectives of the study were to characterize the benthic community in the project area, to verify reestablishment of the benthic community (post-placement), and to provide information on epibenthic colonization on the dike. Benthic infaunal communities were sampled at ten monitoring locations and two reference locations in the vicinity of Poplar Island, which correspond to locations sampled for the water and sediment quality samples. The mean B-IBI for benthic communities at the monitoring locations decreased slightly from pre-placement (2000) results. The post-placement (2002) metrics for the epibenthic community were slightly better than the pre-placement (2000) values.

**EA Engineering, Science, and Technology. 2002.** ***Poplar Island Environmental Restoration Project: Phase I Exterior Monitoring Pre-Placement Benthic Tissue Analysis.*** **Prepared for USACE-Baltimore. October.**

This report presents the results of the chemical analyses of benthic tissue from four monitoring locations and one reference location in the vicinity of Poplar Island. The report provides baseline benthic tissue data that characterize the area prior to dredged material placement and discharge of effluent. Overall, concentrations of organic and inorganic (metals) constituents detected in clam tissue from the pre-placement study (2000) were low and consistent with tissue concentrations in baseline studies conducted at Poplar Island in 1996.

**EA Engineering, Science and Technology (EA). 2004.** ***Poplar Island Environmental Restoration Project Exterior Monitoring. Post-Placement (2002) Tissue Analysis.*** **Prepared for Maryland Environmental Service. March.**

This report presents the results of chemical analysis of benthic tissue collected from four locations in Poplar Harbor, one location south of the Phase II dike, and one reference location east of Poplar Harbor. These data were compared to baseline chemical concentrations in benthic tissue (collected prior to dredged material placement and discharge of effluent) to assess the impact, if any, of the operation of the Poplar Island facility on the exterior environment. Concentrations of chemical constituents detected in clam tissue sampled in the post-placement study (2002) were low and generally comparable to results from the pre-placement (2000) study.

## Natural Oyster Bar (NOB) Sedimentation Studies

**Halka, Jeffrey and Richard Ortt, Jr. 2002.** ***Evaluation of Potential Impacts on Natural Oyster Bar 8-10 from Dike Construction at the Poplar Island Environmental Restoration Project.*** **Coastal and Estuarine Geology, File Report No. 02-01. Maryland Department of Natural Resources, Resource Assessment Office and Maryland Geological Survey.**

The shellfish bed sedimentation study was designed to determine if impacts to the adjacent mapped Natural Oyster Bar 8-10 (NOB 8-10) resulted from the construction of the containment dike surrounding PIERP. Measurements were made using a depth sounder and associated data was collected with a side-scan sonar unit. Post-construction side-scan sonar records suggest that a thin layer of sand covered limited areas of shell in close proximity to the dike. Where present, the sand was apparently a few centimeters thick. Although it could not be definitely stated that this sand was attributed to dike construction, proximity to the dike suggested that the source of the sediment was related to construction activities.

**Halka, Jeffrey and Richard Ortt, Jr. 2002.** ***Evaluation of Potential for Sedimentation on Natural Oyster Bar 8-11 from Dike Construction at the Poplar Island Environmental Restoration Project.*** **Coastal and Estuarine Geology, File Report No. 02-05. Maryland Department of Natural Resources, Resource Assessment Office and Maryland Geological Survey.**

The oyster bar study was designed to determine if impacts to Natural Oyster Bar 8-11 resulted from the construction of the containment dike surrounding Phase II of the island restoration site using a side-scan sonar. The side-scan sonar indicated that there are no commercially harvestable shells located in close proximity to the dike construction area. Comparison of the pre and post-construction side-scan sonar records in the vicinity of the dike construction area provided no indication that additional sediment moved into the boundary of NOB 8-11 as a result of construction activities.

## Fisheries Studies

**National Oceanic and Atmospheric Administration (NOAA). 2001.** ***Annual Report on the Post-Phase I Nekton Surveys of the Poplar Island Beneficial Use Project.*** **Conducted by Dave Meyer and submitted to the USACE-Baltimore District and the Poplar Island Work Group.**

Nekton surveys were conducted in 2001 to examine the effect of the PIERP on adjacent habitat functions. Results were compared to the 1995/1996 baseline surveys. Fyke nets were used to examine nekton use of marsh areas at six sites for the reference wetlands and four at island remnant sites. Gill nets, trawls, crab pots, and throw traps were used to examine fisheries use of exterior proximal waters at six reference sites east of Poplar Island and six sites within Poplar

Harbor. Reductions in abundance for 2001 compared to 1995-96 were observed within Poplar Harbor and the shallow water reference areas for a number of species. However, increases in abundance for some species appeared to occur within the created fishing reefs.

**National Oceanic and Atmospheric Administration (NOAA). 2003.** ***Report on the Pre-Construction Baseline for Cell 4DX: Nekton Surveys of the Poplar Island Beneficial Use Project.*** **Conducted by Dave Meyer and submitted to the USACE-Baltimore District and the Poplar Island Work Group.**

Nekton surveys were conducted in the spring of 2003 to examine pre- versus post-construction effects of cell 4DX of the PIERP on the community structure, composition, and abundance of nekton species. Fyke nets were used to examine nekton use in marsh areas at six sites used previously during 1995-1996 and 2001 nekton surveys. Gill nets and trawls were used to sample fisheries use of exterior proximal waters in April 2003. Six replicate sites were used which correspond to those used during the 1995-1996 and 2001 nekton surveys. Reductions in abundance of nekton were observed in Poplar Harbor for a number of species. Increased abundances were observed for the snag/created fishing reef areas.

## Submerged Aquatic Vegetation (SAV) Studies

**U.S. Fish and Wildlife Service (USFWS). 2001.** ***Baseline submerged aquatic vegetation monitoring for the Poplar Island Restoration Project.*** **Report CBFO-FAO2-01, U.S. Fish and Wildlife Service, Annapolis, Maryland. December.**

The objectives of the monitoring effort were to determine the densities, locations, and species of SAV present in Poplar Harbor, as well as a number of Eastern Shore reference sites. SAV was collected along fixed transects using modified rakes thrown from a small boat. SAV was sampled in both July and September at eight locations within Poplar Harbor and at six reference sites established along shorelines in the vicinity of Tilghman Island. Although the Poplar Harbor SAV beds were sparse and scattered relative to the reference sites, the continued survival of SAV there represents a promising potential for resurgence.

**U.S. Fish and Wildlife Service (USFWS). 2003.** ***Submerged aquatic vegetation monitoring for the Poplar Island Restoration Project - 2002.*** **Report CBFO-FA03-01, U.S. Fish and Wildlife Service, Annapolis, Maryland. May.**

SAV monitoring within Poplar Harbor and at the Eastern Shore reference sites continued in 2002. In summer of 2002, SAV was collected along fixed transects in Poplar Harbor and at reference sites using modified rakes thrown from a small boat. Fourteen locations were sampled – eight locations within Poplar Harbor and six reference locations in the vicinity of Tilghman Island during both July and September 2002. Although SAV in Poplar Harbor remains sparse and scattered relative to the Eastern Shore reference sites, the continued survival of SAV there represents a promising potential for resurgence.

**U.S. Fish and Wildlife Service (USFWS). 2004. *Submerged aquatic vegetation monitoring for the Poplar Island Restoration Project – 2003*. Report CBFO-FAO4-01, U.S. Fish and Wildlife Service, Annapolis, Maryland. August.**

In 2003, SAV monitoring in Poplar Harbor and at the Eastern Shore reference sites was conducted in three surveys during May/June, July, and September using a new grid-based methodology. A 282-acre polygon was digitized for Poplar Harbor, generating a random set of sampling points within the grid for each sampling survey. Based on the results from the 2003 survey, SAV in Poplar Harbor remained sparse and scattered relative to the Eastern Shore reference sites.

## Avian Community Studies

**Erwin, Dr. R. Michael. 2004. *Post Phase I Dike Construction Faunal Component Surveys of the Poplar Island Beneficial Use Project. Field Phase: 2004 Assessment of Waterbird Nesting.* USGS Patuxent Wildlife Research Center, Department of Environmental Sciences, Clark Hall, University of Virginia. Charlottesville, VA. 10 November.**

This report focuses on avian use of the newly created habitats at Poplar Island, including habitat use, breeding population estimates, and estimates of fecundity, or productivity, with an emphasis on common and least terns. Population estimates and nest counts were conducted for colonial waterbirds and waterfowl. For terns, all nests with eggs of least terns were marked in early June. For common terns, estimates of the total nesting population was conducted with Lincoln-Peterson counts using four people. Common and least tern colonies largely failed, probably as a result of fox predation. Osprey production was within the normal range, and snowy egret production was high.

**Erwin, Dr. R. Michael. 2004. *Poplar Island Baseline Monitoring Program, Final Report, Wetland and Upland Use by Wildlife.* USGS Patuxent Wildlife Research Center, Department of Environmental Sciences, Clark Hall, University of Virginia. Charlottesville, VA. 13 November.**

Waterbird surveys were conducted in 2002 and 2003 at reference wetlands and at Poplar Island. Field surveys for waterbirds included visits to seven reference sites and Poplar Island. Nesting surveys were conducted both years, with common and least terns being the primary focus of 2003 surveys. In 2002, created islands were used by cormorants, common terns, and least terns. In 2003, common terns increased from 400 pairs (2002) to 827 pairs, least terns from about 40 to 62 pairs, and ospreys from 5 to 6 nests. Almost total hatching failure was reported for common and least tern nests. Unusually wet weather presumably caused the failure.

**Maryland Environmental Service (MES). 2003. *Poplar Island Environmental Restoration Project, Bird Monitoring. Annual Report. October 2002-October2003*.**

Bird monitoring on Poplar Island was conducted to document bird species occurrence and numbers using project habitats during seasons of the year. Biweekly bird monitoring was conducted throughout the year to ascertain seasonal and long-term bird utilization of habitat within the PIERP. Bird species and numbers were recorded at each cell and offshore around the perimeter of Poplar Island.

**Maryland Environmental Service (MES). 2004. *Poplar Island Environmental Restoration Project, Bird Monitoring. Annual Report. October 2003-October2004*.**

Bird monitoring on Poplar Island was conducted to document bird species occurrence and numbers using project habitats during seasons of the year. Biweekly bird monitoring was conducted throughout the year to ascertain seasonal and long-term bird utilization of habitat within the PIERP. Bird species and numbers were recorded at each cell and offshore around the perimeter of Poplar Island.

## Diamondback Terrapin Studies

**Roosenburg, W.M., and Allman, P.E. 2002. *Terrapin Monitoring at Poplar Island*. Final Report submitted to the Army Corps of Engineers.**

In the summer and fall of 2002, researchers from Ohio University conducted a nesting survey of diamond back terrapins on Poplar Island. The project entailed surveying all potential nesting areas within PIERP, tracking all known nests to monitor hatching success, marking and releasing all hatchlings caught in the study area, and capturing hatchlings from inside Cell 5 and releasing them outside of the cell. A total of fifty nests were discovered, and thirty nests were studied to evaluate nest survivorship. Researchers documented 305 hatchlings and evidence of 24 undeveloped eggs or dead hatchlings. The average hatching success rate was 92.7 percent. Survivorship of known nests on Poplar Island was much higher than normally encountered for terrapins because of the lack of nest predators.

**Roosenburg, W.M., T.A. Razio, and P.E. Allman. 2003. *Terrapin Monitoring at Poplar Island*. Final Report submitted to the Army Corps of Engineers.**

Ohio University researchers conducted a nesting survey of diamondback terrapins during the summer of 2003. The objectives of the 2003 survey were to identify locations of nests at known terrapin nesting sites, track all known nests to monitor hatching success, and mark and release all hatchlings caught in study area. Forty-nine nests were discovered and thirty of those were studied to determine egg survivorship. The research team documented 354 hatchlings and 35 undeveloped eggs or dead hatchlings. The average hatching success rate was 91 percent with several nests having 100 percent survivorship. Researchers concluded that portions Poplar

Island are excellent terrapin nesting habitat because of the large number of nests discovered, high hatchling survivorship, and lack of nest predators.

## Vegetation Studies

**Maryland Environmental Service (MES). 2004. *Poplar Island Environmental Restoration Project, Habitat Development Framework, Talbot County, MD*. Prepared for Maryland Port Administration. April.**

The Habitat Development Framework addresses the framework for the creation of island nesting habitat for colonial waterbirds (sparsely vegetated habitat islands), vegetated habitat islands for colonial wading birds, wetland habitat, upland habitat, other diverse habitats, quiescent conditions for SAV recovery, and to minimize and offset loss of benthic habitat. Habitat restoration using dredged material is dependent on proper hydrologic conditions, adequate tidal flushing, settling and final elevation of substrate, precise grading, accurate soil testing, healthy plant materials, and active monitoring and remediation.

**U.S. Fish and Wildlife Service (USFWS). 2004. *Wetland Vegetation Monitoring for the Poplar Island Restoration Project – 2003*. Report CBFO-FAO4-02, U.S. Fish and Wildlife Service, Annapolis, Maryland. November.**

The wetland vegetation monitoring conducted in 2003 continued to document changes in the stability of the reference marsh community structure and sampled the first constructed marsh on Poplar Island. Using a system of fixed transects, the eight reference marshes and the created marsh on Poplar Island were sampled in August 2003. Indices describing vegetative cover, stem height variation, and plant species diversity were calculated to illustrate vegetation patterns apparent in the local saltmarsh communities. Cell 4DX had generally lower coverage and diversity than the reference site but this only reflects that the initial sampling took place in the same year as the initial planting. Plant survivorship, coalescence, and health in Cell 4DX were better than expected.

## Hydrology/Hydrodynamics Studies

**Moffat & Nichol Engineers. 2002. *Poplar Island Coastal Engineering Investigation. Reconnaissance Study*. October**

This report evaluated the existing available data for the environmental site conditions and data specifically related to coastal engineering aspects of design. The report addressed the design of the containment dikes in regards to armor protection and structure height. The objectives of the study include an analysis of site bathymetry, hindcasting of offshore and nearshore waves at the project site, and determining dike design parameters.

**Moffatt & Nichol Engineers. 2003. *Poplar Island Modifications, Hydrodynamics, and Sedimentation Modeling*. Final Report January 22, 2003. Report submitted to Maryland Port Administration and Maryland Environmental Services.**

The purpose of the study was to evaluate the impacts of the six conceptual lateral alignments included in the reconnaissance study for the PIERP. Moffat & Nichol Engineers' Upper Chesapeake Bay – Finite Element Model (UCB-FEM) was used to predict existing conditions and with – project hydrodynamics and sedimentation. The report summarizes the calibration and implementation of the UCB-FEM two-dimensional numerical model of the Chesapeake Bay and evaluation of hydrodynamic and sedimentation output including time-varying flow velocity, water surface elevations, and patterns of erosion and accretion. The numeric modeling system consisted of the USACE finite element hydrodynamic (RMA-2) and sedimentation (SED-2D) models. Results from the modeling conclude that the primary impacts on local conditions included substantial reduction of shoreline erosion along Jefferson and Coaches Islands and improved water quality within Poplar Harbor.

**Moffatt & Nichol Engineers. 2004. *Poplar Island Environmental Restoration Project, Morphological Modeling*. Draft Report April 5, 2004. Prepared for Maryland Port Administration.**

The report summarizes the development of a morphological model of Poplar Harbor using the Delft3D modeling system to evaluate long-term morphological changes in the area and the SWAN model to access wave action. The models were used to predict hydrodynamic conditions, wind generated waves, and sediment transport, which may cause an accretion of sediment around parts of Poplar Harbor, including blockage of spillway pipes. The model was also used to predict morphological changes for up to eight years at Poplar Harbor. Morphological modeling results showed a small accumulation of cohesive sediment in Poplar Harbor under post-construction conditions, which would not cause blockage of the spillway pipes. Wave modeling showed that Poplar Harbor is quite sheltered from waves generated by wind and therefore, sand (non-cohesive sediment) transport in the harbor is not significant.

**U.S. Army Engineer Research and Development Center (ERDC), Coastal and Hydraulics Laboratory (CHL). 2004. *Life Cycle Analysis of Mid Bay and Poplar Island Projects, Chesapeake Bay, Maryland*. Prepared for U.S. Army Engineer District, Baltimore (NAB). December.**

The report describes procedures and results of a life-cycle analysis study of coastal protection structures at Poplar, James, and Barren Islands. The study consisted of identifying historical tropical and extratropical storms needed to develop design conditions at Chesapeake Bay project sites, acquire wind fields for those historical storms, and analyze historical data to develop local winds over Chesapeake Bay fetches for wave analysis. Historical storm water levels and storm waves were computed using the existing ADCIRC numerical model. A spectral wave transformation model (STWAVE) was used to transform waves through shallow nearshore waters to the shore. Multiple life cycles of storms and project responses were recreated using the Empirical Simulation Technique (EST). Life-cycle simulations were developed and summarized for Poplar Island. The life-cycle simulation approach used in this study drew together some

important recent advances in statistical procedures for hypothesizing future storm sequences and for predicting cumulative structural response to a succession of storms.

**U.S. Army Corps of Engineers, Engineer Research and Development Center (ERDC), Coastal and Hydraulics Laboratory (CHL). 2005. *Shoreline Impact Study for Poplar Island Expansion*. Memorandum for the Record. Prepared for USACE-Baltimore District. 17 February 2005.**

Potential shoreline impacts from the 575-acre northern lateral alignment were evaluated by modeling the relative difference in wave height at the shoreline between the existing PIERP and the existing PIERP with the lateral expansion using the STWAVE model (Smith, Sherlock, and Resio, 2001). Preliminary results of the model indicated that in each case, the maximum difference in wave height for each case is directly in the lee of the lateral expansion, and no increases in wave height along the shoreline were predicted from the lateral expansion, as compared to the conditions from the existing PIERP. The maximum reductions in wave height from the lateral expansion are predicted to be 3-4 ft directly in the lee of lateral expansion. Close to the shore (depth of 9 ft), the maximum reductions in wave height are 1-1.5 ft.

The sheltering effect of the northern lateral expansion was stronger for waves from the north and west, and weaker for waves from the south. Wave height did not increase along the shoreline as a result of the lateral expansion for any cases simulated.

**U.S. Army Corps of Engineers, Engineer Research and Development Center (ERDC), Coastal and Hydraulics Laboratory (CHL). 2005. *Poplar Island Expansion Flushing Study*. Memorandum for the Record. Prepared for USACE-Baltimore District. 23 May 2005.**

The purpose of this study was to assess the flushing performance of proposed wetland cells within the proposed lateral expansion of the PIERP, and the response of the surrounding area to construction of the proposed expanded island. The study was comprised of two tasks:

1. Use of a numerical hydrodynamic circulation model to investigate consequences of construction of the wetland cells within the lateral expansion using the ADvanced CIRCulation (ADCIRC) model to assess the following issues:

    (a) Tidal elevation.
    (b) Current velocity.
    (c) Response of surrounding areas (Coaches Island, mainland) during a storm.
    (d) Changes in flow patterns resulting from the expanded island.
    (e) Feasibility for and functioning of a tidal gut between the existing and expanded island.

2. Use of the Particle Tracking Model to analyze hydrodynamic output from the ADCIRC model to estimate residence times in Poplar Harbor, and to answer questions about flushing within the newly proposed wetland cells.

## Cultural Resources Studies

**R. Christopher Goodwin and Associates, Inc. (RCG&A). 2004. *Phase I Cultural Resource Survey for the Poplar Island Expansion Supplemental Impact Statement (SEIS) Project*. Prepared for EA Engineering, Science, and Technology, Inc. April. Draft.**

Phase I field investigations to investigate the archaeological resources of the proposed Study Area for the Poplar Island expansion study were conducted from December through February 2004. The objective of this study was to identify submerged targets that might represent potentially significant cultural resources within the project area. The survey area consisted of approximately 2,000 acres immediately adjacent to the island, and, in total, 353.66 linear miles of survey track lines (569.15 km) were examined.

The study combined background archival investigations and a marine archeological remote sensing survey, which included a side scan sonar, a magnetometer, a fathometer, and hydrographic navigational computer software. The survey was conducted with a lane spacing of 50 ft (15.2 m) to ensure the greatest detail in coverage. The survey techniques ensured that any abandoned or wrecked historic vessels in the survey area would be detected. During the remote sensing surveys for the Poplar Island Expansion SEIS Project, numerous magnetic (n=795) and acoustic (n=378) anomalies were recorded. A total of five targets were identified that may represent archeological resources eligible for listing on the National Register of Historic Places. Avoidance of these five targets was recommended, and Phase II evaluation (diver investigation) of these sites was warranted if avoidance was not possible.

**R. Christopher Goodwin and Associates, Inc. (RCG&A). 2005. *Additional Phase I Cultural Resource Survey of Two Survey Blocks and Archeological Diver Investigation of Two Targets Adjacent to Poplar Island, MD.* (Technical Addendum to *Phase I Cultural Resource Survey for the Poplar Island Expansion Supplemental Impact Statement (SEIS) Project*). Prepared for EA Engineering, Science, and Technology, Inc. March. Draft.**

Based on proposed design modifications, an additional Phase I (remote sensing) archeological survey and a Phase II (diver investigation) evaluation of two targets within the Study Area were conducted in January 2005. Approximately 157,538 linear feet (29.8 linear miles) were examined in the additional Phase I study.

The study areas for the Phase II investigations were located on the northeast side of Poplar Island in approximately 10 ft of water, and on the east side of Jefferson Island in approximately 6 ft of water. The research objectives for this project were to relocate and identify via archeological diver investigation both anomalies selected for investigation and to assess the significance of any

identified cultural resources. The first target investigated was located off the eastern shore of Jefferson Island, and revealed that it represented submerged tree limbs protruding above the mudline, which mimicked a possible keel and frame set.

The second target was located on the northeast side of Poplar Island. The diver investigation revealed a badly fragmented wooden shipwreck measuring approximately 15 by 50 ft. The bow of the vessel had separated from the body, and lay 30 feet to the north at a $90^{o}$ angle to the linear axis of the wreck. The wreck has been identified as a possible schooner (bugeye or pungie), a vernacular vessel form typically seen on the Chesapeake Bay during the last quarter of the nineteenth century and into the twentieth century. This type of vessel is well documented in numerous sources; in fact, a handful of restored schooners currently exist in personal and museum collections. Because this boat form is well documented, and because it does not appear unique in any fashion, this poorly preserved wreck does not appear to be eligible for listing on the National Register of Historic Places. No further archeological investigation of this site was warranted or recommended.

## Monitoring Studies

**EA Engineering, Science and Technology (EA). 2002. *Reconnaissance Study of Poplar Island Sites for Beneficial Use and Habitat Restoration: Environmental Conditions*. November.**

The report examines the existing conditions of Poplar Island natural resources in the context of six conceptual lateral alignments proposed as potential expansions of the PIERP. Existing conditions data were collected for resources of regional concern from agency database files, published reports, and journal manuscripts, and a site visit/reconnaissance that assessed potential impacts and needs for further investigations prior to site expansion was conducted.

**EA Engineering, Science and Technology (EA). 2003. *Poplar Island Expansion Beneficial Use of Dredged Material, Final Consolidated Reconnaissance Report.* Prepared for Maryland Environmental Service. July.**

This consolidated report combines the findings of several separate reconnaissance-level investigations related to the proposed expansion and includes studies on subsurface geotechnical investigations, coastal engineering investigations, hydrodynamic and sediment modeling, dredging and site engineering, and the existing environmental conditions at Poplar Island. A total of six conceptual lateral alignments with two dike elevations and a 50 percent upland to 50 percent wetland ratio were investigated.

**EA Engineering, Science, and Technology. 2005.** ***Poplar Island Expansion Study – Supplemental Studies to Evaluate Existing Conditions of Aquatic Resources, Spring 2004 through Fall 2004. Chesapeake Bay, Maryland.*** **Prepared for USACE-Baltimore District. May.**

Based on the evaluation of data from the reconnaissance study and the exterior monitoring program, further information was needed to adequately identify the environmental resources within the proposed expansion area. Therefore, supplemental studies on sediment quality, benthic community, commercial shellfish, finfish utilization, SAV, and cultural resources were conducted. This report provides a comprehensive summary of the field methods, data analysis, results, and conclusions for each study component.

**Maryland Environmental Service (MES). 2000.** ***Poplar Island Environmental Restoration Project: Baseline Monitoring Study.*** **Prepared for: The Maryland Port Administration. January.**

The purpose of the baseline conditions study was to describe and assess the existing environment and to ensure the validity of the sampling and reference for use during post-construction, placement, and post-placement studies. The study elements include water quality, benthic community, sediment quality, fishery surveys, wildlife surveys, and vegetation surveys. The findings reported in the baseline study are generally representative of the typical environment to be created and will be used for comparison to studies conducted in subsequent years to assess the impacts, if any, of the construction and site operations at the PIERP once dredged material placement has started.

**Maryland Environmental Service (MES). 2002.** ***Poplar Island Environmental Restoration Project. 2000/2001 Discharge and Exterior Monitoring Annual Draft Report.*** **Prepared for Maryland Port Administration. January.**

This report includes the inflow operations and exterior monitoring studies completed for the first year of operations at PIERP. The exterior monitoring studies for this report includes exterior sediment, benthic community, benthic tissue, water quality, Natural Oyster Bar (NOB 8-10), nekton utilization, SAV, and wetland vegetation monitoring. Comparisons of the 2001 physical analysis of sediments to the baseline survey results indicate a higher percentage of fine-grained material in Poplar Harbor and higher proportions of coarse grain material (sand) outside of Polar Harbor. Benthic tissue and sediment analysis indicate that Poplar Harbor may contain higher concentrations of nutrients and organics. B-IBI scores for the benthic community were generally low, but are expected to increase as communities re-establish themselves. SAV was sparse and scattered within Poplar Harbor and nekton species associated with SAV were not present. Completion of the scheduled future monitoring is necessary before impacts of PIERP on the surrounding habitat can be defined.

**Maryland Environmental Service (MES). 2004.** ***Poplar Island Environmental Restoration Project. 2002 Discharge and Exterior Monitoring Annual Draft Report.*** **Prepared for Maryland Port Administration. April.**

This report describes the inflow operations and exterior monitoring studies completed for the second year of operations at PIERP. The framework monitoring studies included in this report are discharge monitoring, exterior sediment quality, benthic tissue, benthic and epibenthic communities, exterior water quality, fisheries utilization, SAV, Natural Oyster Bar 8-11 (NOB 8-11), and wildlife utilization. Early analysis indicates that there seems to be no detected negative impact to the surrounding environment and the site is providing good habitat for benthic and epibenthic organisms and nekton, avian and terrapin populations. Completion of several more years of scheduled framework monitoring is necessary before a thorough assessment of PIERP's effect on the surrounding environment can be identified.

**Maryland Environmental Service (MES). 2005. *Poplar Island Environmental Restoration Project, 2003 Discharge and Exterior Monitoring Annual Final Report*. Prepared for Maryland Port Administration. January.**

This report includes the inflow operations and exterior monitoring studies completed for the third year of operations at PIERP. The framework monitoring studies include exterior water quality monitoring, discharge monitoring, sediment quality, wildlife usage, fisheries usage, wetland vegetation, and submerged aquatic vegetation (SAV). Early analysis shows that there seems to be no known negative impact to the surrounding environment and the site is providing good habitat for nekton, avian, and terrapin populations.

## Other Environmental Studies

**Maryland Environmental Service (MES). 2003. *Report on Placement of Oyster Shell at the Oyster Sanctuary and Harvest Reserved off the Poplar Island Environmental Restoration Project.* Prepared for the USACE-Baltimore District. November.**

This report documents the placement of oyster shell in a recently permitted oyster sanctuary and harvest reserve in the Chesapeake Bay within NOB 8-10, just west of PIERP. The oyster shell was recovered from dredged material placed at PIERP from dredging in the outer channels of the Bay. Both the oyster sanctuary and harvest reserve area are approximately 2.5 acres. Placement was performed by Langenfelder Marine, Inc. using a pump barge containing two large water cannons. The oyster shell was planted fairly even over the sites by continually washing shells overboard with the water cannons. Both the sanctuary and the harvest reserve sites were planted with approximately 1,870 cubic yards of oyster shell each.

**Maryland Environmental Service (MES). 2003. *Poplar Island Environmental Restoration Project, Spill Prevention Control and Countermeasures Plan*. February.**

A Spill Prevention Control and Countermeasure (SPCC) Plan has been prepared by Maryland Environmental Service (MES) to comply with applicable requirements of EPA Regulations on Oil Pollution Prevention regulations contained in Title 40, Code of Federal Regulations, Part 112 (40 CFR 112) and COMAR 26.10.03. The plan addresses precautions to prevent spills from oil storage tanks, possible spill scenarios, and cleanup and spill reporting procedures.