CHESAPEAKE BAY SHORELINE EROSION FEASIBILITY STUDY
PHASE II: CHESAPEAKE BAY MODEL PACKAGE ENHANCEMENTS

PROJECT MANAGEMENT PLAN

U.S. Army Corps of Engineers
Baltimore District
October 2012

PROJECT MANAGEMENT PLAN CONCURRENCE

The undersigned agree to follow the provisions of this project management plan (PMP). Changes to scope, schedule, costs, or acquisition strategy included in this plan must be coordinated and approved by this team member or their successor.

Project Manager Date

Study Manager Date

Engineer Research and Development Center Date

The undersigned concur with the attached project management plan (PMP), and will provide the necessary resources to meet these commitments. Changes to scope, schedule, costs, or acquisition strategy included in this plan must be coordinated and approved by this resource provider or their successor.

Chief, Civil Project Management Branch, PPMD Date

Chief, Civil Project Development Branch, Planning Division Date

Chief, Engineering Research and Development Center Date

PROJECT MANAGEMENT PLAN CONCURRENCE

The undersigned agree to follow the provisions of this project management plan (PMP) and will provide the necessary resources to meet the sponsor commitments. Changes to scope, schedule, costs, or acquisition strategy included in this plan must be coordinated and approved by this team member or their successor.

Maryland Department of Natural Resources Date

REVISIONS TO PMP

Section 14, Change Management, discusses how and when this PMP will be revised.

Revision Number	Revision Date	Section	Description of Revision

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PROJECT MANAGEMENT PLAN

October 2012

1. INTRODUCTION

This project management plan (PMP) addresses the efforts and resources needed to carry out Phase II (Chesapeake Bay Model Package Enhancements (CBMPE)) of the Chesapeake Bay Shoreline Erosion (CBSE) Feasibility Study under the Agreement signed between the Maryland Department of Natural Resources (DNR) and the Department of the Army dated September 2004. This PMP is an extension of the CBSE-Maryland Coastal Management Plan PMP under which Phase I was completed. Phase I project deliverables included the Chesapeake Bay Shoreline Erosion in Maryland: A Management Guide and Shore Protection Manual as well as other study products including the Erosion Vulnerability Assessment Tool. Phase II will be led by the Baltimore District, U.S. Army Corps of Engineers (USACE) and the DNR, with significant contributions by the Environmental Protection Agency Chesapeake Bay Program (CBP). It is anticipated that Phase III will follow which could focus on cliff and bluff habitats, which are some of the most threatened shoreline habitats in the Bay in Maryland.

This PMP has been prepared in accordance with Engineering Regulation (ER) 5-1-11, dated 17 August 2001, titled "U.S. Army Corps of Engineers Business Process." The PMP was developed with input from USACE technical divisions, the project sponsor (DNR), and CBP.

The PMP is a management tool to help USACE and DNR manage and accomplish project activities. It provides summary information to USACE and DNR decision-makers for use in strategic planning and issue resolution, and generally defines the working relationship between the two organizations legally bound by the cost-sharing agreement. It also outlines the project goals, schedule, and budget as a framework within which the project team defines and accomplishes their actions. It serves as a guide for monitoring project progress, planning future actions, and identifying and resolving issues in a timely manner. In addition, the PMP provides a means for those involved in the study to formally agree to the vision, scope, and conduct of the effort before it is initiated.

The PMP is a living document, and as such, will be updated if changes in scope, schedule, or budget occur during the Phase II. The PMP must be approved by USACE and DNR prior to implementation. These approvals are noted by the signatories at the front of this document.

2. PROJECT AUTHORIZATION

This study is authorized by a resolution of the U.S. Senate Committee on Environment and Public Works dated 23 May 2001, that directs the Corps to re-evaluate the *Chesapeake Bay Shoreline Erosion*

Study, completed as a joint effort by the Baltimore and Norfolk Districts in 1990. The authority reads:

> "That, the Secretary of the Army is requested to review the report of the Army Corps of Engineers on the Chesapeake Bay Study, dated September 1984, and other pertinent reports, with a view to conducting a comprehensive study of shoreline erosion and related sediment management measures which could be undertaken to protect the water and land resources of the Chesapeake Bay watershed and achieve the water quality conditions necessary to protect the Bay's living resources. The study shall be conducted in cooperation with other Federal agencies, the State of Maryland, the Commonwealth of Virginia, and the Commonwealth of Pennsylvania, and their political subdivisions and agencies and instrumentalities thereof and the Chesapeake Bay Program, and shall evaluate structural and nonstructural environmental enhancement opportunities and other innovative protection measures in the interest of ecosystem restoration and protection, and other allied purposes for the Chesapeake Bay."

In addition, the fiscal year 2002 Energy and Water Appropriations conference report provided funding "...for a Chesapeake Bay shoreline erosion study, including an examination of management measures that could be undertaken to address the sediments behind the dams on the Lower Susquehanna River."

The Chesapeake Bay Shoreline Erosion Reconnaissance Report—Part I was completed in December 2002. The first part of the report focused on the Susquehanna and sediment accumulating behind the dams. The Chesapeake Bay Shoreline Erosion Reconnaissance Report--Part II was completed in July 2003 and certified by Corps Headquarters in May 2004. This report concluded that further investigation of management opportunities and project development to reduce shoreline erosion, restore and protect critical coastal habitats, and improve water quality within the Chesapeake Bay watershed was necessary. This mission is within the Federal Corps interest. 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.

During the reconnaissance study for the Chesapeake Bay watershed, preliminary shoreline management opportunities were developed. The reconnaissance report discussed opportunities such as the development of a revised shoreline protection manual, comprehensive regional shore erosion projects, the need for environmental restoration of marsh, beach, and bluff habitat as well as other coastal habitats. The study also identified the critical need for data collection and analysis. Additional issues include addressing hydrologic changes associated with sea level rise, developing innovative solutions to erosion, and improving the water quality within the Chesapeake Bay. If meaningful restoration and water quality improvement are to be implemented, comprehensive approaches must be taken. The study recommended studies that addressed comprehensive environmental restoration and storm/flood damage reduction, moving away from site by site analysis. In addition, the study recommended the creation of high quality coastal niches for plants and animals.

3. PROJECT BACKGROUND

On December 29, 2010, the U.S. Environmental Protection Agency (USEPA) established the Chesapeake Bay Total Maximum Daily Load (TMDL), a historic and comprehensive water quality standard with rigorous accountability measures to initiate sweeping actions to restore clean water in the Chesapeake Bay and the region's streams, creeks, and rivers.

The Chesapeake Bay TMDL is required under the federal Clean Water Act and responds to consent decrees in Virginia and the District of Columbia from the late 1990s. The TMDL identifies the necessary pollution reductions from major sources of nitrogen, phosphorus, and sediment across the District of Columbia and large sections of Delaware, Maryland, New York, Pennsylvania, Virginia, and West Virginia, and sets pollution limits necessary to meet water quality standards in the Bay and its tidal rivers.

Pollution limits, for the Bay and for major river basins, is based on extensive monitoring data, peer-reviewed science, and state-of-the-art modeling tools. The Phase II study outlined here is, in part, the evolution and of these modeling tools for 1) greater understanding of pollutants in near shore environments, 2) greater understanding of shoreline erosion processes, leading to 3) the protection and restoration of critical coastal habitats. The study will help enable Bay jurisdictions meet their obligations for pollutant reduction, and will be used in formulating Phase III of the Chesapeake Bay Shoreline Erosion study, which could focus on cliff and bluff habitats, which are some of the most threatened shoreline habitats in the Bay in Maryland.

4. PROJECT SCOPE

The project scope to be accomplished under this PMP is to develop and apply appropriate technology to the "Living Resource Ribbon (LRR)," the region of the bay system between the shoreline and the 2 to 3 meter depth contour and to enhance the CH3D/ICM model combination.

Major tasks and interim deliverables will include:

Task	Deliverable
1: Extend Present Simulation Through 2011	Revised system-wide eutrophication model with calibration application through 2011.
2: Oysters and Menhaden	Set of scenarios addressing effects of menhaden on water quality and a revised oyster module incorporated into the eutrophication and LRR models.
3: Climate Change	Set of model scenarios which address impacts of climate change including sea level rise and temperature increase.
4: Living Resource Ribbon	Improved model representation of shallow-water regions in time for the 2017 Midpoint Assessment.
5: Wetlands and Shallow-Water Processes	Independent shallow-water processes module which will address water quality impacts from

	wetlands and shoreline erosion. The module will be incorporated into the eutrophication and LRR models.
6: 2017 Midpoint Assessment	Production of a complete Chesapeake Bay model for use in the 2017 Midpoint Assessment.
7: Reporting, Meetings and Workshops	Quarterly Reports

The overall final product will be an enhanced Chesapeake Bay Model Package with improved capability in shallow water, improved representation of living resources, and improved capability to address shoreline erosion and related effects.

A detailed scope narrative developed in conjunction with the US Army Corps of Engineer's Engineer Research and Development Center (ERDC) and CBP is provided in Appendix A.

5. TEAM IDENTIFICATION

The lead Federal agency for the Phase II study is USACE, while the non-Federal sponsor is DNR. Many other Federal, state, and regional agencies, in particular CBP, will be actively involved in the process. The current project team members are listed in Table 1.

Table 1. Identification of Project Delivery Team (PDT) Membership

Name	Role	Affiliation/Office Symbol
Kimberly Gross	Project Manager	USACE, CENAB-PP-C
Andrew Roach	Technical Review Lead, Study Manager	USACE, CENAB-PL-P
Carl Cerco	Technical Lead/Modeler	USACE, ERDC
Dan Bierly	Plan Formulation and Policy Advisor	USACE, CENAB-PL-P
Kevin Smith	Project Manager	DNR
Lewis Linker	Chesapeake Bay Program Manager	CBP

Project Manager. The Project Manager is responsible for the overall management of the project and is the Baltimore District's primary point-of-contact with the sponsor, other project partners, Congressional interests, and the project delivery team. The Project Manager serves as the project leader, responsible for managing the project parameters of funds, budget, schedules, scope, and quality. Communications between the Project Manager and the team members will be in the form of phone, electronic mail, or personal discussions. Team meetings will be scheduled on an as-needed basis (currently planned quarterly).

Project Delivery Team (PDT). The PDT is responsible for preparation of the products as described in the PMP, as well as the continuing adequacy and suitability of this PMP over the life of the study. Individual offices preparing documents and analyses will conduct their own routine quality control of the PDT's products.

Study Coordination Team. During the course of the project, all efforts will be directed by the study coordination team as prescribed in the cost-sharing agreement. The coordination team will consist of the two project managers from USACE and DNR. As such, Ms. Kimberly Gross and Mr. Kevin Smith, are co-chairs of the coordination team, and they will communicate regularly with Mr. Lewis Linker of CBP as needed. The coordination team is responsible for carrying out the day-to-day direction and management of the study. The coordination team will keep the Executive Committee, the PDT, and others informed of the progress of the study and of significant pending issues and actions.

Executive Committee. In the event that the coordination team cannot resolve technical or management issues, the Executive Committee will be convened to decide on a course of action. The Executive Committee consists of senior members of USACE and DNR. Current designated members of the Executive Committee are noted in Table 2. Should the named individual no longer hold their position, his or her successor will be automatically assigned to the Executive Committee. Use of the Executive Committee process is normally not invoked during a normal, functioning study. Its use is reserved for rare cases when issues cannot be satisfactorily resolved within the project team members.

Table 2. Identification of Executive Committee Membership

Name	Title	Affiliation/Office Symbol
Amy Guise	Chief, Planning Division	USACE, CENAB-PL
David B. Morrow	Chief, Program and Project Management Division	USACE, CENAB-PP
Colonel J. Richard Jordan	Baltimore District, Corps of Engineers, District Engineer	USACE, CENAB-DE
John R. Griffin	Secretary, Maryland Department of Natural Resources	DNR

Agency Technical Review Team. Agency technical review (ATR) team members will be identified as needed to match the appropriate disciplines with the products produced during the assessment process. A review plan detailing the ATR requirements for Phase II is included in this document as Appendix B.

Regional Integration Team (RIT) and District Support Team (DST). The Regional Integration Team (RIT) is made up of Headquarters USACE representatives, while the District Support Team (DST) is made up of representatives from USACE's North Atlantic Division. The purpose of these teams is to provide guidance and resolve policy issues before they impact the study schedule. In addition to the RIT and DST, the CSDR-PCX may also be consulted to assist with quality and technical issues including peer reviews and model certifications, if needed.

6. CRITICAL ASSUMPTIONS AND CONSTRAINTS

General assumptions for the Phase II study include:

- No field work will be conducted.

- No NEPA documentation is needed.
- Federal and non-Federal funds will be made available to the study in a timely fashion.

7. WORK BREAKDOWN STRUCTURE (WBS)

The Phase II study will follow the normal work breakdown structure for USACE Civil Works feasibility studies. This standard work breakdown structure is outlined below; however, due to the unique nature of the work some subaccounts will not be utilized for this phase. Those in bold apply to the Phase II effort.

(22A) Public Involvement
(22B) Implementation Studies
(22C) Social Studies
(22D) Cultural Studies
(22E) Environmental Studies
(22F) Fish and Wildlife Studies
(22G) Economic Studies
(22H) Real Estate Studies
(22J) Hydrologic and Hydraulic Studies
(22K) Geotechnical Studies
(22L) Hazardous, Toxic and Radioactive Waste (HTRW) Studies
(22M) All Other Studies (includes Technical Review)
(22N) Surveys and Mapping
(22P) Design and Cost Analyses
(22Q) Technical Management
(22R) Plan Formulation
(22S) Report Preparation
(22T) Project Management

Table 3. Summary of Funding

SUMMARY OF FUNDING	
SUBACCOUNT	TOTAL
(22J) Hydrologic and Hydraulic Studies	$1,472,000
(22Q) Technical Management	$24,000
(22T) Project Management	$47,000
Contingency (5%)	$77,000
Total	$1,620,000
Federal Share (50%)	$810,000
Non-Federal sponsor Share (50%)	$810,000

(22J) Hydrologic and Hydraulic Studies: The tasks associated with this WBS includes the technical elements of the detailed scope of work provided in Appendix A and will be performed, for the most part, by the U.S. Army Corps of Engineers, Engineer and Research Development Center (ERDC).

(22Q) Technical Management: The tasks associated with this WBS will include technical oversight of the scope of work including review of quarterly reports.

(22T) Project Management: The tasks associated with this WBS include predominantly tasks to be completed by the Project Manager as defined in section 5 above.

8. FUNDING

The estimated total cost for the Phase II study is $1,620,000. All costs described in this PMP were prepared for each subaccount of the work breakdown structure using a detailed task cost template. These tasks were then assembled into the detailed task and cost spreadsheet which is found in Appendix C of this PMP. The project costs will be cost shared 50-50 between USACE and DNR. DNR's share of 50 percent is expected to be provided wholly as cash contribution.

This estimated budget is subject to change with actual resources appropriated and released each year to the USACE. It is also subject to refinement and change with subsequent modifications to this PMP between USACE and DNR. To ensure the sponsor's satisfaction with the expenditure of funds on this project, USACE will provide DNR with a quarterly accounting of project costs.

Table 4: Estimated Breakdown of Study Costs by Fiscal Year

	Total Value	Fiscal Year Breakdown			
		FY13 (Jul 13 – Sep 13)	FY14 (Oct 14 – Sep 14)	FY15 (Oct 14 – Sep 15)	FY16 (Oct 15 – Jun 16)
Project Execution	$1,620,000	$300,000	$570,000	$570,000	$180,000
Federal Cash Contribution	$810,000	$150,000	$285,000	$285,000	$90,000
Non-FederalCash Contribution	$810,000	$150,000	$285,000	$285,000	$90,000

9. SCHEDULE

It is anticipated that the Phase II study will take approximately 3 years to complete, assuming full Federal appropriations within this time period to meet the identified DNR and USACE capability, with funding being delivered over four federal fiscal years. A preliminary schedule assuming this flow of USACE funding is included in Appendix D. This schedule will be expanded and routinely updated throughout the study.

The schedule reflects the USACE and DNR's capability with no budgetary or workload restrictions. It assumes that appropriate funding for the project is provided in Federal FY 2013, FY 2014, FY 2015 and FY2016. If funding is not received as planned, the scope of work and schedule will be revised and, if necessary, pared back. The PMP and assessment costs would be updated or revised appropriately at that time.

Key milestones and their planned completion dates are outlined in the project schedule included in Appendix D.

10. QUALITY MANAGEMENT PLAN

The PDT has determined the procedures necessary to achieve the target level of quality for this effort and has developed a Review Plan (Appendix B) to formally document the necessary quality management that will be implemented.

11. PROJECT DELIVERY ACQUISITION STRATEGY

No contract support is envisioned for the Phase II study. However, if the need arises, a strategy will be developed by the PDT.

12. RISK MANAGEMENT PLAN

The major scope, quality, schedule and cost-related risks are outlined below. Risks will be monitored throughout the development of the written work products required by this assessment.

Risks	Triggers	Potential Impact
Loss of Quality	• Communication errors	• Schedule slippage • Re-working tasks • Increased costs
Schedule Slippage	• Lack of Federal or sponsor funding • Changes in scope • Data not available	• Schedule slippage • Fewer products completed • Less detailed analysis
Cost Growth	• Schedule slippage • Additional requirements or studies	• Funding not available

An initial risk register is included in Appendix E.

13. SAFETY AND OCCUPATIONAL HEALTH PLAN

There are no anticipated field investigations that will require a position/activity hazard analysis. Should limited field work be conducted, general field safety requirements will be followed.

14. CHANGE MANAGEMENT

The PMP is a living document, and will be revised to accommodate changes created by progress, new information, changes in policy, and other occurrences. PDT members are responsible for monitoring their work items and identifying when changes are necessary. Scope change requests, including any cost or schedule impacts, will be provided to the PM as soon as the scope change is identified by the team member. The PM, through consultation with the PDT, will respond to change requests by identify technical, funding, and schedule impacts which will result from the

change. Significant changes will require updating this PMP document and the concurrence of the non-Federal sponsor (DNR). These significant changes will be summarized in the PMP revision table at the front of this document. Significant changes may include:

- Congressional funding reductions or other directives;
- Loss or modification of sponsor funding;
- New information or additional data-gathering requirements;
- Sponsor-requested scope changes; and
- Schedule changes delaying project implementation.

15. COMMUNICATIONS PLAN

The Phase II study will require the routine engagement and participation of many stakeholders who have a direct interest, involvement, or investment in the outcome of the study. Depending on their level of involvement, such stakeholders may also become members of the PDT in the future. Additional stakeholders may be identified during future meetings and outreach activities.

Internal Stakeholders. These are the entities responsible for the project as signatories to the cost sharing agreement. They include:

- USACE;
- DNR.

While CBP is not a signatory to the cost-sharing agreement, they provide significant contributions and are a member of the project team.

Other Stakeholders. These are the individuals and groups that may also have interest in the project. These stakeholders include:

- Federal, state, and local regulatory agencies;
- Non-regulatory Federal and state agencies;
- Congressional delegation;
- Local communities.

16. VALUE MANAGEMENT

It should be noted that there is no USACE construction project being studied or proposed for the Phase II study, therefore the value engineer will not be involved.

17. DATA MANAGEMENT

All USACE project files of an administrative nature will be maintained in the project directory in the Baltimore District share drive under Projects/Civil-Projects/Chesapeake Bay Shoreline Erosion. All USACE project files of a technical nature will be maintained at ERDC. Care will be taken to name files for easy retrieval and recognition. Project team members will be given written access to all files

in the project directory with the expectation that individuals will not change the files created by others unless specifically requested. Read access will be available to all USACE employees.

18. CLOSEOUT PLAN

At the completion of all phases (including Phase III and any follow-on phases) of the study, the USACE PM shall initiate the financial closeout process. The non-Federal sponsor (DNR) must provide documentation for all in-kind services and costs associated with the overall study. This documentation will be used for properly crediting DNR for their work effort up to 50 percent of the total study cost; any costs that exceed the 50-percent non-Federal share will not be reimbursed in accordance with the cost-sharing agreement. It is anticipated that Phase II study costs contributed by DNR will be wholly as a cash contribution. Closeout will include a final accounting, a letter to the sponsor informing them of the accounting results, and reconciliation of final cost-sharing obligations. The PDT will ensure that all project documents are appropriately filed

19. APPROVALS

At a minimum, all significant updates of this PMP will require the approval of the PDT and the Civil Works resource providers (the signature lists at the beginning of this document). USACE and DNR will both approve significant changes to the PMP. In addition, the initial version will be submitted to USACE's North Atlantic Division and Headquarters as information for their files. Copies of all subsequent versions of the PMP where significant changes have been made may also be provided to USACE's North Atlantic Division and Headquarters as a courtesy.

APPENDIX A

PREDICTING AND QUANTIFYING ENVIRONMENTAL RESTORATION IN THE NEAR-SHORE REGIONS OF CHESAPEAKE BAY

DETAILED SCOPE NARRATIVE

Developed by
Carl F. Cerco
US Army Corps of Engineers
Engineer Research and Development Center (ERDC)

Introduction

On December 29, 2010, the U.S. Environmental Protection Agency (USEPA) established the Chesapeake Bay Total Maximum Daily Load (TMDL), a historic and comprehensive water quality standard with rigorous accountability measures to initiate sweeping actions to restore clean water in the Chesapeake Bay and the region's streams, creeks, and rivers.

The Chesapeake Bay TMDL is required under the federal Clean Water Act and responds to consent decrees in Virginia and the District of Columbia from the late 1990s. The TMDL identifies the necessary pollution reductions from major sources of nitrogen, phosphorus, and sediment across the District of Columbia and large sections of Delaware, Maryland, New York, Pennsylvania, Virginia, and West Virginia, and sets pollution limits necessary to meet water quality standards in the Bay and its tidal rivers.
Pollution limits, for the Bay and for major river basins, are based on extensive monitoring data, peer-reviewed science, and state-of-the-art modeling tools. The study outlined here is, in part, the evolution and of these modeling tools for 1) greater understanding of pollutants in near shore environments, 2) greater understanding of shoreline erosion processes, leading to 3) the protection and restoration of critical coastal habitats. The study will help enable Bay jurisdictions to meet their obligations for pollutant reduction, and will be used in formulating Phase III of the Chesapeake Bay Shoreline Erosion study, which could focus on cliff and bluff habitats, which are some of the most threatened shoreline habitats in the Maryland portion of the Bay.

Study Overview

The EPA Chesapeake Bay Program (CBP) recently completed a set of Total Maximum Daily Loads (TMDL's) for Chesapeake Bay. Hydrodynamic and water quality models provided by the US Army Engineer Research and Development Center (ERDC) were crucial components in development of the TMDL's. As with previous load management plans, a reassessment is scheduled in order to incorporate new technology and to evaluate progress towards the management goal. Plans call for a reassessment of the Phase III Watershed Implementation Plans (WIP's) in 2017. In order to complete the assessment on schedule, all newly-developed technology must be on-line and available by December 2015. Activities sponsored by the EPA to prepare for the 2017 Midpoint Assessment are commencing in the first quarter of FY 2013. This work plan incorporates products from the EPA-sponsored activities and commences in the final quarter FY 2013.

Corps tools currently in use by the CBP include the CH3D hydrodynamic model and the ICM eutrophication model. These models perform well and are completely satisfactory in the expansive channel reaches of the Bay and major tributaries. In view of the proven technology and the large investment, CBP wishes to retain the CH3D/ICM combination in the regions where it is most effective. Under this scope of work, we will extend and improve the current CH3D/ICM combination to improve their capacity for the 2017 Midpoint Assessment. Results from the existing models are less satisfactory in shallow water systems with complex geometry. The structured grid of CH3D cannot conform to complex geometry and specific shallow-water processes may be missing from the eutrophication model. A second objective of this scope is to

develop and apply appropriate technology to the "Living Resource Ribbon," the region of the Bay system between the shoreline and the 2 to 3 m depth contour.

1. Extend Present Simulation through 2011

The complete Chesapeake Bay Environmental Model Package (CBEMP) incorporates an atmospheric deposition model and a watershed model as well as CH3D and ICM. The CBEMP is operable over the period 1985-2005. The CBP wishes to extend the operation through 2011. A primary objective of the extension is to make use of the observations that have been collected in recent years, especially in shallow water. The CBP and ERDC will cooperate in this endeavor. Prior to commencement of this project, CBP will complete the watershed modeling and run CH3D for the additional years. Tasks required to execute CH3D include;

- Assemble data for model forcing functions and for model validation
- Create model input decks
- Execute an independent wind-driven surface wave model
- Estimate bottom shear stress from waves and currents
- Validate model and compare to previous results
- Create and store hydrodynamic outputs to drive the eutrophication model

ERDC will complete the water quality modeling. Required tasks include:

- Assemble data for model forcing functions and for model validation
- Estimate shoreline erosion
- Create model input decks
- Validate model and compare to previous results

The data assembly will be completed prior to commencement of this project. Estimates of shoreline erosion require information on wave climate to be provided by CBP. This task and the subsequent creation of input decks and model validation will be conducted under this PMP.

The eutrophication model divides suspended solids into two categories, inorganic and organic. Transport of inorganic particles is treated in a rigorous fashion which includes deposition and resuspension. Organic particles rely on an older formulation in which particles deposited on the bottom remain there permanently. As part of the model extension, consideration will be given to extending the representation of particle resuspension to organic particles as well as inorganic particles.

Deliverables: This task will produce a revised system-wide eutrophication model with calibration and application through 2011.

2. Oysters and Menhaden

Investigations have already been conducted into the effects of living resource restoration on water quality. These investigations examined the hypothesis that restoration of phytoplankton consumers would supplement the beneficial effects of nutrient load reduction. In particular, the roles of filter-feeding oysters and menhaden were examined, as called for in the Chesapeake 2000 Agreement. Results to date indicate living resource restoration is a supplement, not a

substitute, for load reductions. Living resource restoration was not considered in the present TMDL, however, and prospects for restoration have changed since the last examination. A reassessment of living resource impacts on water quality is called for.

The previous oyster studies examined the impact of native oyster restoration in their historical habitats. Since then, significant restoration has occurred in the Maryland portion of the Bay, providing the opportunity to add detail to the previous restoration scenarios. A second influence which has occurred since the previous studies is the resurgence of aquaculture, especially in the Virginia portion of the Bay. Aquaculture activities alter the historical distribution of oyster biomass. More significantly, however, aquaculture practices may result in different patterns of water-column filtration and of feces and pseudofeces deposition, compared to native oyster reefs. Nutrient removal due to oyster harvesting must also be taken into account. The oyster model will be revised as necessary to incorporate aquaculture operations. Current and projected data on biomass distribution and abundance, including oyster harvest sanctuaries, will be mapped onto the current computational grid and various combinations of restoration and load reductions will be examined.

Previous investigations of effects of menhaden on water quality were conducted on the original 4,000-cell computational grid developed more than 20 years ago. This grid was employed to facilitate development of the menhaden algorithms and addition to the CBEMP suite. Menhaden activity will be moved to the current computational grid and their role will be reassessed based on current estimations of ambient conditions and loads and projected load reductions.

Deliverables: Products of this task will include a set of scenarios addressing effects of menhaden on water quality and a revised oyster module incorporated into the eutrophication model and the LRR model.

3. Climate Change

The CBP has a long planning period for implementation of its management goals. The effects of climate change over this period may influence or confound management activities. The CBEMP and the LRR models will be used to examine the impact of climate change on projected water quality. This activity requires discussion and planning prior to development of a detailed work plan. The first issue to resolve is to frame the future climate-change scenario. Conditions to be described include land use, rainfall, air temperature, water temperature, sea level rise, and wetland erosion. The WSM will be employed to predict flows and loads from the watershed based on the projected conditions. New hydrodynamics will be required based on projected flows, sea level, and shoreline geometry. Multiple eutrophication model and LRR model runs will be made based on the projected conditions and management plans including the TMDL. Particular attention will be devoted to the effects of climate change on living resource regions including SAV beds and wetlands.

Deliverables: This task will produce a set of model scenarios which address impacts of climate change including sea level rise and temperature increase.

4. The Living Resource Ribbon

Shallow-water regions (depth < 2 to 3 m) adjacent to the Bay shoreline are emerging as "hot spots" for monitoring, modeling, and management. This Living Resource Ribbon (LRR) incorporates virtually all Chesapeake Bay Submerged Aquatic Vegetation (SAV) as well as oyster reefs and additional valued resources. Model performance in the LRR is crucial to this effort due to the action of shoreline erosion in this region and since multiple US Army installations adjoin the LRR.

The Bay Program Scientific and Technical Advisory Committee (STAC) advocates the use of multiple management models for the Bay. The employment and rigorous comparison of different models applied to the same shallow-water systems by different teams is proposed as an initial step towards the development of multiple management models. The CBP intends to fund the proposed STAC activity under a separate scope of work. Under this scope, the modeling team will cooperate with the STAC activity and will contribute to research and development of shallow-water modeling.

The shallow-water region represented by the present model must be improved in time for the 2017 Midpoint Assessment. The improvements can take several forms and require investigation. One path is to attempt to extend and improve the resolution of the present models in shallow water. Simple grid refinement will not be possible due to the difficulty of fitting quadrilateral CH3D cells to complex geometry and bathymetry. Revamping the entire system-wide grid is also undesirable in view of the limited time frame for this activity. An approach involving sub-grids will likely be required or else shallow-water cells, similar to the current SAV cells, may be added to the eutrophication model.

Sub-grids can be rigorously incorporated into the CH3D framework or else sub-grids can be run as independent models potentially employing mesh representations, such as triangles, free of the CH3D grid constraints. In that case, technology to share boundary conditions and additional information must be developed. Full cooperation will be solicited with STAC in the selection of models and systems for sub-grid investigation. The investigation of independent models and grids herein will provide additional information and bases for comparison with the models funded under the STAC multiple models proposal.

Regardless of the configuration, several sub-models and features currently incorporated into the CH3D/ICM combination must be included in the LRR model. These include particle resuspension, sediment diagenesis, SAV, and benthic algae. These features need not be added prior to initial testing, however.

Deliverables: This task will produce improved model representation of shallow-water regions in time for the 2017 Midpoint Assessment.

5. Wetlands and Shallow-Water Processes

Shallow-water regions encompass multiple distinct and complex environments. Shallow water regions range from sandy beaches subject to wave activity to tidal wetlands subject to periodic inundation. The existing CBEMP encompasses shallow water regions to the extent possible with

the current computational grid. Improved representation of the shallow-water regions is certainly feasible and is detailed in the section headed "Living Resource Ribbon." The performance of the present model in shallow water, as distinguished from the physical representation, merits additional investigation. Initial evaluation, based on available data, indicates the model has several shortcomings, notably in the computation of suspended solids and light attenuation. The initial evaluation was performed with a small portion of the shallow water data, however, collected up to 2005. The preponderance of the data was collected after that year. The first step in improved modeling of shallow-water processes will be a comprehensive examination of present model performance, based on observations collected through 2011 and the proposed model extension to that year.

Wetlands are already known to influence model performance in portions of the Bay where they are extensive and incorporate areas many times larger than the adjacent open-water regions represented in the model. A universal, process-based model which encompasses all physical and environmental shallow-water processes is infeasible. We propose to develop one or two simplified models which will describe crucial processes. These include wetlands interactions with water quality and quantitative computations of local shoreline erosion. In view of the multiple specialties necessary to develop models of shallow-water processes, we propose to participate in the development of a community model which will be shared among Bay models and modelers.

The existing CBEMP incorporates a mechanistic SAV model originally implemented for the 2000 version of CBEMP. Since then, significant knowledge has been acquired regarding the processes which determine SAV abundance in the Bay. In particular, summer temperature has been determined to exert a profound effect on abundance of eelgrass. Investigations into factors behind the resurgence of SAV in the upper Bay are presently underway. We will revisit the formulation and calibration of the SAV model following consultation with community scientists. Extensive effort has been devoted to the existing SAV model. The potential benefits of recalibration and enhancements are uncertain. The revised model may be less complex than the existing model and employ empirical relationships which provide improved agreement with observed trends in SAV.

Deliverables: This task will produce an independent shallow-water processes module which will address water quality impacts from wetlands and shoreline erosion. The module will be incorporated into the eutrophication model and the LRR model.

6. 2017 Midpoint Assessment

All efforts described above lead to the 2017 reassessment of the 2010 TMDL's. The reassessment will commence in January 2016 at which time all model enhancements must be completed and available. The reassessment will be based on Phase 6 of the WSM. Initial indications from the CBP are that Phase 6 will be available at the end of calendar year 2014. The first step will be to incorporate the Phase 6 loads into the CBEMP. The CBP may wish to complete a new set of CH3D hydrodynamic simulations based on computed runoff from the Phase 6 WSM. In that case, the new runs must be completed in the first quarter of 2015 and both revised hydrodynamics and loads will be implemented in the eutrophication model. The state of

the model calibration will be assessed and adjustments will be made such that the revised model performs as well as, or better than, the existing CBEMP. Experience indicates these adjustments will be performed in iterative fashion as continuous revisions to the WSM become available.

The Commonwealth of Virginia is sponsoring an independent hydrodynamic and eutrophication model of the James River with an emphasis on prediction of chlorophyll concentration and the occurrence of harmful algal blooms. The Commonwealth and the CBP may wish to rely on results from the enhanced James River model in place of the James River as represented in the CBEMP. In that case, interface methodology and software must be developed. The formulation of the James River model and the extent and nature of its computational grid are presently undetermined. A potential interface arrangement would have the James River grid extend beyond the mouth of the river into Chesapeake Bay, or even to the mouth of the Bay. The CBEMP would provide boundary conditions to the James River model. Or the mass flux at the mouth of the river, determined by the independent model, could be imposed at the river mouth in the CBEMP. We will work with the James River model team to develop an interface procedure and exchange information necessary to complete the 2017 Midpoint Assessment.

Phase III Watershed Implementation Plans (WIP's) will be examined using the new CBEMP commencing in January 2016. Efficacy of these plans will be examined in the model during the remaining portion of the project. We anticipate executing ten management scenarios between January and June 2016. Additional scenarios may be run by the CBP or by ERDC following completion of this project. Feedback from the model to the planners will potentially result in revised WIP's and additional model examination. Final Phase III WIP's will be completed in January 2017.

Deliverables: This task will produce a complete Chesapeake Bay model suitable for use in the 2017 Midpoint Assessment. Results from this model will be as good as or better than the present model. The revised model will be employed in the completion of ten management scenarios.

7. Reporting, Meetings and Workshops

The budget includes travel costs for four trips per annum for one individual from ERDC to the Annapolis MD vicinity. Expenses include airfare, lodging and per diem (two to three days per trip), local transportation, and burdens. The primary purpose of the travel is attendance at the quarterly Modeling and Research Subcommittee (MARS) meetings. ERDC personnel customarily make presentations at these meetings and review and comment on presentations by other researchers. Travel is also anticipated to meetings and workshops sponsored by the Scientific and Technical Advisory Committee, Chesapeake Research Consortium, and other CBP-affiliated organizations.

As the project progresses it will be important to document the progression and the progress subjected to District Quality Control review. ERDC will provide quarterly, as part of their participation in the quarterly meetings of the CBP MARS, interim products and progress reports. Progress reports will incorporate all activities that have occurred and will project expected progress in the next reporting period. Progress reports may include presentation material as well as MARS meeting minutes.

Each quarter, the PDT will evaluate the progress of the study and determine if there are any needed adjustments to this PMP or the study plan. This will be conducted through conference

calls or in-person meetings, if feasible. CENAB staff will be responsible for documenting decisions or revising the PMP as needed

APPENDIX B

REVIEW PLAN

APPENDIX C

DETAILED TASK AND COST SUMMARY

Chesapeake Bay Shoreline Erosion Feasibility Study **October 2012**

Phase II: Chesapeake Bay Model Package Enhancements Detailed Cost Estimate

Appendix C for the PMP

Subaccount				Resource		Cost Calculations					
No.	Name	Task #	Description of Task	Name	Organization Code	Hourly Rate	Labor Hours	Labor Cost	Non-Labor Resource	Total Cost	Notes/ Explanations of Non-Labor Resources
22J	Hydrologic and Hydraulic Studies	1	Estimate shoreline erosion		ERDC	$165.78	40	$6,631		$6,631	Labor for Research Hydrologist
		1	Create model input decks		ERDC	$165.78	80	$13,262		$13,262	Labor for Research Hydrologist
		1	ERDC conducts water quality modeling		ERDC	$144.74	480	$69,473	$9,197	$78,670	Labor for Research Hydrologist and Mathmetician. Non-labor includes contract personnel, computer, supplies, burdens.
		1	Resuspension of POC, PON, POP. Requires modification of sediment diagenesis model.		ERDC	$149.83	240	$35,959		$35,959	Labor for Research Hydrologist and Mathmetician.
		1	Model validation and comparison to previous results		ERDC	$149.83	240	$35,959		$35,959	Labor for Research Hydrologist and Mathmetician.
		2	Examine menhaden with the 2010 model		ERDC	$141.28	320	$45,208		$45,208	Labor for Research Hydrologist
		2	Run menhaden under base and allocation conditions. Examine and inerpret results, prepare for use in 2017 reassessment		ERDC	$145.81	200	$29,162		$29,162	Labor for Research Hydrologist and Mathmetician.
		2	Update oyster reef location and biomass on 50,000-cell grid		ERDC	$163.87	160	$26,219		$26,219	Labor for Research Hydrologist and Mathmetician.
		2	Determine role of aquaculture and incorporate into model		ERDC	$163.87	160	$26,219		$26,219	Labor for Research Hydrologist and Mathmetician.
		3	Development of future climate-change scenario including sea level and temperature changes, marsh		ERDC	$174.17	40	$6,967		$6,967	Labor for Research Hydrologist
		3	Incorporate new flows, loads, hydrodynamics		ERDC	$146.71	240	$35,211	$31,381	$66,591	Labor for Research Hydrologist and Mathmetician. Non-labor includes contract personnel, computer, supplies, burdens.
		3	Evaluate impacts to living resources including SAV		ERDC	$174.17	80	$13,933		$13,933	Labor for Research Hydrologist
		3	Execute climate change scenarios		ERDC	$153.58	320	$49,144		$49,144	Labor for Research Hydrologist and Mathmetician.

4	Develop software links to CH3D, ICM, WSM		ERDC	$145.81	200	$29,162		$29,162	Labor for Research Hydrologist and Mathmetician.
4	Initial application		ERDC	$135.22	880	$118,992	$30,615	$149,608	Labor for Research Hydrologist and Mathmetician. Non-labor includes contract personnel, computer, supplies, burdens.
4	Model improvements including sediment resuspension, submerged aquatic vegetation, benthic algae		ERDC	$135.22	880	$118,992		$118,992	Labor for Research Hydrologist, Mathmetician, Hydraulic Engineer, and Computer Scientist.
4	Incorporate into the system-wide model		ERDC	$140.65	1120	$157,528		$157,528	Labor for Research Hydrologist, Mathmetician, Hydraulic Engineer, and Computer Scientist.
5	Compare shallow-water data with WQSTM through 2011		ERDC	$149.83	240	$35,959		$35,959	Labor for Research Hydrologist and Mathmetician.
5	Empirical or simplified models of wetland		ERDC	$169.92	80	$13,594		$13,594	Labor for Research Hydrologist
5	Additional shallow-water model improvements including revised SAV model, beach and shoreline processes, shoreline erosion, waves in small creeks		ERDC	$153.04	320	$48,974		$48,974	Labor for Research Hydrologist
5	Interface with LRR model, bay model		ERDC	$148.38	400	$59,353		$59,353	Labor for Research Hydrologist and Mathmetician.
6	Incorporate Phase 6 WSM loads, examine results, recalibrate eutrphication model as necessary		ERDC	$154.62	1160	$179,362	$25,987	$205,348	Labor for Research Hydrologist and Mathmetician. Non-labor includes contract personnel, computer, supplies, burdens.
6	Interface with James River chlorophyll model		ERDC	$157.41	160	$25,186		$25,186	Labor for Research Hydrologist and Mathmetician.
6	Evaluation of Phase III Watershed Implementation Plans. Up to 10 scenarios.		ERDC	$157.41	800	$125,932		$125,932	Labor for Research Hydrologist and Mathmetician.
7	Reporting, meetings and workshops.		ERDC	$174.20	120	$20,904	$47,939	$68,843	Labor for Research Hydrologist. Non-labor resources include travel expenses and associated burdens.
Subaccount Subtotal						**$1,327,287**	**$145,119**	**$1,472,405**	

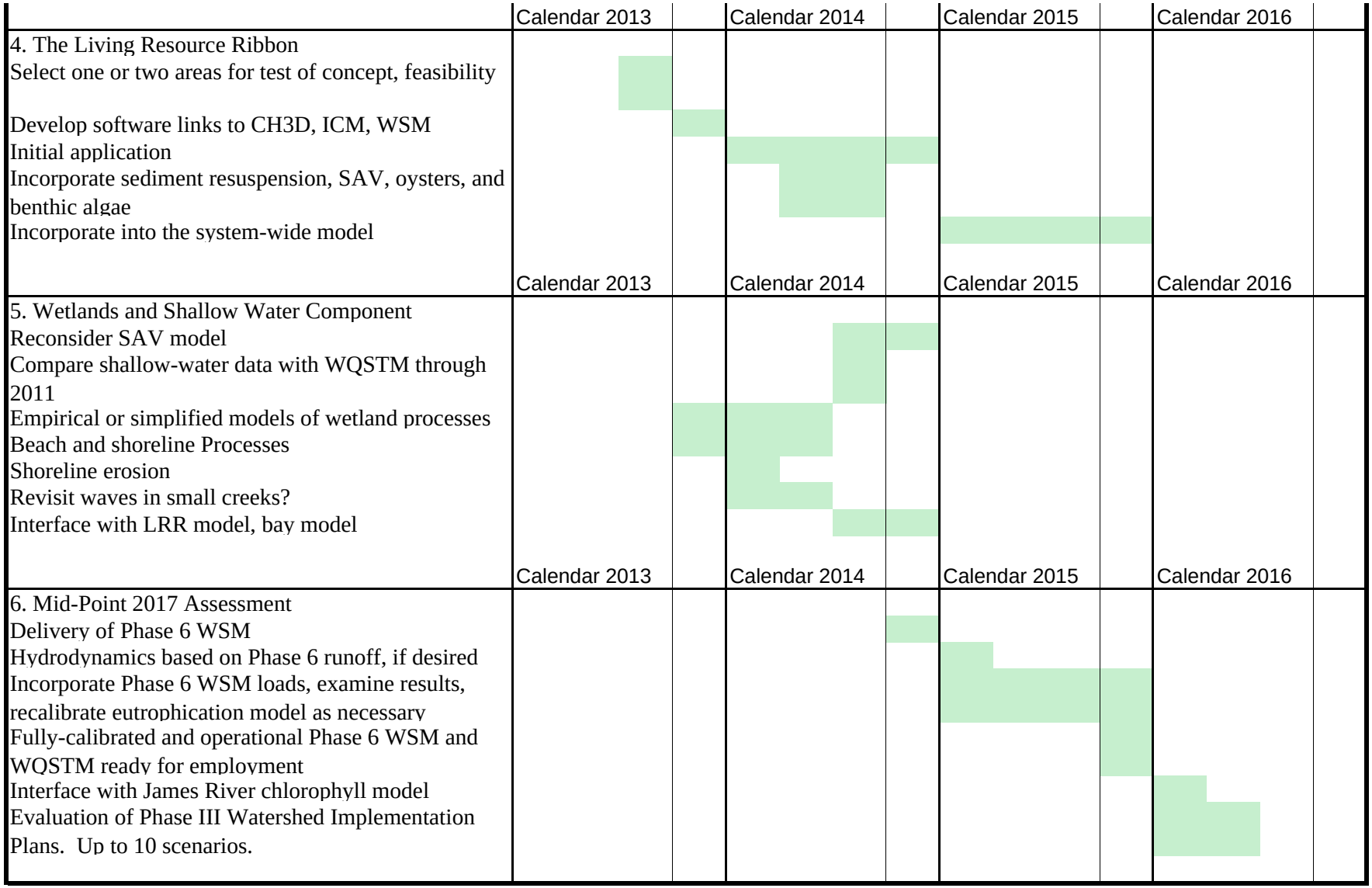
22Q Technical Management	7	Participate in SM-PM-Modeler meetings, as needed, to coordinate funding, schedule, and preparation for sponsor meetings		E1K0500	$130.00	36	$4,680		$4,680	
	7	Manage District Quality Control Reporting/review progress reports		E1K0500	$130.00	112	$14,560		$14,560	8 hrs/quarter plus initial template setup
	7	Technical management administration		E1K0500			$4,810		$4,810	
	Subaccount Subtotal						**$24,050**	**$0**	**$24,050**	
22T Programs and Project Management	7	Initial project set-up in P2 and CEFMS		E1H0400	$145.00	16	$2,320		$2,320	
	7	Participate in SM-PM-Modeler meetings to coordinate funding, schedule, and preparation for		E1H0400	$145.00	36	$5,220		$5,220	
	7	Initiate, lead, and assist in documentation of meetings with sponsor/PDT		E1H0400	$145.00	96	$13,920		$13,920	Quarterly
	7	Project reporting to USACE management -- P2		E1H0400	$145.00	36	$5,220		$5,220	
	7	Prepare/monitor/revise project schedule and funds		E1H0400	$145.00	36	$5,220		$5,220	
	7	Prepare budgetary materials		E1H0400	$145.00	48	$6,960		$6,960	
	7	Branch administration		E1H0400			$3,886		$3,886	
	7	Program support		E1H0400			$3,886		$3,886	
	Subaccount Subtotal						**$46,632**	**$0**	**$46,632**	1 day/month effort

Subtotal of Project Costs	**$1,543,087**
Project Contingency @5%	**$77,154**
Total Project Cost (Rounded)	**$1,620,000**
Sponsor Cash Contribution (50% Share)	**$810,000**
Federal Cash Contriabution (50% Share)	**$810,000**

APPENDIX D

SCHEDULE

	FY 2013 Calendar 2013	FY 2014 Calendar 2014	FY 2015 Calendar 2015	FY 2016 Calendar 2016
1. Extend Present Simulation through 2011 EPA completes hydrodynamics and watershed modeling Estimate shoreline erosion Create model input decks ERDC conducts water quality modeling Resuspension of POC, PON, POP. Requires modification of sediment diagenesis model. Model validation and comparison to previous results	Calendar 2013	Calendar 2014	Calendar 2015	Calendar 2016
2. Oysters and Menhaden Examine menhaden with the 2010 model Compare to previous calculations. Determine differences, if any, and their origins Run menhaden under base and allocation conditions. Examine and interpret results, prepare for use in 2017 reassessment Update oyster reef location and biomass on 50,000-cell grid Determine role of aquaculture and incorporate into model	Calendar 2013	Calendar 2014	Calendar 2015	Calendar 2016
3. Climate Change What is our future climate scenario? What conditions? Sea level change. How to handle? Temperature change. Flows and loads from watershed. New hydrodynamics based on projected flows and sea level Living resource impacts Submerged aquatic vegetation Climate change scenarios				


Calendar 2013
Calendar 2014
Calendar 2015
Calendar 2016
4. The Living Resource Ribbon
Select one or two areas for test of concept, feasibility
Develop software links to CH3D, ICM, WSM
Initial application
Incorporate sediment resuspension, SAV, oysters, and benthic algae
Incorporate into the system-wide model
Calendar 2013
Calendar 2014
Calendar 2015
Calendar 2016
5. Wetlands and Shallow Water Component
Reconsider SAV model
Compare shallow-water data with WQSTM through 2011
Empirical or simplified models of wetland processes
Beach and shoreline Processes
Shoreline erosion
Revisit waves in small creeks?
Interface with LRR model, bay model
Calendar 2013
Calendar 2014
Calendar 2015
Calendar 2016
6. Mid-Point 2017 Assessment
Delivery of Phase 6 WSM
Hydrodynamics based on Phase 6 runoff, if desired
Incorporate Phase 6 WSM loads, examine results, recalibrate eutrophication model as necessary
Fully-calibrated and operational Phase 6 WSM and WQSTM ready for employment
Interface with James River chlorophyll model
Evaluation of Phase III Watershed Implementation Plans. Up to 10 scenarios.

APPENDIX E

RISK REGISTER

Item	Date	Assessors	Action	Risk and its cause	Consequence	Consequence rating	Evidence for consequence rating	Likelihood rating
Id number	*Date of entry (record each date entry was modified)*	*Name(s) of person(s) assessing the task*	*Identify the action you propose to take (i.e., things you will do or not do) in order to accomplish the strategy and develop the information identified in the decision management plan. Be as specific as possible in your description.*	*Briefly identify the risk associated with the action you are taking, i.e., considering the entry in column D, what can go wrong and how can it happen?*	*Describe the consequence of the column E risk. If things do "go wrong" in the way described what is the specific consequence for: i) the study, ii) implementing the project or iii) project outcomes? (List the most significant*	*If the most significant consequence in column F occurs what is its potential magnitude?*	*Enter <u>specific</u> evidence used to support the consequence rating in column G.*	*What is the likelihood that the most significant consequence in column F will occur?*
PM-1	11-Oct-12	Roach	Communication in project executition between USACE, MDDNR, and EPA.	Loss of quality in product through miscommunication and difference in expectations.	The consequence of loss of product quality will be schedule slippage, leading to re-worked tasks, and increased costs.	Medium	Schedule slippage is likely to be small with small cost-increases due to checks on product quality throughout study.	Low
PM-2	11-Oct-12	Roach	Project will be executed according to schedule and completed within the scheduled timeframe.	Schedule slippage due to lack of Federal or sponsor funding and changes in scope.	The consequence of schedule slippage could be fewer study products completed, a loss of quality in study products, and the study products not being used in a timely manner.	High	With schedule slippage, the use of the products will be delayed, affecting the State of Maryland's implementation schedule for Bay TMDLs. Loss of quality and fewer products will affect the ability to adequately model shallow water processes, potentially affecting TMDL implementation.	Medium
PM-3	11-Oct-12	Roach	Project executed within the agreed-upon cost.	Risk is that there will be cost-growth through schedule slippage, scope changes, or additional requirements.	Consequence of cost-growth will be the need for requesting additional funds, or if cost change is large, change in study authorization.	High	Requests for additional funding could lead to schedule slippage, leading to issues described in PM-2.	Low

Evidence for likelihood rating	Confidence rating	Risk Rating	Risk Management Options	Recommendation	Study Tasks Affected	Outcome	Notes
Enter specific evidence used to support the likelihood rating in column I.	*Of the consequence and likelihood ratings choose the one you have the least confidence in and rate your level of confidence in that rating.*	*Qualitative risk rating from lookup table.*	*Enter alternatives to the action you proposed in column D. Be specific. If you can identify the cost or schedule impacts of implementing these instead actions of the chosen action, please do so to help inform PMP options.*	*Identify the preferred course of action for managing the risk you have identified. Tolerate the risk associated with the action in column D is the default option. You may recommend soemthing other than the column D entry.*	*For study risks identify any other technical disciplines or study tasks that could be affected by the outcome of the risk identified for this entry.*	*Describe the effect of your recommended course of action on the study or project outcomes. (This column can only be used once the outcomes are known.)*	*Make note of any significant information not provided in the other cells.*
USACE, MDDNR, and EPA have demonstrated consistent syncronicity in communications over many projects including previous iterations of this study.	High	Low	Alter communication strategy is communication errors occur. This could be through more scheduled meetings, more frequent product quality cheks, or changes to study elements.	PDT will tolerate the risk.	Any study task could be affected by communication errors.		
Past Federal funding cycles have caused delays in project execution and project starts.	High	High	To help alleviate funding cycle uncertainties, the ability to use accelerated funding is being requested through a modified FCSA, which has been sent to HQUSACE for approval. Changes in scope will be managed through close communication between study partners.	Approval for use of accelerated funding.	All study tasks could be affected by schedule slippage.		
Study cost estimate has been prepared by investigators with great experience and a contingency is built in for unexpected cost-increases.		Medium	A contingency factor has been applied to the study cost estimate. The cost estimate is well-within the authorized study cost limits.	PDT will tolerate the risk.	All study tasks could be affected by cost growth.		