Lower Susquehanna River Watershed Assessment

DRAFT

PROJECT MANAGEMENT PLAN

U.S. Army Corps of Engineers
Baltimore District
June 2011

Lower Susquehanna River Watershed Assessment
Executive Summary

The U.S. Army Corps of Engineers, Baltimore District (USACE), and the Maryland Department of the Environment (MDE) have partnered to conduct the Lower Susquehanna River Watershed Assessment – Phase I. The Phase I assessment will comprehensively forecast and evaluate sediment loads to the system of four hydroelectric dams located on the Susquehanna River, analyze hydrodynamic and sedimentation processes and interactions within the Lower Susquehanna River watershed, consider structural and non-structural strategies for sediment management, and assess cumulative impacts of future conditions and sediment management strategies on the Upper Chesapeake Bay. Assuming adequate annual appropriations, Phase I will cost $1.4M, cost-shared 75% Federal/25% non-Federal, over 3 years. Phase I will conclude with a Watershed Assessment Report to better inform all stakeholders undertaking watershed planning efforts related to nutrient, sediment and habitat restoration goals (page ES-2). Phase II, to be scoped at a later date subject to sponsorship and funding, would utilize the Phase I Watershed Assessment Report to develop a Lower Susquehanna River Watershed Plan.

Critical components of the Phase I Watershed Assessment include:

- Identification of watershed-wide sediment management strategies,

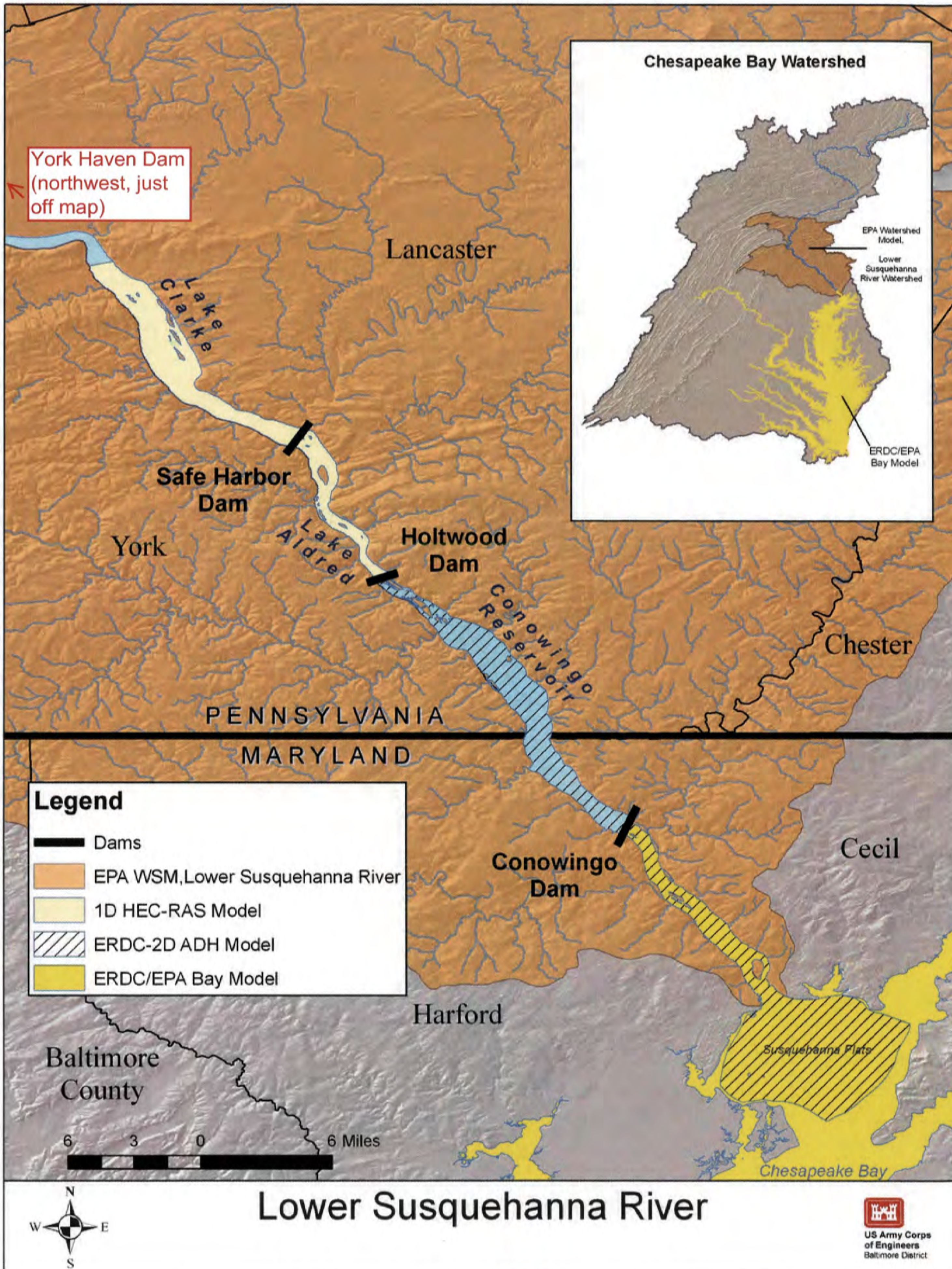
- Use of engineering models to link incoming sediment and associated nutrient projections to in-reservoir processes at the hydroelectric dams and forecast impacts to living resources in the Upper Chesapeake Bay,

- Use of the U.S. Environmental Protection Agency's Chesapeake Bay Program water quality model to assess cumulative impacts of the various sediment management strategies to the Upper Chesapeake Bay, and

- Integration of the Maryland and Pennsylvania Watershed Implementation Plans for nitrogen, phosphorus and sediment reduction, as required to meet the Chesapeake Bay Total Maximum Daily Loads.

Federal agencies share a renewed commitment to restore the Chesapeake Bay embodied in President Obama's Executive Order 13508, Chesapeake Bay Protection and Restoration (May 2009). This Executive Order established the Federal Leadership Committee, through which the Fiscal Year 2011 Federal Action Strategy was endorsed. This document specifically assigns USACE the "lead" role to "advance studies to evaluate the management of sediments" [in the Lower Susquehanna River Watershed, page ES-3].

USACE and MDE, through collaboration with the Maryland Department of Natural Resources, Maryland Geological Survey, Commonwealth of Pennsylvania, U.S. Environmental Protection Agency, U.S. Geological Survey, Susquehanna River Basin Commission, The Nature Conservancy, and others seek to integrate water resources management in the Lower Susquehanna River Basin to ensure sustainable restoration of the Chesapeake Bay, the largest estuary in the United States.



York Haven Dam (northwest, just off map)
Lancaster
Lake Clarke
Safe Harbor Dam
York
Lake Aldred
Holtwood Dam
Conowingo Reservoir
Chester
PENNSYLVANIA
MARYLAND
Conowingo Dam
Cecil
Harford
Baltimore County
Susquehanna Flats
Chesapeake Bay
Chesapeake Bay Watershed
EPA Watershed Model, Lower Susquehanna River Watershed
ERDC/EPA Bay Model
Legend
Dams
EPA WSM,Lower Susquehanna River
1D HEC-RAS Model
ERDC-2D ADH Model
ERDC/EPA Bay Model
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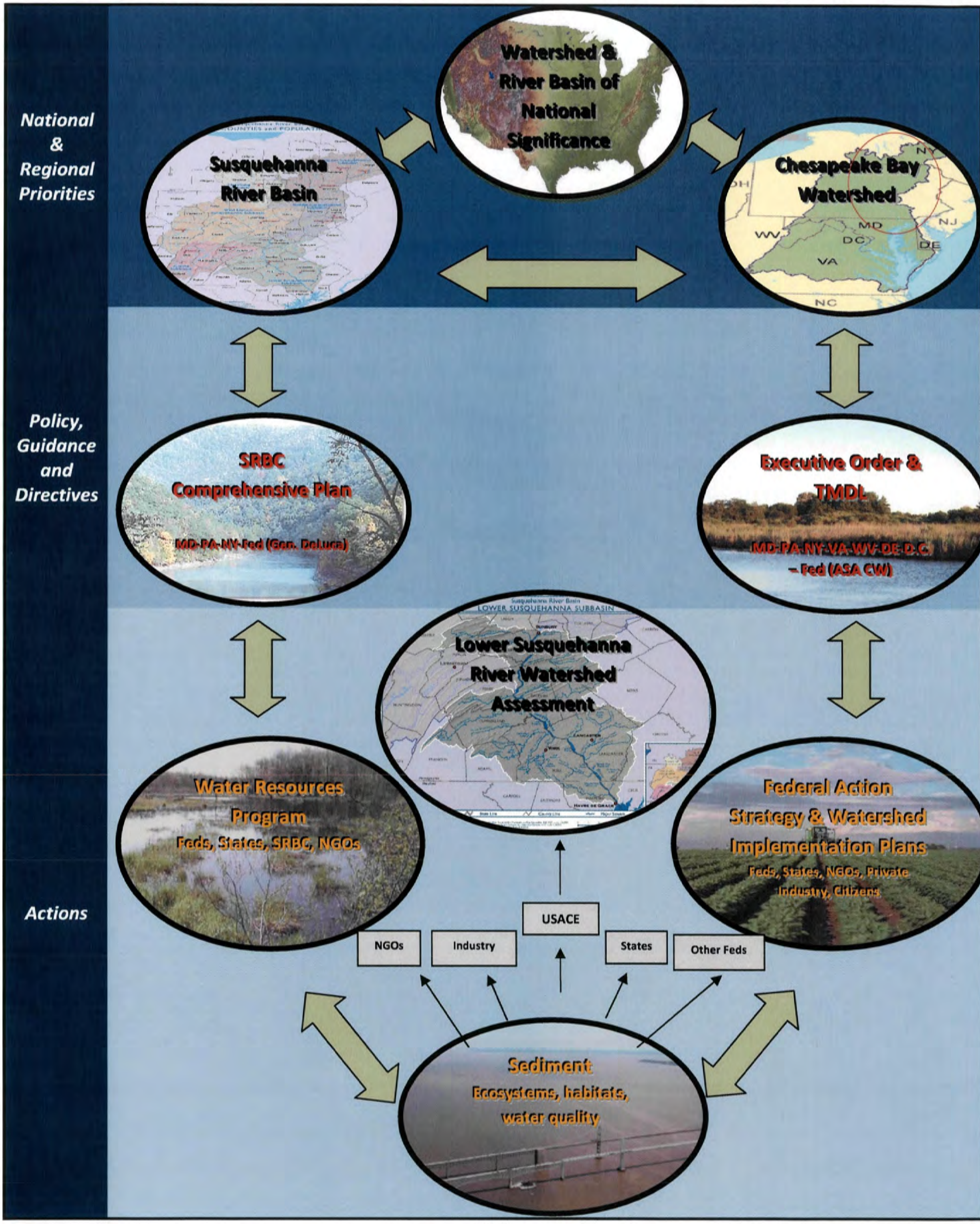
Lower Susquehanna River
US Army Corps of Engineers
Baltimore District

WATERSHED CONTEXT FOR CHESAPEAKE BAY & USACE ACTIONS



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.

Study/Project Manager — Date: April 14, 2011

Environmental Team Member — Date: April 14, 2011

Operations Team Member — Date: April 15, 2011

Engineering Team Member — Date: April 14, 2011

The undersigned concur in 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 Development Branch, Planning Division — Date: April 14, 2011

Chief, Civil Works Branch, Engineering Division — Date: April 14, 2011

Chief, Civil Program and Project Management Division — Date: April 14, 2011

PROJECT MANAGEMENT PLAN CONCURRENCE

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

21 June 2011

David E. Anderson
Colonel, Corps of Engineers
District Engineer

Date

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.

6/20/11

Non-Fed Sponsor Project Manager Date

The undersigned concur in 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.

6/20/11

Non-Fed Sponsor, Secretary or State Director Date

REVISIONS TO PMP

Section 15, Change Management, discusses how and when this PMP will be revised.

Revision Number	Revision Date	Section	Description of Revision

Lower Susquehanna River Watershed Assessment

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PROJECT MANAGEMENT PLAN

June 2011

1.0 INTRODUCTION

This project management plan addresses the efforts and resources needed to conduct an assessment to address the sediment movement in the Lower Susquehanna River, the build-up of these sediments behind a series of dams across the river, and the implications of these sediments and associated nutrients to the Chesapeake Bay Watershed. The Assessment will be led by the Baltimore District, U.S. Army Corps of Engineers (USACE) (federal sponsor) and the Maryland Department of the Environment (MDE) (non-federal sponsor). The MDE will provide their 25% cost-share as in-kind services. In addition both U.S. Geological Survey (USGS), and the USACE Engineering Research and Development Center (ERDC) will be funded through federal funds to participate in major technical portions of the study. The Assessment is expected to include coordination with other key agencies including (but not limited to), the Susquehanna River Basin Commission (SRBC), The Nature Conservancy (TNC), Pennsylvania Department of Environmental Protection (PADEP), Pennsylvania Department of Conservation and Natural Resources; Pennsylvania Fish and Boat Commission; U.S. Environmental Protection Agency (EPA), Exelon, the Lower Susquehanna Riverkeeper, the National Oceanic and Atmospheric Administration (NOAA), the University of Maryland Center for Environmental Science (UMCES), and the U.S. Fish and Wildlife Service (USFWS).

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 main body of the PMP summarizes the scope, schedule, budget, and responsibilities for the actions to be accomplished for the Assessment. Attached to this main PMP are several appendices which present a detailed scope narrative, the review plan, a detailed task and cost summary, in-kind services documentation, and an initial project schedule.

The PMP is a management tool to help USACE and MDE manage and accomplish project activities. It provides summary information to USACE and project sponsor 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 Assessment 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 Assessment. The PMP must be approved by MDE and USACE prior to implementation. These approvals are noted by the signatories at the front of this document.

2.0 PROJECT AUTHORIZATION

The Lower Susquehanna River Watershed Assessment is being conducted under several project authorities. They are as follows:

The U.S. Senate Committee on Environment and Public Works dated 23 May 2001 – Chesapeake Bay Shoreline Erosion. 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."

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."

USACE received appropriations from the 2009 Omnibus Appropriations Act (House Appropriations Committee Print, H.R. Public Law 111-8) to sign a Feasibility Cost-Sharing Agreement (FCSA) with a non-federal sponsor to "examine management measures that could be undertaken to address the sediments behind the dams on the Lower Susquehanna River."

As a watershed assessment, this effort will be conducted under Section 729 of the Water Resources Development Act (WRDA) of 1986, as amended. Guidance (EC 1105-2-411) has been provided in USACE memoranda dated 29 May 2001, 7 March 2008 and 15 January 2012 for watershed planning under "Section 729 of the Water Resourced Development Act (WRDA) of 1986, as amended, and other specifically authorized watershed planning authorities."

3.0 PROJECT BACKGROUND

The Susquehanna River basin is the largest watershed draining to the Chesapeake Bay and contains nearly 30,000 miles of streams, or 60,000 miles of streambanks when one considers both sides of the stream. Consequently, the Susquehanna River is the single largest source of freshwater, 60%, to the Chesapeake Bay. The Susquehanna River basin has a 27,510 square mile drainage area. It originates in Cooperstown, New York, flows through New York and Pennsylvania, and eventually empties into the Chesapeake Bay at Havre de Grace, Maryland. There are four hydroelectric dams on the Lower Susquehanna River below Harrisburg, Pennsylvania creating a reservoir system. Located from north to south, the dams are York Haven, Safe Harbor, Holtwood, and Conowingo, respectively (Figure 1).

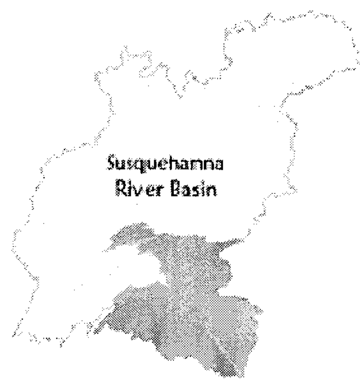

Figure 1. Lower Susquehanna River Watershed Assessment Study Area

General information pertaining to each dam is summarized in Table 1.

Table 1: Information on the Hydroelectric Dams

Dam	Reservoir	Construction Date	Dam Height (ft)	Design Capacity (water, acre-feet)
York Haven, PA*	NA	1904	16	10,000
Safe Harbor, PA	Lake Clarke	1931	75	143,000
Holtwood, PA	Lake Aldred	1910	55	57,000
Conowingo, MD	Conowingo Reservoir	1928	100	330,000

*York Haven Dam does not fully cross the river, is significantly smaller than the other three dams, and does not trap sediment to a significant degree. Therefore, the three remaining dams are considered herein.

Sediments and associated nutrients from the land, floodplain, and streams have been transported and delivered to the area behind the dams over past century. Earlier studies released in 1995 by the USGS and SRBC indicates that the dams have historically acted as a sediment (and associated nutrient) trap, thus reducing the amount of sediments and nutrients reaching the Bay. As the dams reach a steady state, or equilibrium (i.e., when they reach their maximum sediment storage capacity), they no longer influence the ultimate fate of sediments and associated nutrients transported by the Susquehanna.

3.1 Impacts on Chesapeake Bay of Dams Reaching Steady State

The net effect of the reservoir system reaching a steady state is increased loads of sediments and nutrients to the Bay equal to the amount currently being trapped. In 2001 the Scientific, Technical, Advisory Committee (STAC) conducted a workshop on this topic and concluded that if steady state occurred there would be 100% to 250% increase in sediment load; 20% to 70% increase in phosphorus load and a 2%-3% increase in nitrogen load.

Excessive sediments that are carried past the dams to the Chesapeake Bay can limit water clarity, contribute nutrients to the ecosystem resulting in eutrophication, and create problems for recreation and navigation. In addition, sediments contributed from the Susquehanna River to the Bay become part of the continual cycle of and impact from resuspension. Excess sediments from the rivers are not entirely harmful to the Bay if they do not have nutrients or toxins attached to them. Clean sediments and natural processes routinely create and maintain valuable shallow water habitats and tidal wetlands.

The Chesapeake Bay is impacted both physically and biologically by the delivered sediment load from the basin. These impacts are exacerbated during catastrophic and episodic events (such as the 1972 Agnes Flood), which scour additional sediment from behind the dams on the lower Susquehanna River and result in a combined delivered load which shocks the Bay ecosystem.

Flooding occurs on a fairly regular basis in the Susquehanna River; episodic and catastrophic events are hard to predict but occur infrequently (Table 2). There is evidence from USGS and others that river flows in the range of 380,000 to 600,000 cfs (cubic feet per second) create sediment-scouring conditions in the river channels and in the reservoirs. Flows in excess of 600,000 cfs are those that create extensive flooding and environmental damage.

Table 2: Flooding occurrence in the Susquehanna River and Scour Implications

Flow rate (cfs)	Classification	Occurrence (1917-1996)	Implications
250,000	Frequent event flow	99.5%	Unlikely to create any environmental damage.
380,000-600,000	Episodic event	.1%	Sediment scouring conditions
>600,000	Catastrophic	.02%	Extensive flooding and environmental damage

3.2 Expected Time remaining until Storage Capacity is Met

Estimating the time remaining until the reservoir system reaches sediment-storage capacity is difficult because the amount of sediment transported and deposited in the reservoirs depends on such factors as sediment transport and delivery, sediment deposition and reservoir trapping efficiencies, and storm scour threshold. Transport and delivery can be altered by changing land use and management practices and by climatic factors such as amounts of rainfall.

As of 2008 the total amount of sediment trapped by the dams was estimated by USGS to be 280 million tons. Of the three lower dams, two (Holtwood and Safe Harbor) are considered to be effectively at steady state (essentially no remaining sediment and nutrient trapping capacity) and Conowingo is anticipated to reach that status between 2023 and 2028 (15-20 years). Based on current trends (2000-2008) USGS found that the Conowingo is currently trapping approximately 55% of sediment loads (3.1 million tons in, 1.2 million tons out) while trapping 2% of the nitrogen load and 40% of the phosphorus load.

USGS predicts that if there is a decrease in sediment transport into the system in the future (3.1 to 2.5 million tons) 5 years could be added; if statistically expected scour removal (from storms) is included another 5 years could be added, which would mean steady state for Conowingo would be met between 2033-2038 (25-30 years).

3.3 TMDL Development Implications to Study

The issue of sediment build-up behind the dams on the lower Susquehanna River, and more specifically the loss of sediment storage capacity behind those dams, is now drawing considerable attention. There is heightened concern about the issue because of the implications it raises with respect to nutrient and sediment loads to the Chesapeake Bay and management of those loads; more specifically implications to the current development of the Chesapeake Bay Total Maximum Daily Load (TMDL) by the EPA in conjunction with surrounding Bay states.

A TMDL is an estimate of the maximum amount of an impairing substance or stressor (pollutant) that a waterbody can assimilate without violating water quality standards. In developing the Chesapeake Bay TMDL the EPA accounts for the impacts on loadings to the Bay and how to appropriately assign load allocations to each Bay state. EPA has determined that a large influencing factor in sediment and nutrient loads to the Bay is when the dams on the lower Susquehanna no longer function to trap sediment and phosphorus. EPA's intention is to assume the current dam trapping capacity will continue through the TMDL implementation horizon (through 2025). However if future monitoring shows the trapping capacity of the dam is reduced, then EPA will consider adjusting the Pennsylvania, Maryland and New York sediment and nutrient load allocations based on the new delivered loads to determine if the states are meeting their target load obligations (EPA, 2010). It is imperative to the states to determine how to keep the dams on lower Susquehanna acting as sediment and associated nutrient traps to meet the Bay TMDL and protect the aquatic resources of the Chesapeake Bay.

4.0 STUDY PURPOSE AND GOALS

The purpose of the Lower Susquehanna River Watershed Assessment (LSRWA) is to evaluate, identify, and prioritize strategies that reduce sediments and associated nutrients delivered from the Lower Susquehanna River to the Chesapeake Bay.

The goals of the LSRWA are as follows:

1. Evaluate strategies that will maintain or decrease sediment and associated nutrient delivery to the Upper Chesapeake Bay. These strategies will incorporate input from Maryland and Pennsylvania Total Maximum Daily Load Watershed Implementation Plans and evaluations of processes and storage capacity at four hydroelectric dams on the Lower Susquehanna River.

2. Prioritize strategies that will reduce the volume of sediment and associated nutrients available for transport during high flow storm events, and that will reduce adverse impacts to the Upper Chesapeake Bay.

3. Determine the impacts of the loss of sediment and nutrient storage capacity behind the Conowingo Dam to the Chesapeake Bay.

The Watershed Assessment will serve as a useful and important tool to assess sediment management and reduction strategies in the watershed, the loss of sediment storage capacity from the system of dams on the Lower Susquehanna River and the resultant impacts to the Upper Chesapeake Bay. Structural and non-structural strategies to reduce the impact, or potential impact, of sediments and associated nutrients will be analyzed. The Watershed Assessment will include integrated modeling activities, data gathering, and development of broad, planning-level strategies and anticipated impacts/benefits to the Upper Chesapeake Bay. The strategies will not result in a USACE recommended plan but will provide information to be further evaluated by a variety of stakeholders in the future.

5.0 PROJECT SCOPE

A detailed scope narrative describing the tasks intended to be accomplished for the Assessment can be found in Appendix A.

5.1 Technical Tasks

Major technical tasks to be accomplished for the Assessment include:

- Assembling the interagency study team;
- Conducting a model comparison study (see section 5.2) to determine if a two dimensional (2D) hydrodynamic and sediment transport model is appropriate to adequately simulate long term sedimentation and hydrologic processes in Conowingo Reservoir or if a three dimensional (3D) model will be necessary;
- Conducting field sampling (core samples) and a SEDflume analysis of bed sediments in the Conowingo Reservoir to characterize the erosion characteristics (erosion rate and critical shear stress) of fine sediment deposits;
- Conducting field sampling and lab analysis of solids size classes in the Conowingo outflow at baseflow and stormflow with following size classes (clay ($< 2\mu$), very fine silt, fine silt, medium silt, coarse silt, sand);
- Conducting field sampling and lab analysis of nutrients, water quality, and sediments at Conowingo Dam River Input station;
- Conducting bathymetry surveys of Susquehanna flats;
- Constructing a 1D HECRAS model to compute sediment loads (from the watershed) entering the upper two reservoirs (Lake Clark and Aldred) and to assess erosion and depositional characteristics of sediment in the upper two reservoirs;
- Constructing a 2D or 3D model (TBD with model comparison study) to analyze and assess erosion and depositional characteristics of sediments in the Conowingo Reservoir;

- Quantifying sediment transport potential by grain size to the Bay from the reservoir system, including both watershed suspended sediment loads as well as re-suspended sediments in the reservoirs due to large storm events;

- Utilizing a 2D or 3D model to evaluate existing conditions, storm scouring conditions, and sediment management measure impacts by computing change to sediment storage capacity in the reservoirs; change in deposition or erosion in the system, change in bed layer composition by particle size, suspended sediment concentration, bed sediment transport rate, bed shear stress, flow velocity with direction, cumulative mass flux of sediment across reservoir boundaries, channel morphology change below Conowingo Dam to the Susquehanna Flats area; and total sediment load passing through Conowingo dam by grain size with associated phosphorous load and passing it to the Bay;

- Utilizing the Chesapeake Bay Environmental Model package (CBEMP) to examine the effect of existing conditions, storm scouring conditions and various strategies on nutrients and solids loads projected to flow from Conowingo reservoir and the impacts to Bay water quality and living resources (light attenuation, SAV, chlorophyll, nutrients, and dissolved oxygen);

- Reviewing and summarizing reservoir sedimentation throughout the nation and world and incorporating into this assessment

- Conducting a dredging placement site assessment;

- Developing a concept schematic for a dredging plan;

- Developing planning level schematics for selected structural strategies (dredging, by-passing, re-use, etc.);

- Developing planning level costs for selected structural strategies (dredging, by-passing, re-use, etc.);

- Conducting agency coordination meetings including the Sediment Task force to receive input on strategies and recommendations;

- Documenting the modeling analyses;

- Development and prioritization of strategies to manage sediments;

- Transferring knowledge to stakeholders, other interested parties, and USACE districts and divisions; and

- Reviewing all documentation and models to ensure quality.

5.2 Modeling Tools

Four models are necessary to examine the lower Susquehanna River watershed, the reservoir system. These are:

1) EPA Bay Program's Watershed Model (WSM) which provides loads from the watershed at key locations in the reservoir system including the Conowingo outflow;
2) Corps/EPA Chesapeake Bay Environmental Model Package (CBEMP) which computes water quality and living resources in the bay system;
3) The Corps Adaptive Hydrodynamics Model (ADH) which computes detailed sediment transport in the reservoir system;
4) USGS 1D HEC-RAS model to account for watershed sources of sediment) (will be operated in combination with the ADH model. See Figure 2 for designated areas where models will be utilized.

Towards the end of the scoping process for this study, the issue of the fate of the sediments in the Conowingo reservoir was raised and if sediments are significantly influenced by 3D effects that the 2D ADH model may not sufficiently capture. During the scoping of this study there was a 3D model in development at ERDC WES (RMA-10) that would be available in 2011. The trade-off to a 3D model is they cannot run long-term (two decade plus) simulation periods. The decision was made to add an additional task to this scope to conduct a model comparison study evaluating if the 2D ADH model can adequately simulate long term sedimentation processes in Conowingo Reservoir. If the 2D model adequately simulates sedimentation processes then the 3D model will *not* need to be utilized. The assumption at this time is that the 2D ADH model will be sufficient (see Appendix A for full discussion).

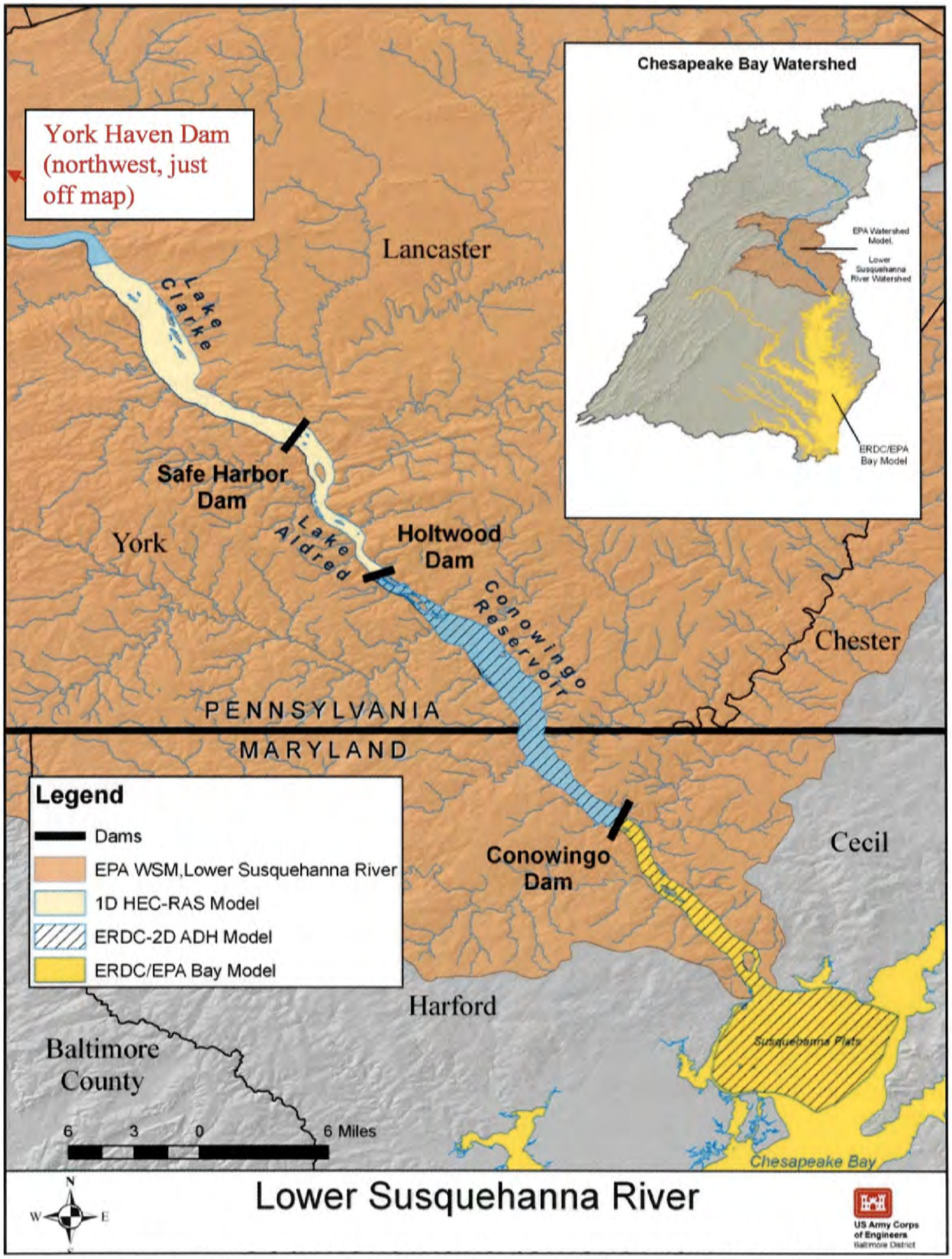

Figure 2. Lower Susquehanna River Watershed Assessment Modeling Tools

5.3 Modeling Scenarios

During the scoping process an initial screening process was done to determine what modeling scenarios would be undertaken in this effort.

Modeling scenarios involve simulating a change to the lower Susquehanna River watershed or reservoir system including management strategies or storm events. Management Strategies broadly divide into those that could reduce incoming sediment and associated nutrient loads (upland and riverine management measures) and those that would manage sediment and associated nutrient loads already in the reservoir (in-reservoir measures).

The assumption for this study is that upland (watershed) and riverine (instream) management measures in the lower Susquehanna watershed will be developed entirely independent of this study effort as part of the ongoing Bay TMDL efforts and Watershed Implementation Plans (WIP) development. Nutrient and sediment loads to the Conowingo Reservoir may vary depending on what management measures (as laid out in the Lower Susquehanna WIP) are implemented and ultimately whether the TMDL is achieved in this watershed (as discussed in section 3.3). Accordingly, watershed inputs as anticipated from full implementation (or not) of the WIP will be included in the modeling scenarios since it will likely have a bearing on strategies developed in this Assessment.

Strategies that would manage sediment and associated nutrient loads already in the reservoir (in-reservoir measures) at this time include dredging (the physical removal of the sediments and associated nutrients from the system entirely) sediment by-passing (transporting sediment from the reservoir to another part of the Bay system) and modifying or altering the operations of the Conowingo dam. These measures would reduce the risk of the scouring of sediment already stored behind the dams and increase amount of time that Conowingo Dam would trap sediments keeping them out of the mainstem of the Bay.

Selected modeling scenarios may require all four models or a subset of the four. One model run may be used in one or more scenarios. Scenarios could either be undertaken individually or in combination (e.g. TMDL achieved in watershed along with sediment by-passing).

The modeling scenarios selected to be undertaken for this study (but not limited to) are shown in Table 3. Once the study is underway further screening will occur to refine scenarios to be modeled; what combinations of scenarios; and to what level of detail.

Table 3: Preliminary Modeling Scenarios for Flooding occurrence in the Susquehanna River and Scour Implications

Scenario	Description	WSM	ADH	CBEMP
1-What is the Base Condition? (No Action)	Examine WQ under existing conditions. Examine a ten-year period, 1991-2000, which spans the EPA's critical year set of 1993-1995. Recommendation is to use the post-processing package employed by EPA to examine management schemes.	Run already made; no new run.	Determine sediment accumulation rate under existing conditions. Use sediment loads to the reservoir system computed by WSM	Run already made; no new run
2- Watershed management	Examine Bay WQ after the EPA's TMDL's are implemented. This scenario and all subsequent scenarios will be executed for the same ten year period as scenario one.	Run already made; no new run.	Make a run to determine sediment accumulation rate with sediment loads based on TMDL's. Use sediment loads to the reservoir system as computed by the WSM.	Run already made; no new run.
3-What happens when the Reservoir Fills?	Examines the impact on the bay when Conowingo Reservoir fills. For this scenario, assume that TMDL's are implemented and no scouring of the reservoir (a run could be made using existing loads). Examine the impact of filling on loads to the bay (are TMDL's still being met) as well as WQ.	Complete a run with no settling in the reservoir system.	No run necessary	Complete a run with no settling in the reservoir system.
4- Effect of Scouring during Winter/Spring Runoff	Examines conditions based on a full reservoir with scouring of the bottom. In this case, the ability of the reservoir to store solids is removed and additional loads come from scouring. The highest flow in recent years occurred in January 1996. We can make use this event as it occurred or move the event to another period by piecing together hydrodynamic files.	Use the run with no settling from Scenario 3.	Compute sediment scour during the 1996 event. Possible to run for a longer period examining additional scouring events or successive periods of scouring and filling.	Complete a run with WSM loads supplemented with sediment and nutrient loads derived from scouring as computed by ADH.

Table 3: Preliminary Modeling Scenarios for Flooding occurrence in the Susquehanna River and Scour Implications

Scenario	Description	WSM	ADH	CBEMP
5-Effect of Scouring from a Tropical Storm	Similar to scenario 4. The difference is in the timing of the flow event. In this case, the event will occur in June or July when SAV is thriving and water quality is critical. No late-summer scouring event occurred during 1991-1999. We will substitute the winter 1996 event into the record or else substitute a major flood event that occurred in September 2004. The advantage of using the 2004 event is that WSM loads will match the late summer period in which the event occurred. The 1996 loads are more appropriate for January.	Use the run with no settling from Scenario 2. Substitute loads from the September 2004 flood event if this event is selected.	Compute sediment scour during the 2004 event, if this event is selected. May want to run for a longer period to examine additional scouring events or successive periods of scouring and filling.	Complete a run with WSM loads supplemented with sediment and nutrient loads derived from scouring as computed by ADH.
6 - Reservoir Bypass	Examine effects of a system constructed to bypass sediment from Conowingo Reservoir to below the dam. Multiple scenarios are necessary; 8-10 will cover a reasonable range of options. Alternatives to be examined can include: • Intake location – At what location and depth will the bypass intake be located? • Placement location – Where will the bypass outfall be located? • Seasonality of placement – When will the bypass operate? Operation affects both the withdrawal rate of solids and the downstream impact on living resources. • Rate of withdrawal and discharge – At what rate (volume, load) will the bypass withdraw and discharge? • Sediment Characteristics – What types of sediments (grain size) will be bypassed?	Will provide boundary conditions at the upstream end of the reservoir system. The necessary WSM runs are completed or will be completed (e.g. sediment loads with the TMDL's in place).	Compute impact on the reservoir morphology of the proposed bypass. Route bypassed material downstream of the dam and compute fate of bypassed material and changes to flats.	Examine the environmental effects of fine material and nutrients resuspended during the bypass operations. CBEMP may not be required for all scenarios. ADH alone may be used to narrow the range of options and then the CBEMP can be employed on a subset of the scenario set.

Table 3: Preliminary Modeling Scenarios for Flooding occurrence in the Susquehanna River and Scour Implications

Scenario	Description	WSM	ADH	CBEMP
Scenario 7- Strategic Dredging	Examine effects of dredging varying amounts of material from behind the Conowingo dam (or possibly the other Lake Clark and Lake Aldred)	Will provide boundary conditions at the upstream end of the reservoir system. The necessary WSM runs are completed or will be completed (e.g. sediment loads with the TMDL's in place).	New bathymetry to be input and run through the ADH model. Compute impact on the reservoir morphology of the proposed dredging.	Examine the environmental effects of fine material and nutrients resuspended during dredging operations CBEMP may not be required for all scenarios. ADH alone may be used to narrow the range of options and then the CBEMP can be employed on a subset of the scenario set.
Scenario -8- Modifying Dam operations	Examine the effects of altering the flow and/or the way the Conowingo is currently operated.			

6.0 TEAM IDENTIFICATION

This collaborative study effort includes participants from several local, state, Federal and non-governmental organizations. The Corps and the non-Federal Sponsor, MDE will lead the study effort. They will be supported by the Interagency Study Team and other stakeholders. Key study participants are listed in Table 4.

Table 4 Interagency Study Team Membership

Name	Role	Affiliation/Office Symbol
Non-Federal Team members		
Bruce Michael	Director	DNR
Shawn Seaman	Project Manager	DNR
Herb Sachs	Special Projects Coordinator	MDE
Matt Rowe	Project Manager	MDE
Tim Fox	Project Manager	MDE
Jeff Halka	Director	MGS
John Balay	Project Manager, Hydrologist	SRBC
Julie Zimmerman	Project Manager	TNC
Mark Bryer	Project Manager	TNC
Federal Team Members		
Anna Compton	Biologist, Study/Project Manager	USACE, CENAB-PL-P
Bob Blama	Biologist, Operations	USACE, CENAB-Ops
Carey Nagoda	Hydrologic and Hydraulic Engineer, Engineering Coordinator	USACE, CENAB-EN-WW
Chris Spaur	Biologist, Environmental Studies	USACE, CENAB-PL-P
Regina Bergner	Environmental Policy Advisor	USACE, CENAB-PL-P
Dan Bierly	Plan Formulation and Policy Advisor	USACE, CENAB-PL-P
Carl Cerco	Research Hydrologist	USACE, ERDC
Steve Scott	Research Hydraulic Engineer	USACE, ERDC
Mike Langland	Hydrologist	USGS

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 study. USACE's Ecosystem Planning Center of Expertise (ECO-PCX) has been notified about this Assessment and coordination will continue, as appropriate, for ATR activities. A review plan detailing the Review requirements for the Assessment was developed and coordination has been initiated with the ECO-PCX. The review plan is included in this document as Appendix B. A further description of the review process is provided in Section 11 of this PMP.

Interagency Study Team. During the course of the Assessment, all efforts will be directed by the Study team as prescribed in the cost-sharing agreement. The Study team will consist of the two project managers from USACE and MDE. As such, USACE project manager and MDE project manager are co-chairs of the Interagency Study team. The Interagency Study team is responsible for carrying out the day-to-day direction and management of the study. The Interagency Study team will keep the Executive Committee and others informed of the progress of the study and of significant pending issues and actions.

Executive Committee. In the event that the Interagency Study 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 MDE. Current designated members of the Executive Committee are noted in Table 5. Should the named individual no longer hold their position, his or her successor will be automatically assigned to the Executive Committee.

The Study team will brief the Executive Committee on unresolved issues and provide recommendations for their resolution. The Executive Committee will consider such recommendations in good faith, but have the discretion to accept, reject, or modify the Interagency Study team's recommendations. It is expected that the Executive Committee will confer and reach consensus for a solution. The Study team will keep the Executive Committee informed of the progress of the study and any issues requiring resolution. The workings of the Executive Committee will not supersede any rights and responsibilities described in the cost-sharing agreement. 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 Interagency Study team members.

Table 5. Identification of Executive Committee Membership

Name	Title	Affiliation/Office Symbol
Robert Pace	Chief, Planning Division	USACE, CENAB-PL
Colonel David Anderson	Baltimore District, Commander	USACE, CENAB-DE
Herb Sachs	Special Assistant	MDE

7.0 CRITICAL ASSUMPTIONS AND CONSTRAINTS

General assumptions for the Lower Susquehanna River Watershed Assessment include:

- Field work will be conducted.
- No formal NEPA documentation required; though impacts to any proposed strategies will be assessed.
- The Assessment report will identify and prioritize cost effective strategies to protect the Chesapeake Bay and may or may not present alternatives for implementation (this will be dependent on Assessment findings).
- The Assessment report will be a stand-alone document.
- A Fish and Wildlife Coordination Act report will not be prepared.
- Watershed strategies in the lower Susquehanna watershed will be developed independent of this study effort as part of the ongoing Bay TMDL efforts and WIP development. These strategies will compliment the study and help to define inputs and future conditions for the analyses.
- If the model comparison study concludes that a 3D model will be required (vs. a 2D) this portion of the study will need to be rescoped to incorporate the new model;
- Once the Assessment is underway and more information is gathered the scenarios to be modeled; combinations of scenarios; and to what level of detail will be refined;
- This Assessment will generate a foundational analysis towards understanding the impacts of the Conowingo Reservoir, the benefits of maintaining sediment storage capacity behind the dams on the Lower Susquehanna River, the types strategies that would reduce or remove accumulated sediments and associated nutrients behind the dams, and conceptual level costs and benefits of these measures; it will not lead directly to implementation (construction) of any strategies. This would require additional funding, formal partnerships, and work beyond the scope of this project.

8.0 WORK BREAKDOWN STRUCTURE (WBS)

Although not technically a traditional Corps feasibility study, this 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 a this study, some subaccounts will not be utilized. Those in bold apply to the Lower Susquehanna River Watershed Assessment. MDE will track its work and cost-share commitments under three subaccounts: (22E) environmental studies, (22 R) plan formulation and (22T) project management. USACE will use the other subaccounts highlighted in bold below for its project tracking purposes.

(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 6. Summary of Funding

LOWER SUSQUEHANNA RIVER WATERSHED ASSESSMENT
SUMMARY OF FUNDING*

SUBACCOUNT	USACE FEDERAL FUNDS	MDE IN-KIND SERVICES	TOTAL
(22E) Environmental Studies	$697,000	$129,000	$826,000
(22J) Hydrologic and Hydraulic Studies	$47,000	$0	$47,000
(22M) All Other Studies/Technical Review	$24,000	$0	$24,000
(22Q) Technical Management	$4,000	$0	$4,000
(22R) Plan Formulation	$160,000	$125,000	$285,000
(22T) Project Management	$60,000	$ 90,000	$150,000
Contingency	$40,000	$0	$40,000
Study Total	**$1,032,000** 75%	**$344,000** 25%	**$1,376,000**

* Note – amounts are rounded

9.0 FUNDING

The estimated total cost for this Assessment is $1,376,000. 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. Table 6 summarizes the costs for the Assessment, both in terms of the USACE subaccounts and the MDE and USACE level of effort.

The costs associated with the Assessment including labor, travel, and contractual services, will be shared 75-25 between USACE and MDE. The costs for developing the PMP and negotiating the cost-sharing agreement were handled under the reconnaissance phase of the project. These reconnaissance-phase costs were entirely borne by the Federal government and as such, will not count towards either the Federal or the non-Federal cost-sharing requirements for the Assessment being undertaken in this phase.

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 MDE. To ensure the sponsor's satisfaction with the expenditure of funds on this project, USACE will provide MDE with a quarterly accounting of its project costs. Similarly, MDE will provide a semi-annual accounting of the in-kind expenditures. It is agreed that USACE will not redirect obligated project funds to uses or entities other than those outlined in this PMP without MDE approval. If USACE finds its component of the work is exceeding the non-Federal cost-share commitments, USACE and MDE will take steps together to re-scope or conclude the project in a mutually acceptable manner.

The non-Federal share of 25 percent is expected to be provided wholly as in-kind services; there is no expected cash contribution to this project.

The labor value of the in-kind services includes salary, benefits, and each contributing partner's federally approved indirect cost rate. MDE labor value in the detailed task list and project budget (attached to the PMP as Appendix C) reflects an amalgam of several staff.

The non-federal sponsors' in-kind service contributions to the project will be documented by a letter from the contributor that attests to the value of the in-kind contribution, which may include salary, benefits, indirect costs, and any other USACE-allowable expenses (e.g., travel per diem if they are officially accounted for). Appendix D is an example of an approved format for reporting non-Federal partner in-kind contributions to the project scope.

The exact final composition of MDE in-kind contributions (among various tasks) is subject to change, but this is acceptable as long as the total amounts to a 75/25 Federal/non-Federal cost-share ratio. MDE may seek out or receive offers of in-kind contributions from additional partners, and will notify USACE of new partners to ensure their acceptability.

Following signing of the cost-sharing agreement, non-Federal partner in-kind cost-share may be accrued at a pace that either is faster or slower than the obligation and expenditure of USACE funding for this project. That is acceptable, as long as the final project accounting reflects completion of the 75/25 cost-share ratio at least at the level identified in this PMP.

Many of the technical tasks to be performed under the Assessment's 75-percent Federal umbrella are planned to be contracted to USGS and ERDC via a military interdepartmental purchase request (MIPR). USACE will be responsible for technical review of all tasks, both those performed as in-kind services and those contracted to those agencies.

10.0 SCHEDULE

It is anticipated that the Assessment will take approximately 34 months to complete, assuming full Federal appropriations within this time period to meet the identified capability, with funding being delivered over approximately over three Federal fiscal years. A preliminary schedule is included in Appendix E. This schedule will be expanded and routinely updated throughout the Assessment.

Key milestones and their planned completion dates are noted below:

Execution of the cost-sharing agreement	July 2011
Initiation of the Assessment	August 2011
In-progress review meeting	December 2013
Completion of the Assessment	April 2014

This schedule reflects the partner's capability with no budgetary or workload restrictions. It assumes that appropriate funding for the study is provided in Federal FY 2011, 2012, 2013, and 2014. If funding is not received as planned, the scope of work and schedule will be revised and, if necessary, pared back. If funding is not forthcoming within a reasonable time period, it might not be possible to complete certain key project components. The PMP and Assessment costs would be updated or revised appropriately at that time.

Project Deliverables

Major Assessment planning activities yielding interim products include (with designation of associated task from Appendix A in parentheses):

- Development of Strategies (Task A);
- Literature Review and summary report of reservoir sedimentation nationally and internationally (Task A);
- Development of a dredging plan with conceptual costs (Task A);
- Estimate environmental impacts/benefits of strategies developed (Task B);
- Estimate sediment deposition and load from watershed; within reservoirs; to the Bay from selected strategies (Task C);
- Conduct Bathymetry surveys of Susquehanna flats (Task D);

- Collect and analyze sediment, water quality, and nutrients at Conowingo dam (Task D)
- Convening Sediment Task Force to present modeling findings and developed strategies and recommendations (Task I);
- Refinement strategies/recommendations through interagency coordination (Task I);
- Technical review of the Assessment report; and (Task J); and
- USACE approval of the Assessment report (Task G).

The final project deliverable is the Lower Susquehanna River Watershed Assessment as described in Task G in Appendix A.

11.0 REVIEW PLAN

The objective of the review plan is to ensure the successful completion of the Assessment and delivery of high-quality products and supporting documents, within budget and on time. The review plan for this Assessment is contained in Appendix B of the PMP. The review plan was prepared by USACE staff and coordinated with the ECO-PCX. The review plan is expected to be approved formally by the ECO-PCX in 2011, with certification by the North Atlantic Division in 2011. The start of the Assessment and execution of the cost-sharing agreement is not dependent on completion of this approval and certification process. To accomplish the review plan, it is anticipated that teams will be assigned with specific study responsibilities, which are described as follows:

Interagency Study Team. The Study team 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. Study assumptions, data sources, analytical methods employed, and assessments will be documented. Individual offices preparing documents and analyses will conduct their own routine quality control of the study products.

Agency Technical Review (ATR) Team. The ATR team will be made up of personnel with experience in the major disciplines related to the Assessment. The ATR team is expected to solely consist of USACE staff, primarily derived from the ECO-PCX. The ECO-PCX will select the ATR team members and direct the ATR process. The ATR team members will not have had any involvement in the preparation of the products. The team's purpose is to provide an independent review of all elements of the study products and to insure that planning, analysis, and design conform to applicable USACE standards, policy, and guidance, as appropriate. It is anticipated that not all products produced as part of this Assessment will have established USACE guidance criteria; in which case, best available methods will be used.

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 ECO-PCX may also be consulted to assist with quality and technical issues including peer reviews and model certifications, if needed.

The aforementioned teams are responsible for several processes selected to ensure that the quality requirements are achieved. These include:

- Assessment of Lessons Learned / After Action Review Information – The Study team will review the lessons learned database (https://kme.usace.army.mil/CE/QMS/Pages/Welcome.aspx) to determine whether or not quality issues or suggested improvements have been developed on similar projects. Relevant information will be considered in the development of the written work products for this phase of the study.
- Team Meetings – Periodic meetings of the Study team will be conducted to coordinate the efforts of its members. These meetings will be used to discuss the study process, issues, budget, and schedules. The USACE project manager will be responsible for scheduling the meetings and will issue an agenda prior to each meeting so Study team members can determine if their attendance is required. The USACE project manager will provide meeting summaries to team members, regardless of attendance. At this time, monthly meetings are planned. The location of these meetings is expected to rotate among Baltimore and Annapolis, MD.
- Technical Requirements – Studies conducted for the Lower Susquehanna River Watershed Assessment are subject, but not limited, to the technical requirements contained in the following primary references and other appropriate USACE documents, such as policy guidance letters. Most of the following documents can be found at www.usace.army.mil/publications/. It is important to understand these references and guidance, as they may apply the Assessment products.
    - *Planning Guidance Notebook*, ER 1105-2-100;
    - *USACE Business Process*, ER 5-1-11;
    - *Digest of Water Resources Policies and Authorities*, EP 1165-2-1;
    - *Application of Watershed Perspective to Corps of Engineers Civil Works Programs and Activities*, Policy Guidance Letter (PGL) Number 61, 27 Jan 99;
    - *Economic and Environmental Principles and Guidelines for Water and Related Land Resources Implementation Studies*, U.S. Water Resources Council;
    - *Restoration of Fish and Wildlife Habitat Resources*, PGL Number 24, 7 Mar 91;
    - *Procedures for Implementing NEPA*, ER 200-2-2;
    - *Civil Works Ecosystem Restoration Policy*, ER 1165-2-501;
    - *Ecosystem Restoration Supporting Information*, EP 1165-2-502; and
    - *Corps of Engineers Participation in Improvements of Environmental Quality*, ER 1165-2-28.
- Sustainability Considerations – The study team will ensure that appropriate elements of the current version of USACE environmental operating principles and

implementation guidance are considered in the development of the written work products required as a result of this Assessment.

- Review Requirements – Since this is not a traditional feasibility report as defined in ER 1105-2-100 will not be produced. Therefore, the feasibility scoping meeting and alternative formulation briefing documents will not be completed. An in-progress review meeting may be required and may include USACE's North Atlantic Division, Headquarters, and the ECO-PCX.

- Any legal reviews will be conducted and subsequent certification obtained prior to USACE submitting the reports to Headquarters, USACE, as appropriate.

- After-Action Review – The Study team shall conduct an after-action review after completion of any key processes, or decision points, as necessary.

12.0 ACQUISITION STRATEGY

The Assessment will be performed using in-house, contracted, non-Federal sponsor and other partner resources. Specifically, it is expected that a portion of the technical work slated to be performed as the Federal share will be funded by the Corps but performed by ERDC and USGS. Funding will be provided to ERDC and USGS via military interdepartmental purchase requests (MIPRs). In-house USACE resources will be used for quality control review and project management. The ECO-PCX will perform the agency technical review via MIPR or cross-charge labor codes.

13.0 RISK ANALYSIS

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
Schedule Slippage	• USACE policy issues • Lack of Federal or sponsor funding • Changes in scope • Absence of site/regional data	• Schedule slippage • Increased watershed planning costs • Fewer products completed • Less detailed analysis of focus areas
Cost Growth	• Schedule slippage • Additional requirements or studies	• Non-Federal funding not available

14.0 SAFETY AND OCCUPATIONAL HEALTH PLAN

There are no anticipated field investigations that will require a position/activity hazard analysis. Field work be conducted by Interagency Study team will follow general field safety requirements.

15.0 CHANGE MANAGEMENT

Study team members are responsible for monitoring their work items and identifying when changes are necessary. Scope changes, including any cost or schedule impacts, will be provided to the project manager as soon as the scope change is identified by the team member. Scope changes are to be signed by the branch chief executing this PMP as a resource provider, unless authority has been delegated to another supervisor. Significant changes will require updating this PMP document and the concurrence of the non-Federal sponsor. 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; and
- Sponsor-requested scope changes.

The Interagency Study team will determine whether the cost, schedule, or scope changes warrant a formal update of the PMP (i.e., a revised document). Routine scope or budget changes that can be funded out of the project contingency or handled by task transfers will be considered minor and not significant. These changes will be documented by the project managers for USACE and MDE and recorded in the project files.

Should the projected cost of the Assessment exceed the amount indicated in the cost-sharing agreement or should responsibilities outlined in the agreement change significantly, then an amendment to the cost-sharing agreement may be warranted. The Interagency Study team is responsible for identifying the need for an agreement amendment to the Executive Committee. With the Executive Committee's concurrence, the Interagency Study team will prepare and negotiate the amendment with the USACE project manager having the lead in the amendment drafting process. Legal counsel from both USACE and MDE will be consulted and approve the amendment. Depending on the nature of the amendment, approval within USACE may reside at the district level (Baltimore District) or may require approval by the Assistant Secretary of the Army (Civil Works). Once approved, the amendment will be executed by pertinent signatories from USACE and MDE.

16.0 COMMUNICATIONS STRATEGY

The Assessment will require the routine engagement and participation of many stakeholders who have a direct interest, involvement, or investment in the outcome of the

Assessment. Depending on their level of involvement, such stakeholders may also become members of the Interagency Study Team in the future. Additional stakeholders may be identified during future meetings and outreach activities.

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

- USACE (Baltimore District; North Atlantic Division and Headquarters have provided appropriate approvals); and
- MDE

Stakeholders & Partners. These are the entities or groups having Federal or state-mandated responsibilities for development and protection of natural resources. The Interagency Study team will coordinate and consult with these project proponents, including but not limited to:

- U.S. Geological Survey;
- U.S. Fish and Wildlife Service;
- Natural Resources Conservation Service;
- U.S. Environmental Protection Agency
- National Oceanic and Atmospheric Administration;
- Chesapeake Bay Program (USACE, EPA, NOAA, USFWS, states and DC);
- Susquehanna River Basin Commission (SRBC);
- The Nature Conservancy (TNC);
- Maryland Department of Natural Resources;
- Maryland Geological Survey;
- Pennsylvania Department of Environmental Protection;
- Pennsylvania Department of Conservation and Natural Resources;
- Pennsylvania Fish and Boat Commission.

It is anticipated that the operating stakeholders will be requested to engage in the Assessment via participation in expert technical workshops, provision of background data and technical expertise, and other reviews as necessary. Included in this list are representatives from the cabinet departments or agencies (Departments of Agriculture, Commerce, and Interior, as well as the U.S. Environmental Protection Agency).

General Stakeholders. These are the individuals and groups having no mandated responsibilities for the project, but may have interest in the Assessment. This includes the national and global context of social, political, regulatory, economic and technological conditions. These stakeholders include:

- Non-regulatory Federal and state agencies;
- Congressional delegation;
- Recreation interests;

- Watershed organizations;
- Other agencies and non-governmental organizations (NGOs) conducting studies in the Potomac River basin;
- Water suppliers (including Exelon.); and
- Water users.

17.0 VALUE MANAGEMENT

It should be noted that there is no USACE construction project being studied or proposed; therefore the value engineer will not be involved during the management plan process.

18.0 CLOSEOUT PLAN

At the completion of the Assessment, the USACE project manager shall initiate the financial closeout process. The non-Federal sponsor must provide documentation for all in-kind services and costs attributed to this Assessment. This documentation will be used for properly crediting sponsor for their work effort up to 25 percent of the total study cost; any costs that exceed the 25-percent non-Federal share will not be reimbursed in accordance with the cost-sharing agreement. 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 Interagency Study team will ensure that all project documents are appropriately filed.

19.0 APPROVALS

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

PROJECT MANAGEMENT PLAN

APPENDIX A

DETAILED SCOPE NARRATIVE

LOWER SUSQUEHANNA RIVER WATERSHED ASSESSMENT (LSRWA)

APPENDIX A

DETAILED SCOPE NARRATIVE

OVERVIEW OF TASKS

The following sections are an elaboration of the tasks that will be conducted for the Lower Susquehanna River Watershed Assessment. The Interagency Study team's understanding of these tasks leads to the funding requirements noted in Sections 8 and 9 of the project management plan. The estimated costs for these tasks are detailed in Appendix C and are broken down by the USACE code of accounts for Civil Works studies.

A. **Develop Strategies**

1. Literature Search
   Review, analyze, and synthesize literature on managing reservoir sedimentation nationally and internationally and prepare a brief summary report. The summary report will be reviewed by the Interagency Study team and the findings and lessons learned will be incorporated into refining sediment and nutrient management strategies (combination of one or more measures or strategies structural or non-structural) for this study. The summary report will most likely be an Appendix to the Assessment. USACE will have the lead on preparing the summary report but will coordinate with the team and other agencies in gathering literature and review of the summary report.

2. Develop Strategies including concept designs and costs This task involves analyzing strategies and determining which ones will be evaluated and to what extent (i.e. modeled, etc). Various strategies will be developed and evaluated over the course of the study including (but not limited to) No Action, By-passing, Dredging, Innovative (beneficial) re-use of sediments in the reservoirs; upland and riverine management measures (utilizing forecasted nutrient and sediment load reductions developed from the Watershed Implementation Plans as part of the Bay Total Maximum Daily Load program See Task F); and modifying Conowingo dam operations. The team will determine what strategies will be run through the models and warrant development of conceptual level costs and schematics (designs).

   USACE Engineering and Operations sections will have the lead on developing concept level costs and schematics for any dredging (within the reservoir system) strategies or strategies involving a sediment by-passing system. For dredging, two site visits are planned to visit potential placement sites and evaluate potential options for innovative (beneficial) use of the dredged material. This information will be incorporated into a dredging plan. The cost may be a range per cubic yard of material removed.

Experts under the direction of MDE will have the lead on developing any strategies that involve modifying dam operations at Conowingo. One site visit is planned so the team can have an understanding of operations at the Conowingo dam and for consideration when developing any of the other strategies within the reservoir.

See Task F regarding upland and riverine strategy development

3. Screen and Evaluate Strategies
This task involves comparing, evaluating, and potentially recommending/prioritizing strategies to be implemented in the future and by whom. The screening of strategies will be a team effort and criteria will include (but is not limited to) (1) costs, (2) feasibility, (3) benefits (amount and kind of sediments and nutrients removed as forecasted by modeling), (4) ecosystem response to the reductions as forecasted by the models (5) public acceptability and (6) environmental impacts. USACE Planning section will have the lead on developing screening methodology and impacts but will rely on team input and consensus to determine screening criteria of strategies and selection.

B. **Determine environmental benefits/impacts of strategies**
This task involves forecasting the potential impacts and benefits of any potential alternative evaluated during the study. ERDC (Cerco) will have the lead in this task. The Chesapeake Bay Environmental Model Package (CBEMP) will be the tool utilized for this task. The parameters that can be forecasted with this tool include light attenuation, submerged aquatic vegetation, chlorophyll, nutrient recycling, and dissolved oxygen, among other factors. See Attachment A-1 for the full Scope of Work.

C. **Simulate sediment deposition and transport in Lower Susquehanna River watershed and within reservoirs in the River**

1. Estimate sediment deposition and load changes within Conowingo Reservoir and the Susquehanna flats (ERDC)
This task involves simulation of sediment deposition and transport in Conowingo Reservoir and the Susquehanna River flats. ERDC (Scott) will have the lead in this task. The 2D Adaptive Hydraulics (AdH) model will be used to route sediment loadings through the reservoir, simulating both deposition and erosion over the two dimensional domain. Although the 2D model will most likely capture the dominant hydrodynamic and sediment transport processes in the reservoir, three dimensional impacts will occur due to vertical stratification of suspended sediment during low flow periods. A 2D / 3D model comparison study will be performed to evaluate the relative impacts of this stratification to sediment

transport. The study outcome will determine which model (2D or 3D) is appropriate for the study. This study assumes that the 2D model will be adequate (enough certainty) however if the comparison study shows that the 2D model is not adequate a 3D model will need to be used and some rescoping will need to occur. See Attachment A-2 for the Full scope of work.

2. Estimate sediment deposition and load changes from the watershed and upper reservoirs in the Lower Susquehanna River watershed (USGS) - The 2D (or 3D) model as described in task C-1 requires an incoming sediment load from the upper two reservoirs in the lower Susquehanna River. Both 2D (and 3D) models are computationally intensive, therefore this task involves constructing a one dimensional (1D) HECRAS model for the upper two reservoirs (Lake Clarke, Lake Aldred). USGS (Langland) will have the lead in this task. The Susquehanna River sediment load entering the upper reservoirs will be used for the 1D sediment rating curve. The 1D model will route the inflowing sediment through the reservoirs, accounting for both sediment deposition and erosion in the reservoirs. The output of the model will then be used as the input sediment rating curve for the 2D (or 3D) model. See Attachment A-3 for the full scope of work.

D. Data Collection

This Assessment is computer-model intense and the models require data to forecast accurately. No formal literature review was conducted during the study scoping phase however data gaps were identified by the experts involved in this scoping effort (ERDC and USGS). It was determined that much existing data is available that is adequate to meet modeling needs; however there are some gaps which will require some field investigations and laboratory analysis.

Existing data (sediment physical and biogeochemical properties) will be obtained from previous USGS and MGS studies and reports. Additionally cores and samples from previous field/lab work may have been archived and be physically available for additional investigations though this has not been determined at this time. Review of this data and its implications to this Assessment will be conducted once this study commences. Existing information may be used to frame and further refine field/laboratory investigations. This literature review is captured in separate ERDC SOWs (Attachment C-1 and C-2). Table 1 (below) provides details on the field investigations and laboratory analysis that will be conducted during this Assessment.

Table 1. Summary of field/laboratory investigations for LSRWA

Investigation Area/Topic	Purpose/Sampling will occur under this Scope?	Field Sampling	Agency Responsible for Field Sampling	Laboratory Analyses	Agency Responsible for Laboratory Analyses
Conowingo Reservoir bottom Sediments: Erosion vulnerability	Determine erosion rate coefficients and critical bed shear stress for mobility for ADH model. **SAMPLING**	Collect sediment cores in Conowingo Reservoir. Up to 20 sediment cores will be collected.	ERDCWES *USACE Funded	SEDflume	ERDCWES *USACE Funded
Conowingo Reservoir bottom Sediments: Grain Size	Determine Grain-size distribution for ADH model and Bay model **SAMPLING**	Same as above, utilize subset of 20 sediment cores.	ERDCWES with USGS/Langland Assistance (past locations) USACE Funded	Grain-size	ERDCWES *USACE Funded
Conowingo Reservoir bottom Sediments-Nutrients	Characterize nutrients. USGS archival data is extensive; likely that bottom sediment nutrient content can be characterized from this. **NOT SAMPLING**	NA	NA	NA	NA
Conowingo Outflow (River Input Station)- Storm Flow level-Sediments Suspended solids, and nutrients analysis. See Attachment A-4 for details of scope.	Establish association between grain-size and particulate P, and determine how to model N during storms. Both inputs to Bay Model. Will support analysis of detailed suspended-sediment size fractions and physical and chemical measures of sediment **SAMPLING**	Collect base flow and stormflow samples. Will supplement current sampling USGS (DNR funded) During eight storm-flow events in Water-Year 2010, large-volume samples will be collected	Supplement to MDNR contract with (USGS who collects) USACE will fund	Total suspended solids, sediment solid size classes, fixed and volatile solids by size class, and particulate C, N, and P	MDNR (contracting USGS) USACE will fund.

Conowingo Outflow (River Input Station)- Normal Flow data collection on water quality, sediments, and nutrients.	Same inputs as above for Bay model except during normal flow. **SAMPLING**	Same as above sampling conducted during normal flows	MDNR (contracting USGS)	Same as above	MDNR (contracting USGS)
Susquehanna Flats-Bathymetry	Existing bathymetry data for Conowingo Reservoir and Susquehanna Flats area is not adequate for ADH model runs **SAMPLING**	25 Transects every 4,000 feet	MGS (MGS funded as well)	NA	NA
Susquehanna Flats-Bottom Sediments	Grain Size distribution in flats for ADH model. Analysis may or may not be done during study. MGS has 6 existing cores for grain size analysis in the vicinity of the flats. 2 are directly on the flats and 2 each are located near Furnace Bay (north side) and to the SW of Havre de Grace. **SAMPLING NOT ANALYZING**	24 surficial grab samples in bathymetry survey area.	MGS	NA	NA

E. Technical Integration and Coordination of Exelon (Conowingo dam) relicensing studies

This task involves integrating and incorporating information gathered through the Exelon (Conowingo Dam) relicensing studies into this Assessment as well as serving as the Interagency Study team liaison to Exelon; including any necessary site visits to the dam. MD DNR will have the lead in this task.

The Conowingo Dam is owned and operated by Exelon. The Conowingo Dam is currently going through a relicensing process which the Federal Energy Regulatory Commission (FERC) has purview over. The relicensing process will be completed in 2014 whereupon FERC will issue a new license to Exelon for Conowingo Dam. During this relicensing process various Federal, State, and Non-governmental organizations request studies to determine impacts of

Conowingo Dam and its operations on the surrounding environment (FERC determines which of these study requests Exelon must undertake to acquire a new license). FERC and the resource agencies review and comment on the findings of the studies undertaken and this information get incorporated into the new requirements of the license.

FERC approved Exelon's Study Plan. Exelon is not conducting any sediment modeling or quantifying economic/environmental impacts of a "no action" response to the build-up of sediment behind dam but they are conducting a hydraulic model (River 2D model) and collecting a variety of data and doing analysis that could be utilized for this Assessment including: (1) a compilation of existing data on sediment and nutrient storage capacity; accumulation rates; scour events; surface and sub-surface sediment properties; areas of deposition and scour; sediment movement within Conowingo reservoir; sediment and nutrient movement past Conowingo (delivered to the mouth of Bay) and impacts on the Bay (from Sediment and Nutrient Transport study) (2) a literature review of nutrient and sediment loadings into the bay to development of a cumulative impact analysis (3) an analysis of existing info to characterize trapping efficiency of reservoir and degree that project operations affect distribution of habitat and substrate below dam (4) collection of bathymetric data (from Instream flow habitat assessment) (5) velocity, depth, discharge and bottom shear stress values generated by River 2D model (model developed for instream flow habitat assessment); (6) substrate properties (sediment grain size, etc) measured and mapped from 2008 Exelon habitat survey (7) substrate properties (from Instream Flow Habitat Assessment and Downstream SAV study) (8) computation of boundary sheer stress at the stream bed (9) Cross channel shear stress distribution of simulated flow compared to habitat location and critical shear stress (shear stress at which particle movement begins) to determine entrainment (sediment movement) potential (10) Usage of HEC-6 form sediment transport simulation output and the USGS bottom scour regression model to determine sediment outflow during storm events (11) review and summarization of watershed-based sediment/nutrient management efforts and successes in load reductions to Conowingo (13) review of existing types of BMP's and identification of BMP's that would be successful at managing, mitigating and removing sediment related to the project (14) development of a sediment management plan that includes projections of sediment accumulation options to manage, mitigate, and remove accumulated sediment as well as benchmarks (triggers) for potential impacts and actions.

F. Technical Integration and Coordination of TMDL (MDE lead)

This task involves coordination with EPA and Bay states with regards to integrating Total Maximum Daily Load (TMDL) and corresponding Watershed Implementation efforts into this Assessment. MDE will have the lead in this task.

There is heightened concern about the issue of the loss of sediment storage capacity behind the dams on the lower Susquehanna River because of the implications it raises with respect to nutrient and sediment loads to the Chesapeake Bay and management of those loads; more specifically implications to the current development of the Chesapeake Bay TMDL by the EPA in conjunction with surrounding Bay states. A TMDL is an estimate of the maximum amount of an impairing substance or stressor (pollutant) that a waterbody can assimilate without violating water quality standards. In developing the Chesapeake Bay TMDL the EPA accounts for the impacts on loadings to the Bay and how to appropriately assign load allocations to each Bay state. EPA has determined that a large influencing factor in sediment and nutrient loads to the Bay is when the dams on the lower Susquehanna no longer function to trap sediment and phosphorus. EPA's intention is to assume the current dam trapping capacity will continue through the TMDL implementation horizon (through 2025). However if future monitoring shows the trapping capacity of the dam is reduced, then EPA will consider adjusting the Pennsylvania, Maryland and New York sediment and nutrient load allocations based on the new delivered loads to determine if the states are meeting their target load obligations (EPA, 2010). It is imperative to the states to determine how to keep the dams on lower Susquehanna acting as sediment and associated nutrient traps to meet the Bay TMDL and protect the aquatic resources of the Chesapeake Bay.

The assumption for this study is that upland (watershed) and riverine (instream) management options in the lower Susquehanna watershed will be developed entirely independent of this study effort as part of the ongoing Bay (TMDL) efforts and Watershed Implementation Plans (WIP) development.

Nutrient and sediment loads to the Conowingo Reservoir may vary depending on what management measures (as laid out in the Lower Susquehanna WIP) are implemented and ultimately whether the TMDL will be met or not in this watershed. Accordingly, watershed inputs as anticipated from full implementation (or not) of the WIP will be included in the modeling scenarios since it will likely have a bearing on feasibility of other alternatives developed in this study. Alternatively management measures investigated in this Assessment may forecast altered sediment and nutrient loads to the Bay potentially which would need to be looked in the context of the Bay TMDL and WIPS and coordinated with EPA accordingly.

G. **Prepare, Finalize, and Reproduce LSRWA Report**

All of the tasks described above contribute to this Assessment. The outputs of these tasks will be used to develop a report. The information developed through tasks A - F as described above will be synthesized into a cohesive narrative, with full modeling analyses and results as well as the literature search included as appendices. Any graphics (maps, figures, etc.) necessary for the assessment will be developed as well. USACE will have the lead on this task. The entire team will provide review and input on the report.

The report will also need to undergo USACE reviews and quality control procedures as stipulated in USACE guidance and documented in the review plan (Appendix B). Reviews will be conducted on the draft and final reports and will include internal team review, Baltimore District Quality Control (supervisory review), review by the USACE's Ecosystem Planning Center of Expertise (ECO-PCX) in its Mississippi Valley Division, and review by USACE higher authorities (North Atlantic Division, Headquarters and Assistant secretary of the Army Civil Works office).

Coordination will be required at each level of review to resolve comments through discussion and revision of Assessment report or Assessment process as warranted.

Two In-Progress Review (IPR) meetings are anticipated for this Assessment. These meetings are held between the Interagency Study team, USACE higher authorities, and the Eco-PCX to discuss the status of the Assessment, highlight and resolve any issues and receive buy-in on the status of the Assessment at that point. Read-Ahead Materials (RAM) are prepared for IPR's which are written to eventually be consolidated into the final report (i.e. not an additional product to be developed). IPR meeting summary and resolution papers are prepared after the IPR which contain a summary of discussion major issues and resolution of issues. The IPR's are anticipated to occur during this Assessment when sediment management measures have been initially evaluated and some modeling has occurred and before the draft report is goes out for public review.

H. Develop Review Plan

The objective of the review plan is to ensure the successful completion of the Assessment and delivery of high-quality products and supporting documents. USACE has the lead on the task.

Based on recent guidance, USACE is required to undergo stringent review of products developed during cost-shared studies. Although the specific guidance dealing with the Section 729 authority is still under development, certain processes are likely to be required and have been included in the scope of this Assessment.

A review plan has been drafted to outline necessary reviews for the products to be developed for this Assessment and initial coordination with the ECO-PCX has been completed. The review plan is will need to be coordinated further and formally approved by the ECO-PCX in 2011, with certification by the North Atlantic Division in 2011. The start of the Assessment and execution of the cost-sharing agreement is not dependent on completion of this approval and certification process.

I. <u>Develop and Execute Communications Strategy</u>

The Assessment will need the routine engagement and participation of many stakeholders who have a direct interest, involvement, or investment in the outcome of the Assessment.

Depending on their level of involvement, such stakeholders may also become members of the Interagency Study team in the future. Additional stakeholders may be identified during future meetings and outreach activities.

The results of the final Assessment and any interim products or findings of broad public interest will be announced and disseminated to the general public and targeted stakeholder audiences through email and meetings. These communications and information sharing efforts will be coordinated through the Interagency Study team. The frequency and timing of this information sharing will occur at appropriate times during the study when engagement is necessary which will be determined once the study commences by consensus of the team.

J. USACE Required Quality Control Reviews

The ECO-PCX has the lead on this task. As discussed in tasks G and H USACE is required to undergo stringent review of products developed during cost-shared studies. USACE coordinates with the ECO-PCX (entity within USACE that provides technical review of products) for review of products. The Eco-PCX will review and certify review plan for Assessment. They will also coordinate an Agency technical review (ATR) team to review the draft and final report as well as the IPR "read-ahead" report. They will attend in-progress review meeting. Also included is a review of the models that will be used for this effort. Should any of these steps not be required, the costs for these tasks will be revised accordingly.

K. Participation in Interagency Study Team

At least one representative from USACE, MDE, MD DNR, TNC, SRBC, ERDC, and USGS shall serve as the core Interagency Study team. This team will have monthly conference calls and quarterly meetings to ensure that the project is proceeding according to schedule and within budget. This is an average over the course of the entire study. At critical times more meetings may be warranted and at other times fewer meetings may be warranted. USACE will have the lead in documenting these meetings.

Both USACE and MDE will conduct financial management and will prepare, monitor/revise project schedule and funds as necessary.

Attachment A-1

ERDC- Carl Cerco

Scope of Work

The Chesapeake Bay Environmental Model package (CBEMP)

Scope

The Chesapeake Bay Environmental Model package (CBEMP) has been used for more than twenty years as a tool for examining the effect of nutrients and solids loads on Bay water quality and living resources. The core of the CBEMP consists of the CH3D hydrodynamic model, which computes transport processes in three dimensions, and the Integrated Compartment model (ICM) water quality model, which computes water quality and living resources. ICM incorporates representations of estuarine carbon, nutrient, and oxygen cycling as well as living resources such as submerged aquatic vegetation (SAV), filter feeders, and menhaden. The most recent application of ICM to Chesapeake Bay includes a predictive sediment transport model for four classes of sediments: fine clay, clay, silt, and sand. The model operates on a 50,000 cell three-dimensional grid and has been applied to the period 1985-2005. This is the model that has been used to aid in development of the 2010 set of Total Maximum Daily Loads (TMDL's) for Chesapeake Bay.

The CBEMP will be used to examine the effect of solids and nutrient loads projected to flow from Conowingo Reservoir as a result of multiple scenarios. The projections will be provided by an application of the Corps' Adaptive Hydrodynamics Model (ADH) to three reservoirs above Conowingo Dam. Effects on light attenuation, SAV, chlorophyll, nutrients, and dissolved oxygen will be computed and compared to a base case. Additional information may also be derived. We will work with the project sponsor to determine the specific information desired and to develop presentation formats.

We have from the CBEMP a 21-year hindcast, 1985-2005, of hydrodynamics and water quality. This period includes tropical storm and spring flood events. We highly recommend that scenarios be developed based on this period. In particular, we wish to employ the existing hydrodynamics and change only the loading at Conowingo. In this fashion, the existing hindcast can be used as a base for comparison to scenario conditions and significant economies are realized by not re-running the hydrodynamic model.

Assumptions

A key assumption is that the flow regime does not change as a result of various scenarios. This assumption is reasonable since Conowingo is a "run of the river" reservoir and does not substantially alter the flow of the Susquehanna River into Chesapeake Bay during storm events. This assumption allows the use of existing hydrodynamics sets. We can set up CH3D and create new hydrodynamics sets based on scenario flows at additional costs which are not reflected in the present project budget.

The CBEMP represents four inorganic solids classes as well as organic solids. In the absence of adequate data, the splits of total suspended solids loads at the dam are obtained from the Chesapeake Bay Program Watershed Model (WSM). We assume here that these splits are not substantially altered during scenarios. If the splits are substantially altered, additional calibration of the WQM may be necessary at costs not reflected in the present budget.

Deliverables

The primary deliverable will be a final report. One revision of the report will be completed following reviews of a draft. We will travel to the Baltimore vicinity four times to meet with project participants and present results. We will work with the sponsor to develop specific formats for presenting model outputs. These outputs will be included in a CD-ROM that will accompany the report. All model outputs will be archived at ERDC for future use, should the need arise.

Costs

Costs are outlined by task on an accompanying spreadsheet. Total cost including ten scenarios is estimated at $235,101.

Timeframe

The project is planned for two years commencing in fall 2011. We anticipate the first year will be largely devoted to the ADH modeling. We expect initial scenario loads from ADH one year after project commencement. Provision of scenario loads may continue for up to a six-month period. All information required by the CBEMP must be available six months before planned project completion for on-time delivery of results from the CBEMP.

Data Requirements

The CBEMP data requirements are extensive and include forcing functions for the hydrodynamic model (tides, wind, flows), forcing functions for the water quality model (boundary conditions and loads), and calibration data for both models. Most of this data has already been compiled in order to complete the hindcasts and computation of TMDL's. Data is lacking in two key areas, however. The first involves the composition and bioavailability of the existing and anticipated phosphorus loads at Conowingo Dam. An increase in phosphorus loading as a result of scour is one anticipated result of reservoir filling. Available information indicates a substantial portion of this phosphorus load is in recalcitrant mineral form that is not biologically available. The exact fractionation and reactivity of the present and anticipated loads is not known, however. Knowledge of the solids forms with which the particulate phosphorus is associated (fine clay, clay, silt?) is necessary also so that the particulate phosphorus is correctly transported. We recommend an investigation during the first year of the study to fill gaps in our knowledge of the nature of the phosphorus loads. Refinement of the existing phosphorus model may be required in the first year in order for the WQM to be ready and fully-capable when loads are provided by ADH.

Comprehensive observations of total solids loads from Conowingo Reservoir to the Bay exist. We have found minimal information on the fractionation of the total solids into various size classes and organic versus inorganic forms. Additional searches for relevant information are being conducted as part of proposal preparation. If no additional data is located, we recommend measures of the solids composition and size distribution be conducted immediately.

Table 1 Budget

Task	
Retrieve model and associated files from mass storage, project set up	$11,739
Develop specific outputs, graphics, and processors for this study.	$16,662
Additional developments and refinements to phosphorus model	$37,109
One Scenario	$11,739
Report preparation and revisions	$37,109
Travel (four trips to Baltimore)	$6,000
Secretarial and Administration	$9,091
Total (10 scenarios)	$235,101

Attachment A-2

ERDC- Steve Scott

Scope of Work

Simulation of Sediment deposition and Transport in Lower Susquehanna River Reservoirs

Introduction

The Susquehanna River flows through South Central New York State, Central and Southern Pennsylvania, and Northeastern Maryland, draining a watershed of approximately 27,000 square miles. Three hydroelectric dams and the associated reservoirs are located in series on the lower Susquehanna River within a 35 mile span of the river upstream of Chesapeake Bay. The upper most reservoir, Lake Clark, is impounded by Safe Harbor Dam located approximately 32 miles upstream of Chesapeake Bay. It was constructed in 1931, with a design water storage capacity of 150,000 acre-ft. The middle reservoir, Lake Aldred, was impounded by Holtwood Dam in 1910, with a water storage capacity of 60,000 acre-ft. It is located approximately 25 miles upstream of Chesapeake Bay. The lowermost reservoir, Conowingo reservoir, was constructed in 1928 with a water storage capacity of 300,000 acre-ft. Conowingo Dam is located approximately 10 miles upstream of the Bay.

Inflowing sediments have been depositing in these reservoirs since construction. The inflowing sediment load is dependent on many factors including watershed area, land use, and regional hydrology. In addition to the natural sediment load, coal entered the Susquehanna River system through mining and processing operations. These coal sediments comprise approximately 10 percent of the sediment deposited in the reservoirs (USGS 1994).

The Susquehanna River is a major tributary to Chesapeake Bay, delivering a substantial amount of sediment and nutrients to the bay. High inflowing nutrient loads have resulted in negative impacts to the ecology of the bay. In an effort to mitigate these negative impacts, regulatory agencies have requested a TMDL limit for nutrient releases into the bay. To meet the TMDL guidelines, sediment and nutrient releases from Conowingo Dam must be controlled. If sedimentation processes within the three upstream reservoirs were currently in a steady state condition, a TMDL standard could possibly be enforced. However, sediment deposition and erosion throughout the system is in flux. The top two reservoirs have reached a quasi equilibrium sediment transport condition in that the capacity to store sediments has been significantly reduced. In the absence of large flow events, the majority of sediments that enter the two upstream reservoirs transport to the lowermost Conowingo reservoir. However, large flow events will scour and transport bed sediment deposits in these reservoirs, thus temporarily restoring some incoming sediment storage capacity. Conowingo Reservoir currently has not reached an equilibrium state and continues to store inflowing sediments. However, the storage capacity of Conowingo will decrease over time similar to the upstream reservoirs. Eventually, all three reservoirs will be in a quasi-equilibrium condition for which the incoming Susquehanna River sediment load will pass through the system and enter the Bay. Thus as the storage capacity decreases over time, the amount of sediment and nutrients delivered to the Bay will increase.

The hydrodynamic and sediment transport processes in the reservoirs are complex and unsteady in nature. Although deposition in the reservoirs is the primary process, scour does occur during large flow events, and significant amounts of sediment can be eroded, mobilized, and transported through the reservoir system and ultimately into the bay. Thus a thorough understanding of both sediment deposition and erosion processes is required for evaluating how the system currently functions, and how it will function in the future. To facilitate analysis of the reservoir system, a numerical model of Conowingo reservoir hydrodynamics and sediment transport is proposed. Because the reservoir domain is two dimensional, and the processes are fully unsteady, a two dimensional model (2D) will provide the best resolution. However, there are three dimensional effects within reservoirs that must be investigated before committing to the 2D model. A one dimensional model developed and applied by the Pennsylvania USGS will be constructed for Lake Clark and Lake Aldred to provide sediment transport boundary conditions for the 2D model. This proposal will describe the models, data requirements, and analysis methodology.

Background

The USGS has performed a number of significant studies on the three reservoirs. Their study findings indicate that top two reservoirs are in a quasi-equilibrium status, with Conowingo reservoir currently having capacity to store incoming sediment load. The USGS predicts that Conowingo Dam has approximately 15 – 10 years of sediment storage capacity remaining (USGS 2009). Data presented by the USGS studies show the average inflowing sediment into the reservoir system as well as the Conowingo Reservoir deposition rate over time. Figure 1 presents the average sediment delivery to the system by decade, along with the estimated sediment deposition in Conowingo Dam. The estimated sediment deposition in Conowingo was determined by interpolating data presented in the 2009 USGS publication referenced above.

From 1929 to 1959, the upper two reservoirs were actively trapping sediments. The inflowing loads during that period were much higher. By approximately 1959, the two uppermost reservoirs reached their sediment trapping capacity, and the inflowing sediment load remained relatively constant at about 3.2 million tons per year, with the exception of the 1970's which was impacted by Hurricane Agnes. During this time of relatively constant average sediment inflow, the average deposition of sediment in Conowingo Reservoir is decreasing. A constant sediment inflow combined with a reduction in sediment deposition indicates a possible decrease in trap efficiency with a resulting increase in sediment outflow from the reservoir. The

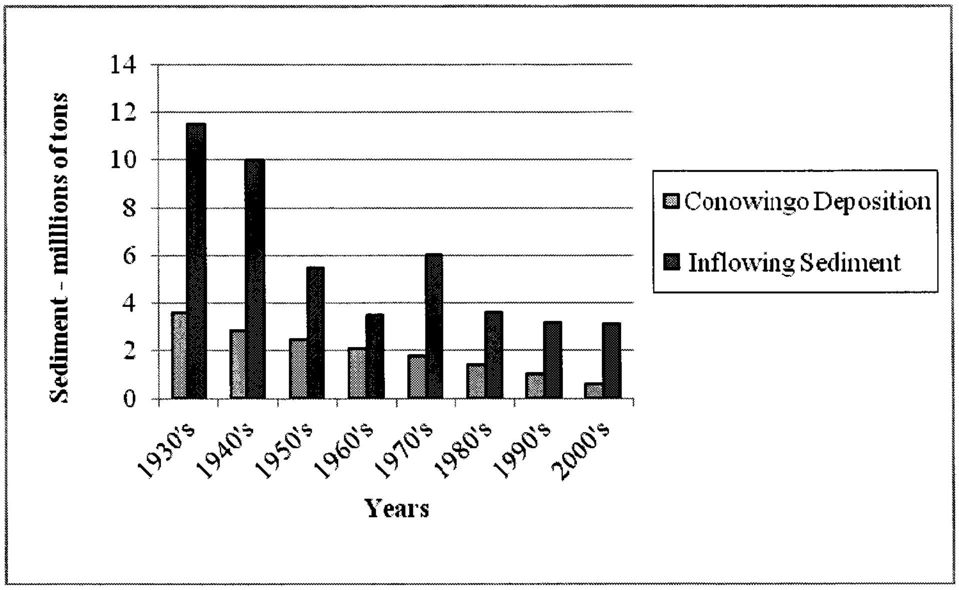

Figure 1. Average annual Inflowing sediment into the lower Susquehanna along with Conowingo Reservoir deposition

USGS estimates that the current trap efficiency of Conowingo is approximately 55 percent considering scour events, with an average inflow of about 3.1 million tons per year and Conowingo deposition ranging from 1.5 to 2.0 million tons per year. A similar type reservoir with adequate storage capacity can have a trap efficiency ranging from 70 – 80 percent. Although the data indicate that, on the average, the trap efficiency of Conowingo Dam is decreasing, large flow events can temporarily increase trap efficiency by scouring existing bed sediments out of the system. The USGS indicates that flow events on the order of 400,000 cfs will result in scour of reservoir bed sediments. This flow is approximately a 6 year return flood (Figure 2). To put this flow in perspective, a one year return flood on the lower Susquehanna is approximately 130,000 cfs, with a 100 year return flood approaching 900,000 cfs.

Because of the complexity of the flow and sediment boundary conditions, unsteady flow conditions, spatial variation in bed sediment, and variable erosion rates of fine sediment deposits, a physics based 2D model is required to sufficiently define the problem domain and simulate both erosion and depositional processes in Conowingo Reservoir. A description of the recommended model to address the reservoir sedimentation and sediment transport is provided below.

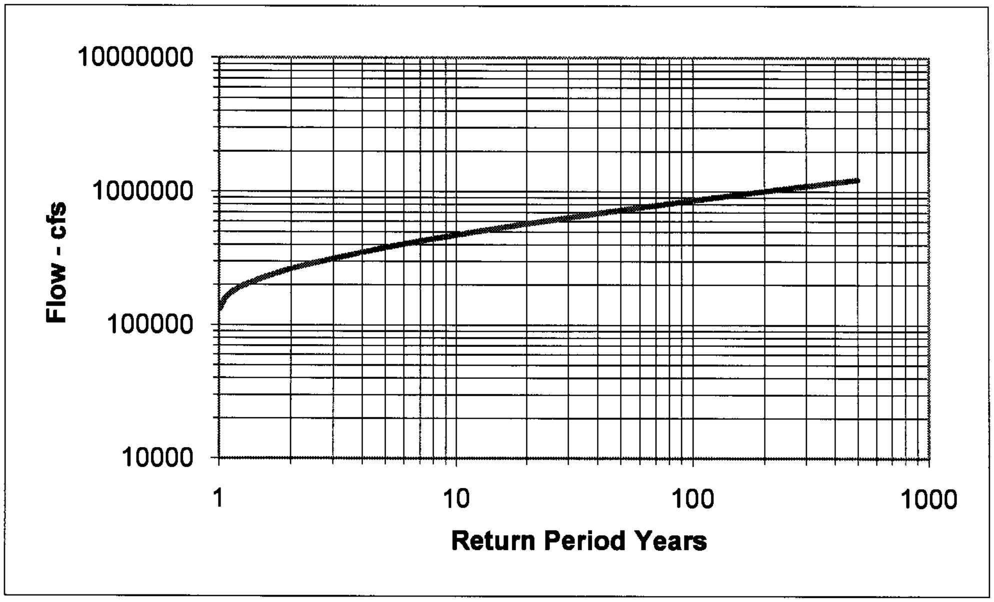

Figure 2. Return flood period for lower Susquehanna River flows

Description of Work

Description of the recommended numerical models

The complexity of Conowingo reservoir hydrodynamics and sediment transport dictate that a physics based model be applied to the problem. The appropriate model must contain either physical or empirical formulations that will adequately simulate the processes found in the domain. The 2D Adaptive Hydraulics (AdH) numerical model developed by the ERDCWES is a finite element implicit scheme model utilizing an unstructured mesh. It provides a fully unsteady solution of system hydrodynamics and sediment transport. The sediment transport model is capable of simulating coarse sediment transport (sand sized or greater), fine sediment transport (silt and clay sizes) or mixed sediment transport. Multiple bed layers can be simulated, with sorting of mixed load due to variable erosion and deposition processes. The model contains sediment transport capacity functions for coarse sediment transport. However, silt and clay deposits in reservoirs will most likely display cohesive behavior due to consolidation and particle to particle attractions. Functions that describe the prototype sediment behavior can be directly input into AdH to describe the erosion and deposition characteristics. For the Susquehanna Reservoir study, it is recommended that the bed sediments in the Conowingo Reservoir be sampled and analyzed in the laboratory to develop these erosion rate functions specific to the sediments in the reservoirs. A more complete description of the model can be found on the following web site:
http://chl.erdc.usace.army.mil/adh

Although the 2D model will most likely capture the dominant hydrodynamic and sediment transport processes in the reservoir, three dimensional impacts will occur due to vertical stratification of suspended sediment during low flow periods. It is proposed that a 2D / 3D model comparison study be performed to evaluate the relative impacts to sediment transport. The study outcome will determine which model (2D or 3D) is appropriate for the study. This proposal assumes that the 2D model will suffice. If a 3D model is required, additional costs will be incurred. These costs will be discussed later in the proposal.

The Conowingo 2D model requires an incoming sediment load from the upper two reservoirs. Because 2D models are so computationally intensive, it is proposed that a one dimensional (1D) HECRAS model be constructed for the upper reservoirs. The end result is that the 2D model will be significantly smaller (only representing Conowingo Reservoir and the lower channel), and will thus will be more computationally efficient for long simulation periods. The Susquehanna River sediment load entering Lake Clark will be used for the 1D sediment rating curve. The 1D model will route the inflowing sediment through the reservoirs, accounting for both sediment deposition and erosion in the reservoirs. The output of the model will then be used as the input sediment rating curve for the 2D model. The Pennsylvania USGS will be performing the HECRAS 1D model simulations.

Description of proposed work

The objective of the model development and application is to provide a tool which will evaluate the impacts of reservoir modification to increase sediment storage capacity (dredging or hydro-siphoning), changes in reservoir operation to support a reduction of the TMDL of sediment and nutrients to the Bay, and channel morphology change below Conowingo Dam to the Susquehanna Flats area.

The initial effort in this study will be to perform the 2D /3D model comparison study to evaluate if the three dimensional effects are significant enough to warrant the use of a more costly 3D model. A number of sediment transport scenarios will be simulated with RMA10, a three-dimensional hydrodynamic and sediment transport model developed at ERDCWES. Fine sediment inflows (clay and silt) will be evaluated for a number of flow conditions representing low inflow stratified reservoir conditions, high inflow non-stratified conditions, and flood flow scenarios. Both the 3D and 2D simulations will be conducted with identical boundary conditions, with model output compared. A letter report will be written detailing the study findings and recommending model applicability for simulating sediment transport in Conowingo Reservoir.

The sediment transport out of the reservoir system and into the lower Susquehanna is directly influenced by the sediment that enters the upstream reservoirs, and bed sediment that is scoured from these reservoirs during storm events. If daily sediment load measurements by grain size below Holtwood Dam were available, there would be no need to include the upper two reservoirs in the modeling process. However, there are no measured sediment load data entering Conowingo Reservoir. The only record of inflowing sediment into the reservoir system is above Lake Clark. Although the USGS states that the upper two reservoirs are filled to capacity, and that most of the sediment passes through the reservoirs to Conowingo, there is still some temporary capacity left in these reservoirs, particularly after storm events. The only way to capture the impacts of large storms on the sediment supply to Conowingo is to simulate the upper two reservoirs in series with a 1D model.

The output of the 2D model at Conowingo Dam will serve as an input boundary condition for the water quality model that is currently being proposed for evaluating the transport of nutrients and sediment to the Bay. The water quality model is based on hydrodynamics generated by another model, CH3D. These hydrodynamics were previously generated for Susquehanna River flows over the 1995 – 2005 timeframe. A required input into the water quality model is the constituent load, such as phosphorus, from Conowingo Reservoir. In many cases, the phosphorous is associated with sediment by grain size. The AdH model will output the total sediment load passing through Conowingo dam by grain size. The water quality model will take this load for a given grain size and associated phosphorous load, couple it to the hydrodynamics, and pass it to the Bay. Additional AdH model output to support the analysis are bed change (deposition or erosion across the domain), change in bed layer composition by particle size, suspended sediment concentration, bed sediment transport rate (if pertinent), bed shear stress, flow velocity with direction (vectors), and cumulative mass flux of sediment across reservoir boundaries for each sediment particle size simulated. Of critical importance to the project is the mass flux of sediment discharged from Conowingo reservoir by particle size. This will be directly dependent on the mass flux of sediment from the upper reservoirs, which in turn is dependent on the trapping efficiency of the reservoirs.

In addition to Conowingo Reservoir, the AdH model will contain the river channel below the dam down to the Susquehanna Flats area. Thus the model will have the additional capability for evaluating channel morphology change (erosion and deposition) in the lower channel due to sediment loads leaving the reservoir, or from sediment bypassed or dredged from the reservoir to the downstream channel.

The proposed modeling domain is presented in Figure 3. The model will consist of all three reservoirs, with the upstream flow boundary at the upper end of Lake Clark near Marietta Pennsylvania, and the downstream stage boundary below Conowingo Dam. Lake Clark and Lake Aldred will be represented by the 1D model, while Conowingo Reservoir will be represented by the 2D model. The 2D model will extend below Conowingo Dam to Susquehanna Flats. Flow and stage data, as well as bed sediment gradation data are available from the USGS. In 1990's the USGS conducted a one dimensional sediment transport model study of the reservoir system using the Corps of Engineers HEC-6 model. For this model they developed detailed inflowing sediment rating curves from suspended sediment samples collected upstream of the reservoir system. Ten sediment grain sizes are represented in these curves, from very fine clay to coarse sand.

Deposits of silt and clay in the mid to lower sections of the reservoir are subject to scour from large flow events. The coarse sediments in the upper end of the reservoirs may temporarily mobilize during large flows, but will likely re-deposit in the reservoir. Because the fine sediments deposits are typically cohesive in nature, they must be characterized in the laboratory to determine erosion rate and critical shear stress for erosion. It is proposed that core samples be taken in Conowingo Reservoir to characterize the erosion characteristics of the fine sediment deposits. The samples will be analyzed with the SEDflume, a small-scale circulating flume that is used to evaluate core sample erosion rate and critical shear stress for erosion. The results from the SEDflume tests will be utilized in AdH as a predictive function (equation) which relates computed bed shear stress to erosion rate. A more complete description of SEDflume is provided at the following web site:

http://www.erdc.usace.army.mil/pls/erdcpub/www_welcome.navigation_page?tmp_next_page=1058087

In addition to the sediment cores, it is recommended that suspended sediment sampling commence below Conowingo dam as soon as possible. The samples should be analyzed for grain size fractions, water quality parameters, and total suspended load. These data will be invaluable for validating both the water quality and reservoir models.

The AdH 2D model will be executed on the High Performance Computer (HPC) at ERDCWES. After completion of the work, the models will be transferred to the Baltimore district or the partner resource agencies for future applications.

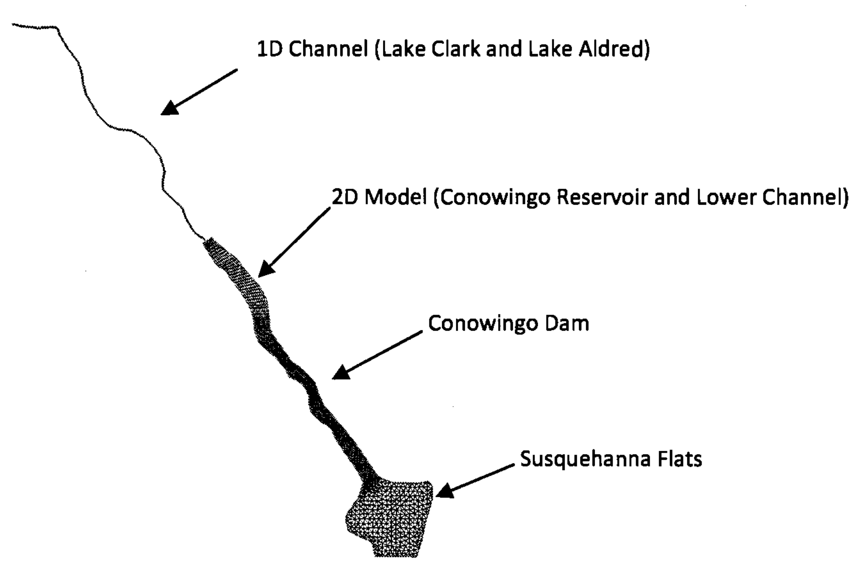

Figure 3. Model representation over the problem domain

Proposed Project Tasks

The following task descriptions detail how the project will proceed

- TASK 1 – 2D / 3D model comparison study

A number of simulations will be conducted to evaluate the influence of three dimensional reservoir processes on hydrodynamic and sediment transport in Conowingo. Four general subtasks will be considered for the study:

- Simulation of low flow reservoir stratification – temperature and density variation considering low sediment inflows into Conowingo. This would be typical of a base flow summer scenario.
- Simulation of flood flows through Conowingo – scour and deposition patterns for flows greater than 400,000 cfs
- Simulation of a typical storm hydrograph through Conowingo Dam – hydrodynamic and sediment transport characteristics during a mean flood condition
- Simulation of impacts of hydropower water takeoff on sediment transported through Conowingo Dam

If the results of this study indicate that a 3D model is appropriate, the costs for model development, testing, and application will increase approximately 10 – 25 percent (20k to 50k).

- TASK 2 – Literature search and data compilation

Data necessary for the study will be obtained and analyzed, if necessary, to build the model boundary condition file. These data include, but are not limited to, Susquehanna inflows, reservoir stages, hydropower turbine capacity, floodgate capacity, sediment rating curves, suspended sediment measurements (size gradation as well as total load) at the inflow and outflow of the reservoirs, bed sediment sample geo-referenced locations, bed sediment gradations and other physical data, and reservoir bathymetry surveys with appropriate horizontal coordinates and vertical datum. This effort also includes additional research into the subject matter if necessary, and any other data reduction and analysis procedures necessary for building the model.

- TASK 3 – Field data collection and SEDflume laboratory analysis

Sediment cores will be collected in Conowingo Reservoir for SEDflume analysis. Up to 20 fine sediment cores will be taken by either ERDCWES or USGS personnel.
The sample cores will be analyzed in the SEDflume, with data analysis conducted for determining erosion rate coefficients and critical bed shear stress for mobility

- TASK 4 – Construction of the 2D numerical model

The AdH 2D model mesh will be generated with the Surface Water Modeling System (SMS) at the ERDCWES. Data necessary for constructing the mesh are reservoir bathymetry surveys, digital elevation maps, satellite image files, and crest elevations along the length of the dams. .

- TASK 5 – AdH code modifications

The model will be modified to approximately represent dam operations. Capability will be added for representing lateral flow distribution along the dam (turbine and flood gate flows) as well as defining sediment transport boundaries at the dams

- TASK 6 – Development of the initial 2D hydrodynamic model and proofing the mesh

  The initial boundary condition file will be constructed to evaluate a first case flow scenario. This involves defining the flow and stage boundary conditions, assigning roughness coefficients, and running a number of flow scenarios to optimize the model and insure stable hydrodynamics.

- TASK 7 – Validating the hydrodynamics

  This involves running model simulations to compare model output to known water surface elevations or velocities within the reservoir system.

- TASK 8 – Construction of the sediment model and proofing the mesh

  Develop the initial sediment transport boundary condition file and run scenarios to insure a stable and optimized sediment model.

- TASK 9 – 2D Sediment model validation

  The sediment model will be validated to measured data. The USGS has collected a significant amount of sediment load data for selected storm events. From this data, they have developed a mass balance through the reservoir system. The models will be applied to a given storm event in an effort to replicate the USGS findings. This entails building the models, simulating the event, and modifying model variables until the model output reflects measured data trends. The principle variable used to validate the model will be the erosion rate coefficient or exponent developed from the SEDflume tests. It is expected that there will be variability in the coefficient and exponent resulting from the laboratory tests. Each reservoir will initially need to be considered individually during the validation. It is an iterative process which is time intensive when simulating a large problem.

- TASK 10 – Conduct 2D sediment transport simulations – Conowingo sediment loads to the Bay model

  Simulations that develop sediment rating curves or daily sediment discharge by sediment grain size from Conowingo Reservoir for input into the Bay model

- TASK 11 – Conduct 2D sediment transport simulations – Conowingo Reservoir remediation / lower channel response simulations

Conduct existing condition and plan condition simulations for evaluating changes in reservoir operation and /or sediment removal alternatives, and the impacts of extreme flow events on sediment transport in the reservoirs. Potential simulations include a long-term simulation (years) of sediment trapping efficiency in the reservoirs, including sediment transport below Conowingo Dam. If a 3D model is required, long term simulations (years) may not be possible.

The cost estimate for the sediment transport simulations is based on a total of 5 model run scenario simulations which may include simulations to develop sediment boundary conditions below Conowingo Dam for the bay model, various storm event simulations to evaluate impact on reservoir capacity, simulations to evaluate alterative reservoir operations, or simulations to evaluate Susquehanna River channel morphology change below Conowingo Dam. As a rule of thumb, the cost of running a 2D simulation, analyzing it, and reporting it is 7k per simulation. For a 3D model, the costs are approximately 10k – 15k per event.

Time and Cost

The proposed effort will require a funding level of $385,000 over a 21 month period, with the 3 month 2D / 3D comparison study beginning three months before the reservoir modeling. The following tables summarize the time and cost of the proposed work.

Project duration by task:

Time in months from project start

Task	2	4	6	8	10	12	14	16	18	21
1	-----	---								
2		-----								
3		-----	-----							
4		-----	-----							
5			-----							
6				-----						
7				-----						
8				-----	-----					
9					-----	-----				
10						-----	-----	-----		
11							-----	-----	-----	-----

Project cost by task:

Task	**Cost $k**
1	65
2	20
3	120
4	10
5	20
6	25
7	20
8	25
9	20
10	25
11	35
Total	**385**

Notes:

1) The final report is included in costs. A draft report will be provided in the final month
2) The project completion schedule is based on the timely receipt of data and information critical to work flow.
3) The proposed effort assumes that reservoir and channel geometry surveys are available for constructing the models
4) If a 3D model is required for the study, simulations will be limited to relatively short storm events

References

Hainly R.A. et al, "Deposition and Simulation of Sediment Transport in the Lower Susquehanna River Reservoir System", U.S. Geological Survey Water Resources Investigations Report 94 – 4122, November 1994.

Langland M.J., "Bathymetry and Sediment-Storage Capacity Change in Three Reservoirs on the Lower Susquehanna River, 1996 – 2008", U.S Geological Survey Scientific Investigations Report 2009 – 5110.

Attachment A-3

SEDIMENT DEPOSITION AND TRANSPORT SIMULATION IN THE RESERVOIR SYSTEM LOCATED IN THE LOWER SUSQUEHANNA RIVER BASIN, PENNSYLVANIA AND MARYLAND

Mike Langland – Hydrologist
USGS Pennsylvania Science Center
215 Limekiln Rd
New Cumberland, Pa 17070

INTRODUCTION

The District of Columbia, the State of Maryland, the Commonwealths of Pennsylvania and Virginia, the Chesapeake Bay Commission, and the U.S. Environmental Protection Agency (USEPA) have agreed to a plan to reduce nutrient loads to the Chesapeake Bay in an attempt to restore and protect the estuarine environment of the Bay. The USEPA has established a TMDL and has proposed sediment and nutrient allocation goals for each of the six states draining into the Chesapeake Bay to not exceed.

The Susquehanna River is the largest tributary to the Bay and transports about one-half of the freshwater and substantial amounts of sediment, nitrogen, and phosphorus to the Bay. The loads transported by the Susquehanna River to the Bay are significantly affected by the deposition of sediment and nutrients behind three large hydroelectric dams on the Lower Susquehanna River near its mouth. The three consecutive reservoirs (Lake Clarke, Lake Aldred, and Conowingo Reservoir) formed behind the three dams (Safe Harbor, Holtwood, and Conowingo) involve nearly 32 miles of the river and have a combined storage capacity of 510,000 acre-feet at their normal pool elevations (figure 1). Previous studies by Ott and others (1991), Hainly and others (1995), Reed and Hoffman (1996), and Langland and Hainly (1997) have documented the reservoirs' trap efficiency, bottom-sediment volumes and chemistry, and reduced storage capacity. Each of these studies has provided important information relating to the effect of the reservoirs on sediment and nutrient transport and sediment deposition in the Lower Susquehanna River Reservoirs. Langland (2009) provides a historical perspective to reservoir filling rates and projection when possible sediment storage capacity will be reached. At storage capacity, sediment and nutrient (phosphorus) loads to the Chesapeake Bay discharged through the reservoir system will substantially increase.

PROBLEM

The sediment transport out of the reservoir system and into the lower Susquehanna is directly influenced by the sediment that enters the upstream reservoirs, and bed sediment that is scoured from these reservoirs during storm events. Currently, suspended-sediment samples are collected above and below the reservoir system. No samples are collected in the reservoirs to provide information on the within-reservoir transport. The only way to capture the impacts of transport events on the sediment supply to Conowingo is to simulate the upper two reservoirs in series with a 1D model. Sediment load entering Lake Clark from the Susquehanna River will be used for the 1D sediment rating curve. Sediment will be routed through the upper two reservoirs using the 1D model, accounting for both sediment deposition and erosion in the reservoirs. The output of the model will then be used as the input sediment rating curve for the 2D model.

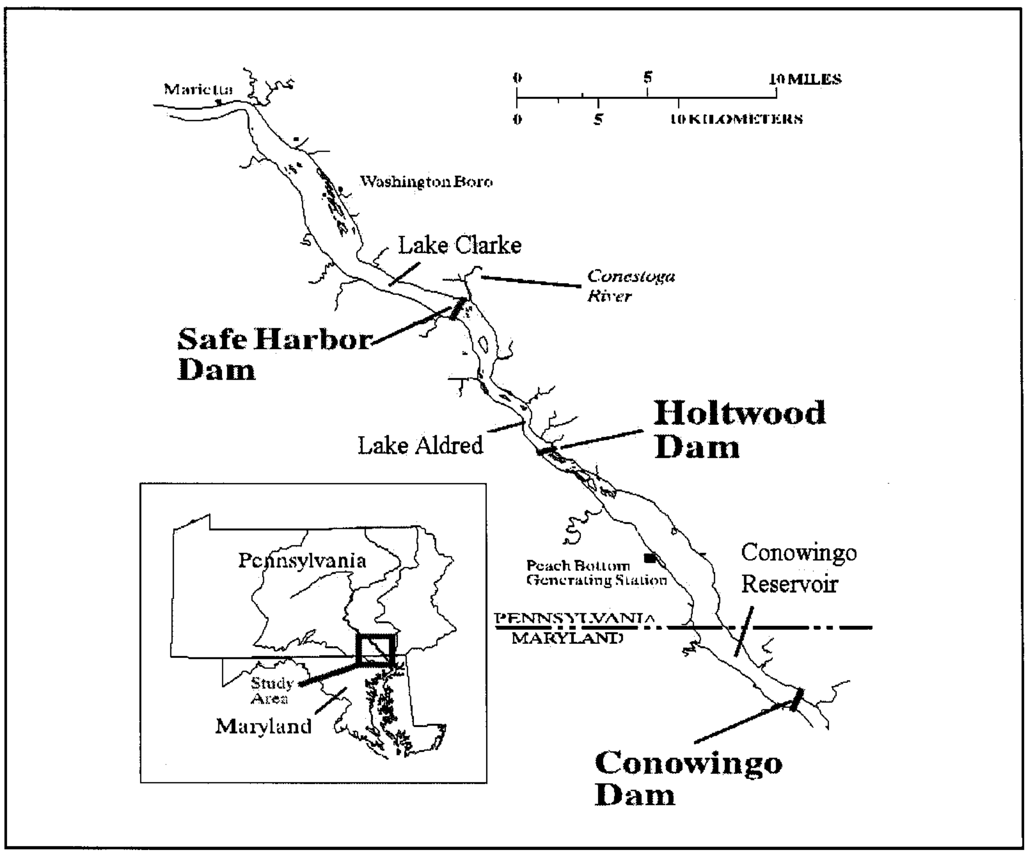

Figure 1. Location of three dams and associated reservoirs in the lower Susquehanna River Basin.

SCOPE and APPROACH

During Federal Fiscal Years (FY) FY11-12, the USGS in cooperation with the US Army Corps of Engineers (USCOE) and the Maryland Department of the Environment (MDDNR) propose to collect sediment cores from one or more of the reservoirs, collect, process, and deliver additional bathymetry data, and participate in sediment transport simulations in the reservoirs. USGS tasks are proposed to help provide locational support for the core collection (task 1), to support additional bathymetry data collection (task 2), and construct, validate, and simulate a 1D numerical model in the reservoirs (task 3).

Task 1

USGS will provide support in the collection of sediment cores in one or more of the reservoirs by providing information on previous core sampling locations and subsequent analysis and help assist in the collection of bottom cores. The sediment cores are to be tested for erosion rate coefficients and critical bed shear stress for mobility by USCOE. Additional chemical analysis may be needed based on project needs. (Approximate cost $4,500)

Task 2

If needed, USGS will collect additional bathymetry (depth to bottom) data to improve the transect resolution in Conowingo Reservoir. The distance between transects in previous bathymetry studies averaged approximately 2,000 feet. Some areas of the reservoir may require less transect distance to provide more detailed information on bottom features. The additional transect data will be used for the proposed 2-D model simulation by USCOE in Conowingo Reservoir. (Approximate cost $9,500)

Task 3

USGS previously developed a 1D sediment transport model using the USCOE HEC-6 model (Hainly and others, 1995). USGS will construct, calibrate, and validate a new model using the USCOE HECRAS. The 1D model will route the inflowing sediment through the reservoirs, accounting for both sediment deposition and erosion in the reservoirs. Boundary condition files will be verified from the upper 2 reservoirs and delivered to the USCOE for use in the 2D model in the Conowingo Reservoir. (Approximate cost $46,000 which includes project report)

REPORTS

A joint product is proposed with the USCOE. Either a journal article or a USGS Science Investigations Report (SIR) describing the results of the study will be published.

BENEFITS AND ANTICIPATED ACCOMPLISHMENTS

The results of this study will enhance the understanding of the sediment transport and filling rates in the Lower Susquehanna River reservoir system to better predict loads to the Chesapeake Bay. In addition, the data collected can be used as a continuum for future studies relating to reservoir trap efficiency sediment, changes in bottom-sediment profiles, and predicating/modeling the potential impact of the sediments from the reservoirs to the Bay. The data and interpretations produced by this study will benefit several agencies involved in efforts to measure and manage nutrient loads to the Chesapeake Bay. Each of the states that comprise the Susquehanna River Basin (New York, Pennsylvania, and Maryland) has agreed to sediment load allocations entering the Chesapeake Bay estuary. A better understanding of the reservoir dynamics will enhance the each states ability to make nutrient and sediment management decisions. The USEPA Chesapeake Bay Program and the U.S. Army Corps of Engineers also benefit from improved transport and deposition rates for a planned sediment model of the Chesapeake Bay watershed.

PERSONNEL

Personnel required to successfully complete this 15 month project include a Project Chief (GS-12), a field/boat assistant/operator (GS 9/10), and GIS/Model specialist (GS-12), and various levels of short-term technical assistance. Technical assistance would involve the wiring and set-up of instrumentation software to simultaneously measure and record "depth to bottom" and GPS position.

ESTIMATED BUDGET

Category	FY-11	FY12	TOTAL
Salaries	$15,900	$15,700	$31,600
Travel/Boat	$ 2,000	$ 0	$ 2,000
Equipment	$ 1,000	$ 1,000	$ 2,000
Report	$ 1,000	$ 2,500	$ 3,500
Indirect	$10,100	$10,800	$20,900
USCOE funds	**$30,000**	**$30,000**	**$60,000**

Total project costs requested from USCOE are $60,000. Any costs that exceed $60,000 will be paid by the USGS and not affect the project total budget costs. Travel and boats costs are associated with travel, lodging, per Diem expenses, and boat use if needed for Task 2. Report costs include time to draft, review, and publish the document. Indirect costs reflect the Pennsylvania Science Center administrative costs, the USGS North East Region costs and Department of Interior costs.

PROJECT TIMELINE

Project Activity	Projected from project start (months)																	
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
Planning phase																		
Project planning meeting																		
Task 1																		
Locate and collect																		
sediment core data																		
Task 2																		
Collect additional																		
bathymetry data, if needed																		
Task 3																		
Develop, calibrate, and																		
verify 1D HECRAS model																		
Report finalization																		

REFERENCES

Hainly, R.A., Reed, L.A., Flippo, H.N., Jr., and Barton, G.J., 1995, Deposition and simulation of sediment transport in the Lower Susquehanna River reservoir system: U.S. Geological Survey Water-Resources Investigations Report 95-4122, 39 p.

Langland, M.J., and Hainly, R.A., 1997, Changes in bottom-surface elevations in the three reservoirs on the Lower Susquehanna River, Pennsylvania and Maryland, following the January 1996 flood—Implications for nutrient and sediment loads to the Chesapeake Bay: U.S. Geological Survey Water-Resources Investigation Report 97-4138, 34 p.

Langland, Michael J., 2009, Bathymetry and Sediment-Storage Capacity Change in Three Reservoirs on the Lower Susquehanna River, 1996-2008: SIR 2009-5110, 21 p.

Ledvina, J.P., 1962, 1961 Holtwood River bed silt survey, Holtwood Dam to Shenk's Ferry, September-November 1961: Holtwood Steam Electric Station and the Pennsylvania Power and Light Company, Holtwood, Pa., 80 p.

Ott, A.N., Takita, C.S., Edwards, R.E., and Bollinger, S.W., 1991, Loads and yields of nutrients and suspended sediment transported in the Susquehanna River Basin, 1985-89: Susquehanna River Basin Commission Publication No. 136, 253 p.

Reed, L.A. and Hoffman, S.A., 1996, Sediment deposition in Lake Clarke, Lake Aldred, and Conowingo Reservoir, Pennsylvania and Maryland, 1910-93: U.S. Geological Survey Water-Resources Investigations Report 96-4048, 14 p.

Schuleen, E.T. and Higgins, G.R., 1953, Analysis of suspended-sediment measurements for Lake Clarke, inflow and outflow, 1948-53: Pennsylvania Power and Light Co. Report 970, 40 p.

Whaley, R.C., 1960, Physical and chemical limnology of Conowingo Reservoir: The Chesapeake Bay Institute, Johns Hopkins University, Technical Data Report, 140 p.

Attachment A-4

Supplemental Collection and Analysis of Suspended Sediment Samples at Susquehanna River at Conowingo, Maryland (USGS Gage 01578310)

Draft Scope of Work

Background

The U.S. Army Corps of Engineers (COE) and Maryland Department of Natural Resources (DNR) seek chemical and physical measures of suspended sediment flowing through Conowingo Dam. These measures are needed to support sediment-transport and sediment-process models for Susquehanna River and Chesapeake Bay. In addition, these measures are needed as a reference to the quality of reservoir-bed sediments stored in upstream reservoirs.

USGS proposes to supplement the current sample collection at Susquehanna River at Conowingo, MD, (USGS station ID 01578310) that is supported by the USGS-DNR Maryland River-Input Monitoring Program (RIM) and the USGS National Stream-Quality Accounting Network (NASQAN). During eight storm-flow events in Water-Year 2010, large-volume samples will be collected to support analysis of detailed suspended-sediment size fractions and physical and chemical measures of sediment at the USGS Kentucky Sediment Laboratory in Louisville, KY., and the USGS Sediment Chemistry Research Laboratory in Atlanta, GA.

Sample Collection and Analysis

Suspended-sediment size fractionation and chemical analyses of suspended sediment require a sufficiently-large mass of sediment to support analysis. Size fractionation and chemical analyses each require approximately 1 gram of sediment after concentration. Concentrations during base flow are generally less than 50 mg/L, and often much less (near 10 mg/L). Concentrations during higher flows often exceed 100 mg/L and less frequently are greater than 200 mg/L. Based on this concentration-discharge pattern, we propose to target sample collection during high discharge periods. This recommendation is based on two criteria: 1) it represents the period where a significant mass of sediment is being transported, and 2) operationally, sample-volume requirements for the analyses can be achieved with a sample of about 10 liters.

Sample collection will be accomplished concurrently with RIM storm-sample measurements of stream water quality. Additional field support staff will be required for these events and the budget table below presents only the supplemental help required. Samples will be collected across the cross-section from the turbine outflow along the catwalk of Conowingo Dam. Water discharging through the spillways will not be included in the samples.

Fine-grained particle-size analysis has been identified by the COE as a priority for their purposes. These analyses will be performed by the USGS Kentucky Sediment Laboratory. The following measures will be provided by standard pipet analysis:

Sediment Size Class	Size break, in mm
coarse clay	.002
very fine silt	.004
fine silt,	.008
medium silt,	.016
coarse silt,	.031
sand	.063

Each of these size fractions will be expressed as percent finer than the specified size class.

Additional physical and chemical analyses will be conducted on a separate 10-liter sample at the USGS Sediment Chemistry Research Laboratory in Atlanta, GA. Suspended-sediment samples will be concentrated using a centrifuge, dried and analyzed for the list of constituents shown below. The entire mass of sediment recovered will be analyzed as a whole, without regard to size classes. Samples will be analyzed for:

(1) particulate Mn, Fe, Al, and phosphorus,- by optical ICP analysis

(2) particulate N and C

(3) loss on ignition

Because these are independent analysis processes, and each measure requires sufficient sediment mass, analysts will attempt to perform each of these three measures. If sample mass is insufficient for all three measures, the analyst will perform chemical measures in the order listed above.

Deliverables

Initial results will be transmitted to DNR in electronic form upon completion of analysis. Final results will be published in the USGS Annual Water-Data Report, and archived and publically available through the USGS NWIS / NWIS-WEB database.

Budget

The total estimated cost for this project is $17,000 and includes salary, supplies and materials, shipping, analytical costs, and USGS indirect charges. A summary of these estimates is shown below.

Cost Category	Cost
Salary and benefits	$4,800
FedEx Shipping	$ 400
Supplies (bottles, containers, etc.)	$ 1,200
Lab (KY Sediment Size)	$1,600
Lab (GA Sediment Chemistry)	$3,200
Indirect Costs	$5,800
Total Funding	$17,000

Project Staff and Contacts:

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Lower Susquehanna River Watershed Assessment

PROJECT MANAGEMENT PLAN

APPENDIX B

USACE REVIEW PLAN

ECO-PCX endorsement

Guise, Amy M NAB02

To: Guise, Amy M NAB02
Subject: FW: Lower Susquehanna River Watershed Assessment (UNCLASSIFIED)

-----Original Message-----
From: Ferguson, Sue L LRN
Sent: Tuesday, June 21, 2011 2:57 PM
To: Bierly, Daniel M NAB
Cc: Compton, Anna M NAB; Dan, Mary NAB; Guise, Amy M NAB02
Subject: RE: Lower Susquehanna River Watershed Assessment (UNCLASSIFIED)

Classification: UNCLASSIFIED
Caveats: NONE

I think you have answered my comments and I can accept the changes, delete comments if you like. I will also start the endorsement preparation.

Sue Ferguson
615-736-7192

-----Original Message-----
From: Bierly, Daniel M NAB
Sent: Monday, June 20, 2011 12:11 PM
To: Ferguson, Sue L LRN
Cc: Guise, Amy M NAB02; Compton, Anna M NAB; Sowers, Angela NAB02
Subject: Lower Susquehanna River Watershed Assessment (UNCLASSIFIED)

Classification: UNCLASSIFIED
Caveats: NONE

Sue,

Based on the e-mail below and some coordination between Angie Sowers and Jodi, I am submitting to you the review plan for the Lower Susquehanna River Watershed Assessment (LSRWA). Note that it used to be called Sediment Behind the Dams, but the name has been changed to better reflect the watershed nature of the study.

This effort is on a very fast track right now. HQ is fully involved, as is our General DeLuca (NAD) and up to the ASA herself. We are having issues with HQ as far as some policy stuff is concerned. Toward that end, they are insisting that our RP be approved and certified before we can sign the cost-sharing agreement. This seems unusual to me, but this is a 729 effort and it is a bit unique in some ways, so maybe that has something to do with it.

At any rate, Jodi has instructed us to send this directly to you for quick action. Please note that we have no funding as of now, but upon execution of the agreement, we do have work plan funding that we could send your way. Is $1500 still the going rate?

REVIEW PLAN

Lower Susquehanna River Watershed Assessment

Baltimore District

MSC Approval Date: Pending
Last Revision Date: NONE

US Army Corps
of Engineers ®

REVIEW PLAN

Lower Susquehanna River Watershed Assessment

TABLE OF CONTENTS

1. PURPOSE AND REQUIREMENTS

a. **Purpose.** This Review Plan defines the scope and level of peer review for the Lower Susquehanna River Watershed Assessment (LSRWA), Maryland and Pennsylvania.

b. **References**

(1) Engineering Circular (EC) 1165-2-209, Civil Works Review Policy, 31 Jan 2010
(2) EC 1105-2-412, Assuring Quality of Planning Models, 31 Mar 2011
(3) Engineering Regulation (ER) 1110-1-12, Quality Management, 30 Sep 2006
(4) ER 1105-2-100, Planning Guidance Notebook, Appendix H, Policy Compliance Review and Approval of Decision Documents, Amendment #1, 20 Nov 2007
(5) Project Management Plan (PMP)for study
(6) NAB Quality Management Plan

c. **Requirements.** This review plan was developed in accordance with EC 1165-2-209, which establishes an accountable, comprehensive, life-cycle review strategy for Civil Works products by providing a seamless process for review of all Civil Works projects from initial planning through design, construction, and operation, maintenance, repair, replacement and rehabilitation (OMRR&R). The EC outlines four general levels of review: District Quality Control/Quality Assurance (DQC), Agency Technical Review (ATR), Independent External Peer Review (IEPR), and Policy and Legal Compliance Review. In addition to these levels of review, decision documents are subject to cost engineering review and certification (per EC 1165-2-209) and planning model certification/approval (per EC 1105-2-412).

2. REVIEW MANAGEMENT ORGANIZATION (RMO) COORDINATION

The RMO is responsible for managing the overall peer review effort described in this Review Plan. The RMO for decision documents is typically either a Planning Center of Expertise (PCX) or the Risk Management Center (RMC), depending on the primary purpose of the decision document. The RMO for the peer review effort described in this Review Plan is National Ecosystem Planning Center of Expertise (ECO-PCX).

Since this is not a decision document, the RMO will not need to coordinate with the Cost Engineering Directory of Expertise (DX) to ensure the appropriate expertise is included on the review teams to assess the adequacy of cost estimates, construction schedules and contingencies.

3. STUDY INFORMATION

a. **Watershed Assessment.** The Lower Susquehanna River Watershed Assessment (Assessment) will serve as a useful and important tool to investigate structural and non-structural strategies for sediment reduction and habitat restoration, including evaluations of the largest known sediment sink, and the risk and impacts to the Upper Chesapeake Bay. Sediment has been identified as one of the primary pollutants in Chesapeake Bay. This assessment will provide information and tools to the State of Maryland and the Chesapeake Bay community as they determine the best methods to reduce sediment inputs to the Bay and to meet EPA-mandated Total Maximum Daily Loads. The assessment utilizes various watershed-level models to characterize very complex relationships between river flow/sediment and ecological resources in the Lower Susquehanna River system and in the Chesapeake Bay. These include complex and state-of-the-art river flow and sediment transport models, reservoir models, and environmental models to evaluate Bay water quality and living resources. The Assessment is not a decision document and will not require action by Congress or approval of HQUSACE. CENAD has reviewed and has approval authority for the Assessment. There will be no National Environmental Policy Act (NEPA) documentation developed in conjunction with this Assessment.

In determining sediment loads entering the reservoir system, USACE scientists will work closely with watershed practitioners to ensure that proper and coordinated assumptions are made regarding efforts to reduce sediment loads from the land. These are being developed by others as part of Watershed Implementation Plans, pursuant to the Total Maximum Daily Load (TMDL) requirements under the Clean Water Act and Chesapeake Bay commitments of the states.

The underlying assumptions of how much sediment enters into the system will be based on ongoing and extensive watershed implementation planning now underway by all six Chesapeake Bay states and the U.S. Environmental Protection Agency. Their Watershed Implementation Plans (WIP) will lay out land-based management measures such that sediment run-off is limited to that allowable by the defined total maximum daily load (TMDL). This study is a necessary link and will parlay with these activities. It will use the assumptions of sediment delivery rates from the land to complete the systems evaluation of the ultimate fate of existing and future sediments on the Chesapeake Bay. Understanding the impacts of various management scenarios on the ecological resources of the Lower Susquehanna River and Chesapeake Bay will be key to providing informed choices for decision-makers.

b. Study/Project Description. The Susquehanna River provides 48% of the freshwater to the Chesapeake Bay, drains an area of 27,510 square miles and is one of the most flood prone rivers in the United States. Near the mouth of the Susquehanna River, where it discharges into the Upper Chesapeake Bay, there are a series of four privately-owned hydropower dams. By trapping sediment and pollutants upstream, these dams play an integral function to reduce adverse impacts to the Bay.

USACE, through General DeLuca, North Atlantic Division, is the Federal Commissioner on the Susquehanna River Basin Commission (SRBC). The SRBC updated their Comprehensive Plan in 2009, and cited in the actions to, "Identify and garner support for a study of the sediment behind the hydro-electric dams along the lower Susquehanna River and development of Regional Sediment Management Plan to result in the signing of a feasibility cost-sharing agreement."

As sediment accumulates in the reservoirs, there is increasing risk that it will be mobilized and cause adverse impacts to the Chesapeake Bay, the largest estuary in the United States, and could devastate restoration efforts to date. Tropical Storm Agnes in 1972 was responsible for the loss of almost 2/3 of the SAV in the Upper Chesapeake Bay in the early 1970s due to the delivery of 14 years worth of sediment in a matter of days (USGS estimate). It is estimated that 70% of this material was scoured from the reservoirs. It is well documented that excess suspended sediment is one of the leading causes of the Chesapeake Bay's poor health.

Per President Obama's Executive Order (EO) 13508, Chesapeake Bay Protection and Restoration (May 2009), Federal agencies share a renewed commitment to restore the Bay. This EO established the Federal Leadership Committee, on which Ms. Darcy, ASA(CW), represents USACE and through which the FY11 Federal Action Strategy was endorsed. The FY11 Action Strategy conveys the efforts the Federal government will undertake from October 1, 2010, through September 30, 2011. This document (http://executiveorder.chesapeakebay.net/) specifically assigns USACE as the "lead" role to, among other actions, "advance studies to evaluate the management of sediments behind Conowingo Dam and from within the watershed," and strengthen science "to better address EO goals through coordination of the federal science capabilities of NOAA, USGS, FWS, NPS, USFS, and USACE." The strategy recognizes that ecosystem-based management requires sophisticated, integrated, system-wide collaboration and computer models to enhance decision-making for all the goals therein.

USACE received study authority from the U.S. Senate Committee on Environment and Public Works dated 23 May 2001 – Chesapeake Bay Shoreline Erosion and received appropriations from the fiscal year 2002 Energy and Water Appropriations conference report and the 2009 Omnibus Appropriations Act (House Appropriations Committee Print, H.R. Public Law 111-8) to sign a Feasibility Cost-Sharing Agreement (FCSA) with a non-federal sponsor to "examine management measures that could be undertaken to address the sediments behind the dams on the Lower Susquehanna River."

In October 2009 USACE reconvened the Sediment Task Force (STF) to reinvestigate this issue and generate interest among potential sponsors to sign an agreement with USACE to conduct a feasibility study. The STF was originally assembled in 1999 and consisted of stakeholders including various State, Federal, Local, business, and non-Governmental organizational entities. The STF was tasked with providing policy recommendations to resolve this issue. One of the recommendations was to conduct a Feasibility study but there was no sponsor at the time. The 2009 STF meeting generated interest in several sponsors and in 2010 an interagency team was formed in to determine the best way to tackle this issue and they have been actively involved in the study scoping activities to date. The Maryland Department of the Environment (MDE) agreed to sign a FSCA (75/25) with USACE to be the project sponsor.

Due to the complexity of this issue and the study authority language to "examine management measures," the consensus of the interagency team was to conduct a watershed assessment vs conducting a traditional Feasibility study leading to construction. The Assessment will be a useful and important tool to assist the state in gaining a better understanding of (1) the impact to Chesapeake Bay of sediment transported from the Susquehanna River under various scenarios, (2) the benefits of maintaining sediment storage capacity behind the dams on the Lower Susquehanna River and (3) the most effective management measures that would reduce or maintain the level of sediment and associated nutrient delivery to the Bay.

Upland and riverine strategies are measures that reduce incoming sediment and associated nutrient loads and in-reservoir strategies are those that remove sediment and associated nutrient loads already in the reservoir. The interagency team agreed that the ongoing Bay TMDL efforts and coordinating WIPs will be critical components of the analyses. The Bay TMDL (nutrient and sediment limits) and WIPs (implementation plans to meet limits) are an effort by the US Environmental Protection Agency (EPA) and surrounding Bay states to develop implementation plans to limit nutrient and sediment inputs (from the watershed) to the Bay; full implementation of management measures to meet established limits is expected by 2025. The Assessment will evaluate various scenarios assuming full and partial implementation and effectiveness of the WIPs. The projected loads from the TMDL will be incorporated into this Assessment.

The in-reservoir strategies to be addressed in this Assessment include (but are not limited too) sediment by-passing; dredging/innovative re-use; and modifying dam operations options. The Assessment will also forecast and describe potential effects of the Conowingo dam filling with sediment, that is reaching steady state (i.e. if no actions are taken to address problems). This Assessment will include modeling activities, data gathering, and conceptual (schematic) strategy development with conceptual costs. Conceptual plans will provide enough level of detail in any alternative (a combination of one or more management measures) developed to compare costs and benefits if implemented. This Assessment will be coordinated with stakeholders. It will not make any general or site-specific USACE project recommendations. Any conclusions of the assessment and the ongoing efforts, assumptions and work products will be considered by the STF, US Geological Survay (USGS), and other interested groups and agencies. It is anticipated that the STF will be reconvened as appropriate during the assessment effort. The Assessment will generate a foundational analysis of sedimentation processes in the Lower Susquehanna River and upper Chesapeake Bay and the costs and benefits of various sediment stategies. Any desire by the sponsor to implement any of these measures with USACE will require additional funding, formal partnerships, and work beyond the scope of this Assessment.

c. **Factors Affecting the Scope and Level of Review.** This document would differ from a typical USACE feasibility study/decision document in the following ways:

- The Assessment will contain conceptual costs and/or ranges of costs for various sediment strategies but will not contain detailed cost estimates using the Corps' Tri-Service Automated Cost Engineering System (TRACES) for individual recommended sites;
- The Assessment will not be making any recommendations for Federal Action therefore it is not a Decision Document and a formal NEPA document will not be prepared;
- This Assessment will not result in USACE recommendations or a Decision Document. In addition this Assessment will not contain formal cost estimates or engineering designs.
- Sediment strategies will not have a direct impact on, or require any modifications of, any of the dams along the Susquehanna River and so they will not involve life safety issues or have a relevant impact on life safety, therefore Type II IEPR will not be required;
- There is no request by the Governor of Maryland or Pennsylvania for a peer review by independent experts;
- The Assessment may include a dredging placement site Assessment including innovative re-use options, but without a detailed description of site-specific recommended plans, LERRDs (lands, easements, rights-of-way, relocation, and disposal areas), and construction considerations;
- The Assessment will include an examination of the effects of and development of a concept schematic for a sediment by-passing system but will not include detailed designs or site-specific recommended plans, LERRDs and construction considerations;

- The Assessment will include an examination of the effects of and development of a concept schematic for dredging varying amounts of material from behind the Conowingo dam (or possibly the other dams) but will not include detailed designs or site-specific recommended plans, LERRDs and construction considerations;

- The Assessment will include an examination of the effects of altering the flow and/or the way the Conowingo is currently operated but will not include detailed designs or site-specific recommended plans, LERRDs and construction considerations, and will not suggest structural modifications to the Dam itself;

- MDE is the sponsor for the study however MD Department of Natural Resources, Md Geologic Survey, USGS, The Nature Conservancy, and Susquehanna River Basin Commission will be part of the interagency team, making decisions for the Assessment and the STF will be used as appropriate to verify decisions or to judge acceptability;

- The Assessment will not likely involve significant public dispute as to the size, nature, or effects of the project since it is only an Assessment of various sediment strategies at a conceptual (not detailed design or cost) level and will not lead to construction of any of these measures;

- The Assessment will not likely involve significant public dispute as to the economic or environmental cost or benefit of the project since it is only an Assessment of various sediment strategies at a conceptual (not detailed design or cost) level and will not lead to construction of any of these measures;

- A model comparison study will be conducted early on in the study to determine if a two dimensional (2D) hydrodynamic and sediment transport model is appropriate to adequately simulate long term sedimentation processes in Conowingo Reservoir or if a three dimensional (3D) model will be necessary. If the 2D model adequately simulates sedimentation processes then the 3D model will not need to be utilized. The assumption at this time is that the 2D ADH model will be sufficient. If this is not the case the PMP and review plan will be updated;

- The STF will be coordinated with during this Assessment to provide input and review of technical products developed;

- There is public interest/concern about the issue of sediment build-up behind the dams because of the implications it raises with respect to nutrient and sediment loads to the Chesapeake Bay and management of those loads; more specifically implications to the current development of the Chesapeake Bay TMDL by the EPA in conjunction with surrounding Bay states. EPA has determined that a large influencing factor in sediment and nutrient loads to the Bay is when the dams on the lower Susquehanna no longer function to trap sediment and phosphorus. EPA's intention is to assume the current dam trapping capacity will continue through the TMDL implementation horizon (through 2025). However if future monitoring shows the trapping capacity of the dam is reduced, then EPA will consider adjusting the Pennsylvania, Maryland and New York sediment and nutrient load allocations based on the new delivered loads to determine if the states are meeting their target load obligations. EPA has stated that it is imperative to the states to determine how to keep the dams on lower Susquehanna acting as sediment and associated nutrient traps to meet the Bay TMDL and protect the aquatic resources of the Chesapeake Bay;

- There is public interest/concern about the issue of sediment build-up behind the dams due to the potential for a catastrophic or episodic flooding events (such as the 1972 Agnes Storm), which can scour additional sediment from behind the dams on the lower Susquehanna River and result in a load which shocks the Bay ecosystem.

- In accordance with EC 1165-2-209, the "Risk Informed Decisions on Appropriate Reviews" checklist was reviewed. Of the 17 questions on the checklist only Question 2 "Does it evaluate alternatives?" has a "yes" answer since the Assessment will include a general screening of various sediment strategies. In light of this the Assessment is not required to undergo ATR or IEPR but will undergo DQC.

d. **In-Kind Contributions.** Products and analyses provided by non-Federal sponsors as in-kind services are subject to DQC, ATR, and IEPR. The in-kind products and analyses to be provided by the non-Federal sponsor include:

  - Input into selection and development of sediment strategies and screening of measures as well as modeling scenarios;
  - Review of modeling results, collected field data, and Assessment report;
  - Meeting Attendance;
  - Conducting Bathymetry Surveys of Susquehanna Flats;
  - Collecting water quality, sediment, and nutrient samples at Conowingo Dam River Input station and providing analysis;
  - Review and incorporation of Exelon(owner and operator of Conowingo dam) study results(Exelon is currently conducting several studies at the request of various resource agencies as required through the dam relicensing process that are related to this study) into this Assessment;
  - Coordination with EPA and Bay states, integrating TMDL efforts/WIPS/changes into this Assessment; and
  - Management of data collection contracts and tracking of non-federal match activities.

4. DISTRICT QUALITY CONTROL (DQC)

All decision documents (including supporting data, analyses, environmental compliance documents, etc.) shall undergo DQC. DQC is an internal review process of basic science and engineering work products focused on fulfilling the project quality requirements defined in the Project Management Plan (PMP). The home district shall manage DQC. Documentation of DQC activities is required and should be in accordance with the Quality Manual of the District and the home MSC.

a. **Documentation of DQC.** DQC will be documented via a memorandum signed by the NAB Planning Division chief certifying DQC has been accomplished. This memorandum will be provided to the ECO-PCX as proof of the conduct of DQC.

b. **Products to Undergo DQC.** The Assessment and its supporting documentation including any in-kind products will undergo DQC.

c. **Required DQC Expertise.** DQC will be conducted by individuals on the interagency study team as well as peers not affiliated with the Assessment and supervisors.

5. AGENCY TECHNICAL REVIEW (ATR)

ATR is mandatory for all decision documents (including supporting data, analyses, environmental compliance documents, etc.). The objective of ATR is to ensure consistency with established criteria, guidance, procedures, and policy. The ATR will assess whether the analyses presented are technically correct and comply with published USACE guidance, and that the document explains the analyses and results in a reasonably clear manner for the public and decision makers. ATR is managed within USACE by the designated RMO and is conducted by a qualified team from outside the home district that is not involved in the day-to-day production of the project/product. ATR teams will be comprised of senior USACE personnel and may be supplemented by outside experts as appropriate. The ATR team lead will be from outside the home MSC.

a. **Products to Undergo ATR.** This Assessment will not result in USACE recommendations, a Decision Document or a watershed plan. In addition a NEPA document will not be prepared and the Assessment will not result formal cost estimates or engineering designs. In accordance with EC 1165-2-209, the "Risk Informed Decisions on Appropriate Reviews" checklist was reviewed. Of the 17 questions on the checklist only Question 2 "Does it evaluate alternatives?" has a "yes" answer since the Assessment will include a general screening of various sediment strategies. It has been determined that the Assessment will not require ATR. See Section 3.c of this review plan.

b. **Required ATR Team Expertise.** N/A

c. **Documentation of ATR.** N/A

6. INDEPENDENT EXTERNAL PEER REVIEW (IEPR)

IEPR may be required for decision documents under certain circumstances. IEPR is the most independent level of review, and is applied in cases that meet certain criteria where the risk and magnitude of the proposed project are such that a critical examination by a qualified team outside of USACE is warranted. A risk-informed decision, as described in EC 1165-2-209, is made as to whether IEPR is appropriate. IEPR panels will consist of independent, recognized experts from outside of the USACE in the appropriate disciplines, representing a balance of areas of expertise suitable for the review being conducted. There are two types of IEPR:

- Type I IEPR. Type I IEPR reviews are managed outside the USACE and are conducted on project studies. Type I IEPR panels assess the adequacy and acceptability of the economic and environmental assumptions and projections, project evaluation data, economic analysis, environmental analyses, engineering analyses, formulation of alternative plans, methods for integrating risk and uncertainty, models used in the evaluation of environmental impacts of proposed projects, and biological opinions of the project study. Type I IEPR will cover the entire decision document or action and will address all underlying engineering, economics, and environmental work, not just one aspect of the study. For decision documents where a Type II IEPR (Safety Assurance Review) is anticipated during project implementation, safety assurance shall also be addressed during the Type I IEPR per EC 1165-2-209.

- Type II IEPR. Type II IEPR, or Safety Assurance Review (SAR), are managed outside the USACE and are conducted on design and construction activities for hurricane, storm, and flood risk management projects or other projects where existing and potential hazards pose a significant threat to human life. Type II IEPR panels will conduct reviews of the design and construction activities prior to initiation of physical construction and, until construction activities are completed, periodically thereafter on a regular schedule. The reviews shall consider the adequacy, appropriateness, and acceptability of the design and construction activities in assuring public health safety and welfare.

a. **Decision on IEPR.** Coordination was conducted with CENAD to seek guidance on determination of EC 1165-2-209 requirements and a determination on whether this Assessment would be considered a decision document. it was determined that this Assessment was not considered a decision document. In addition to this, based on a risk-informed decision analysis conducted by CENAD; this Assessment is not subject to ATR or IEPR. The PDT concurs with CENAD findings that a Type I IEPR is not required for this Assessment and will not be pursued. In addition, since this Assessment is not a decision document that would be subject to Type I IEPR, an exclusion from Type I IEPR is not required and will not be pursued.

b. **Products to Undergo Type I IEPR.** N/A

c. **Required Type I IEPR Panel Expertise.** N/A

d. **Documentation of Type I IEPR.** N/A

7. POLICY AND LEGAL COMPLIANCE REVIEW

All decision documents will be reviewed throughout the study process for their compliance with law and policy. Guidance for policy and legal compliance reviews is addressed in Appendix H, ER 1105-2-100. These reviews culminate in determinations that the recommendations in the reports and the supporting analyses and coordination comply with law and policy, and warrant approval or further recommendation to higher authority by the home MSC Commander. DQC and ATR augment and complement the policy review processes by addressing compliance with pertinent published Army policies, particularly policies on analytical methods and the presentation of findings in decision documents. Since this Assessment is not a decision document, it will not be subject to a formal policy and legal compliance review

8. COST ENGINEERING DIRECTORY OF EXPERTISE (DX) REVIEW AND CERTIFICATION

All decision documents shall be coordinated with the Cost Engineering DX, located in the Walla Walla

District. The DX will assist in determining the expertise needed on the ATR team and Type I IEPR team (if required) and in the development of the review charge(s). The DX will also provide the Cost Engineering DX certification. The RMO is responsible for coordination with the Cost Engineering DX. Since this Assessment is not a decision document and will not be used for budget justifications, a cost reviewer from the Cost Engineering DX will not be required and a Cost Engineering DX certification will not be obtained.

9. MODEL CERTIFICATION AND APPROVAL

EC 1105-2-412 mandates the use of certified or approved models for all planning activities to ensure the models are technically and theoretically sound, compliant with USACE policy, computationally accurate, and based on reasonable assumptions. Planning models, for the purposes of the EC, are defined as any models and analytical tools that planners use to define water resources management problems and opportunities, to formulate potential alternatives to address the problems and take advantage of the opportunities, to evaluate potential effects of alternatives and to support decision making. The use of a certified/approved planning model does not constitute technical review of the planning product. The selection and application of the model and the input and output data is still the responsibility of the users and is subject to DQC, ATR, and IEPR (if required).

EC 1105-2-412 does not cover engineering models used in planning. The responsible use of well-known and proven USACE developed and commercial engineering software will continue and the professional practice of documenting the application of the software and modeling results will be followed. As part of the USACE Scientific and Engineering Technology (SET) Initiative, many engineering models have been identified as preferred or acceptable for use on Corps studies and these models should be used whenever appropriate. The selection and application of the model and the input and output data is still the responsibility of the users and is subject to DQC, ATR, and IEPR (if required).

Planning Models. The following planning models are anticipated to be used in the development of the decision document:

a. EPA/ERDC Chesapeake Bay Environmental Model package (CBEMP)

Model Name and Version	Brief Description of the Model and How It Will Be Applied in the Study	Certification / Approval Status
EPA/ERDC Chesapeake Bay Environmental Model package (CBEMP)	CBEMP has been used for more than twenty years as a tool for examining the effect of nutrients and solids loads on Bay water quality and living resources. The components of the CBEMP are engineering models. The core of the CBEMP consists of the CH3D hydrodynamic model, which computes transport processes in three dimensions, and the ICM (Integrated Compartment Model) water quality model, which computes water quality and living resources. ICM incorporates representations of estuarine carbon, nutrient, and oxygen cycling as well as living resources such as submerged aquatic vegetation (SAV), filter feeders, and menhaden. The most recent application of ICM to Chesapeake Bay includes a predictive sediment transport model for four classes of sediments: fine clay, clay, silt, and sand. The model operates on a 50,000 cell three-dimensional grid and has been applied to the period 1985-2005. This is the model that has been used to aid in development of the	This modeling package has been developed by EPA in conjunction with ERDC and has been refined and improved in the 20 years of its

	2010 set of TMDL's for Chesapeake Bay. This package will be used to examine the effect of solids and nutrient loads projected to flow from the Susquehanna River as a result of multiple scenarios including various sediment strategies. The sediment and hydrodynamic projections will be provided by an application of the Adaptive Hydrodynamics Model (ADH) and HEC-RAS models to the three reservoirs above Conowingo Dam. Effects on light attenuation, SAV, chlorophyll, nutrients, and dissolved oxygen will be computed and compared between selected sediment management measures. Link on EPA website: http://www.chesapeakebay.net/committee_msc_projects.aspx?menuitem=16525#stm.	development and usage and has undergone extensive peer reviews which are laid out in EPA's website. Therefore certification and approval for use are not required.

b. Engineering Models. The following engineering models are anticipated to be used in the development of the decision document:

Model Name and Version	Brief Description of the Model and How It Will Be Applied in the Study	Approval Status
EPA Bay Program Watershed Model (WSM)	Calculates nutrient and sediment loads from the watershed at all locations in the Chesapeake Bay. : http://www.chesapeakebay.net/committee_msc_projects.aspx?menuitem=16525#stm. This program will be used to provide loads from the watershed at key locations in the reservoir system;	The model has been refined and improved in the 20 years of its development and usage and undergone extensive peer reviews which are laid out on EPA's website:
2D Adaptive Hydraulics (AdH)	Developed by the ERDCWES this numerical model is a finite element implicit scheme model utilizing an unstructured mesh. It provides a fully unsteady solution of system hydrodynamics and sediment transport. http://chl.erdc.usace.army.mil/adh. The program will be used to represent the Conowingo Reservoir and the Susquehanna Flats to analyze and will assess erosion and depositional characteristics of sediments in the Conowingo Reservoir and quantify sediment transport potential by grain size to the Bay from the reservoir system.	HH&C CoP Preferred Model

HEC-RAS (River Analysis System)	The Hydrologic Engineering Center's River Analysis System (HEC-RAS) program provides the capability to perform one-dimensional steady and unsteady flow river hydraulics calculations. The program will be used to capture the impacts of transport events on the sediment supply to Conowingo by simulating the upper reservoirs in the lower Susquehanna river reservoir system. Sediment loads entering the upper reservoirs from the Susquehanna River will be used for the 1D sediment rating curve. Sediment will be routed through the upper two reservoirs using the model, accounting for both sediment deposition and erosion in the reservoirs. The output of the model will then be used as the input sediment rating curve for the 2D model.]	HH&C CoP Preferred Model

10. REVIEW SCHEDULES AND COSTS

a. ATR Schedule and Cost. N/A

b. Type I IEPR Schedule and Cost. N/A

c. Model Certification/Approval Schedule and Cost. N/A

11. PUBLIC PARTICIPATION

A formal public review period is expected to be held on the draft report in January 2014. Inclusive in this period will be multiple public meetings planned for the first two weeks of January. Comments made during this period will be consolidated and incorporated into a revised draft.

12. REVIEW PLAN APPROVAL AND UPDATES

The North Atlantic Division Commander is responsible for approving this Review Plan. The Commander's approval reflects vertical team input (involving district, MSC, RMO, and HQUSACE members) as to the appropriate scope and level of review for the decision document. Like the PMP, the Review Plan is a living document and may change as the study progresses. The home district is responsible for keeping the Review Plan up to date. Minor changes to the review plan since the last MSC Commander approval are documented in Attachment 3. Significant changes to the Review Plan (such as changes to the scope and/or level of review) should be re-approved by the MSC Commander following the process used for initially approving the plan. The latest version of the Review Plan, along with the Commanders' approval memorandum, should be posted on the Home District's webpage. The latest Review Plan should also be provided to the RMO and home MSC.

13. REVIEW PLAN POINTS OF CONTACT

Public questions and/or comments on this review plan can be directed to the following points of contact:

- QC Manager, Baltimore District, 410-962-4633
- DST Environmental Team Leader, North Atlantic Division, 347-370-4562
- Operational Director, ECO-PCX, 309-794-5448

ATTACHMENT 1: TEAM ROSTERS

Table 1: Interagency Study Team Members

Name	Role	Affiliation/Office Symbol
Non-Federal Team members		
Bruce Michael	Director	DNR
Shawn Seaman	Project Manager	DNR
Herb Sachs	Special Projects Coordinator	MDE
Matt Rowe	Project Manager	MDE
Tim Fox	Project Manager	MDE
Jeff Halka	Director	MGS
Federal Team Members		
Anna Compton	Biologist, Study Manager	USACE, CENAB-PL-P
Bob Blama	Biologist, Operations	USACE, CENAB-Ops
Carey Nagoda	Hydrologic and Hydraulic Engineer, Engineering Coordinator	USACE, CENAB-EN-WW
Chris Spaur	Biologist, Environmental Studies	USACE, CENAB-PL-P
Angie Sowers	Environmental Policy Advisor	USACE, CENAB-PL-P
Dan Bierly	Plan Formulation and Policy Advisor	USACE, CENAB-PL-P
Mary Dan	Project Manager	USACE, CENAB-PP-C
Carl Cerco	Research Hydrologist	USACE, ERDC
Steve Scott	Research Hydraulic Engineer	USACE, ERDC
Mike Langland	Hydrologist	USGS

Table 2: Vertical Team Members

Name	Discipline	Phone	Email
Roselle Henn	Environmental Team Lead, CENAD	347-370-4562	Roselle.E.Henn@usace.army.mil
Jodi Staebell	Operational Director/ECO-PCX/ CEMVD	309-794-5448	Jodi.K.Staebell@usace.army.mil
Joe Vietri	Chief, Planning & Policy, CENAD	347-370-4570	Joseph.R.Vietri@usace.army.mil
Robert Pace	Chief, Planning Division, CENAB	410-962-4900	Robert.S.Pace@usace.army.mil

ATTACHMENT 2: SAMPLE STATEMENT OF TECHNICAL REVIEW FOR DECSION DOCUMENTS

COMPLETION OF AGENCY TECHNICAL REVIEW

N/A

ATTACHMENT 3: REVIEW PLAN REVISIONS

Revision Date	Description of Change	Page / Paragraph Number

Lower Susquehanna River Watershed Assessment

PROJECT MANAGEMENT PLAN

APPENDIX C

DETAILED TASK AND COST SUMMARY

Lower Susquehanna River Watershed Assessment 1-Apr-11

Task Number/Subaccount	Sub-Task Number	Description of Task	Resource: Organization Code	Cost Calculations: Hourly Rate	Man-Hours	Labor Cost	Non-Labor Resource	Total Cost	Notes
A		Develop Sediment and Nutrient management alternatives							
22R	1	Review, analyze, and synethesize literature on managing reservoir sedimentation (i.e. lit search); coordinate review ;incorporate into alternative development	E1K0500	$122.00	56	$6,832		$6,832	
22R	2	Coordinate and assist in forumulation of conceptual level reservoir sediment management alternative plans, with range of costs and benefits.	E1K0500	$122.00	40	$4,880		$4,880	
22R	3	Coordinate and assist in screening and prioritizing Concept Level alternatives	E1K0500	$122.00	24	$2,928		$2,928	
22R	4	2 (day)- Site visits by to reservoirs and potential placement sites.	E1K0500	$122.00	20	$2,440		$2,440	
22J	5	Operations input into sediment management alternative development and screening.	E1R0600	$108.00	40	$4,320		$4,320	
22J	6	Dredging Placement Site Evaluation	E1R0600	$108.00	40	$4,320		$4,320	
22J	7	Dredging and by-passing alternatives cost development.	E1R0600	$108.00	40	$4,320		$4,320	
22J	8	Alternative devlepment meeting attendance by Ops (5 meetings, 2 hrs each)	E1R0600	$108.00	20	$2,160		$2,160	
22J	9	2 (day)- Site visits by Ops to reservoirs and potential placement sites	E1R0600	$108.00	20	$2,160		$2,160	Coordination of Site visit to Conowingo could be IKS
22J	10	Ops review of pertinent existing data to develop dredging and by-passing alternatives and screening.	E1R0600	$108.00	8	$864		$864	
22J	11	Review literature search and assess information for design	E1L0430	$100.00	4	$400		$400	
22J	12	H&H Engineer coordinate with Ops to develop dredging plan	E1L0430	$100.00	8	$800		$800	
22J	13	H&H Engineer write up concept schematic for dredging plan .	E1L0430	$100.00	40	$4,000		$4,000	

Task Number/Subaccount	Sub-Task Number	Description of Task	Resource Organization Code	1 Apr 2011 Hourly Rate	Man-Hours	Cost Calculations Labor Cost	Non-Labor Resource	Total Cost	Notes
22J	14	H&H Engineer develop concepts for 1)by-passing 2)In-reservior 3) Innovateive re-use	E1L0430	$100.00	72	$7,200		$7,200	
22J	15	H&H provide input on concpet cost development and coordinate with Ops	E1L0430	$100.00	16	$1,600		$1,600	
22J	16	H&H provide discuss and coordinate screening with project team	E1L0430	$100.00	8	$800		$800	
22J	17	2 (day)- Site visits by H&H engineer to reservoirs and potential placement sites.	E1L0430	$100.00	20	$2,000		$2,000	
22R	18	Review literature search and assess information for alternative development	E1K0500	$115.00	4	$460		$460	
22R	19	Biologist provide input on alternative development	E1K0500	$115.00	8	$920		$920	
22R	20	Biologist provide input on screening alternative plans.	E1K0500	$115.00	12	$1,380		$1,380	
22R	21	2 (day)- Site visits by biologist to reservoirs and potential placement sites.	E1K0500	$115.00	20	$2,300		$2,300	
22R	22	Expert input into reservoir opertions strategy development, review, meeting attendence	IKS			$20,000		$20,000	Labor estimate includes salary/benefits/indirect cost rate and reflects an amalgam of several staff; actual costs will be broken out by individual and their personal hourly rate.
22R	23	Expert input into watershed, strategy development, review, meeting attendance	IKS			$15,000		$15,000	Labor estimate includes salary/benefits/indirect cost rate and reflects an amalgam of several staff; actual costs will be broken out by individual and their personal hourly rate.
B		Determine environemtanl benefits and impacts of proposed strategies							
	1	Utilize Chesapeake Bay Environmental Modeling Package Package (CBEMP) to evaluate impacts.	MIPR (USACE Funds)			$235,100		$235,100	See Cerco Proposal for full details on costs. USACE will MIPR funds.
22R	2	Study manger review of model documentation and outputs	E1K0500	$122.00	4	$488		$488	

Task Number/Subaccount	Sub-Task Number	Description of Task	Resource Organization Code	1 Apr 2011 Hourly Rate	Cost Calculations Man-Hours	Labor Cost	Non-Labor Resource	Total Cost	Notes
22R	3	Study manger coordination with ERDC/data needs/technical POC on project team.	E1K0500	$122.00	30	$3,660		$3,660	
22J	4	H&H review and input of results	E1L0430	$100.00	4	$400		$400	
22R	5	Biologist review of model documentation. Prepare summary for report.	E1K0500	$115.00	8	$920		$920	
C		<u>Simulate sediment deposition and load in reservior and watershed</u>							
22E	1	Compare 2D ADH and 3D RMA-10 models in reservior; select one; and model 3 reservoir systems in the lower susquehanna to Susquehanna flats.	MIPR (USACE funds)			$385,000		$385,000	See Scott Proposal for full details on Costs. USACE will MIPR funds
22E		Develop and Utilize 1D HEC RAS model to quantify watershed inputs and provide upper boundary Conowingo Reservoir	MIPR (MIPR USACE Funds)			$60,000		$60,000	See Langland Proposal for full details on costs. USACE will MIPR funds.
22J	2	H&H review and input of results	E1L0430	$100.00	16	$1,600		$1,600	
22R	3	Study manger review of model documentation and outputs	E1K0500	$122.00	4	$488		$488	
22R	4	Study manger coordination with ERDC/data needs/technical POC on project team	E1K0500	$122.00	30	$3,660		$3,660	
22R	5	Biologist review of model documentation. Prepare summary for report; assess environmental impacts.	E1K0500	$115.00	12	$1,380		$1,380	
D		<u>Data Collection</u>							
22E	1	Conduct Bathymetry Surveys of Susquehannna Flats and collect sediment Grab samples.	IKS				$60,000	$60,000	Bathymetry to be conducted after federal funding has been appropriated.
22E	2	Collect solids size classes in the Conowingo outflow during storm events and analyze.	MIPR (USACE FUNDS)			$4,800	$12,200	$17,000	USACE will MIPR funds to USGS
22E	3	Collect water quality, sediments, and nutrients at Conowingo Dam outflow and analyze	IKS				$68,659	$68,659	WQ monitoring at Conowingo Dam

Task Number/Subaccount	Sub-Task Number	Description of Task	Resource Organization Code	1 Apr 2011 Hourly Rate	Man-Hours	Cost Calculations Labor Cost	Non-Labor Resource	Total Cost	Notes
22R	4	Biologist review of collected data and integration into report.	E1K0500	$115.00	6	$690		$690	
E		Technical Integration and Coordination of Exelon (Conowingo Reliscensing) Studies							
22R	1	Incorporate Exelon study results into alternative development	IKS			$30,452		$30,452	Labor estimate includes salary/benefits/indirect cost rate and reflects an amalgam of several staff; actual costs will be broken out by individual and their personal hourly rate.
F		Technical Integration and Coordinaton of TMDL							
22R	1	Coordinate with EPA and states integrating TMDL efforts/WIPS/changes into study.	IKS			$20,190		$20,190	Labor estimate includes salary/benefits/indirect cost rate and reflects an amalgam of several staff; actual costs will be broken out by individual and their personal hourly rate.
22R	2	Coordinate with EPA and states integrating TMDL efforts/WIPS/changes into study.	IKS			$39,860		$39,860	Same as note above.
G		Prepare, Finalize and Reproduce Report							
22R	1	Prepare read-ahead material for In-progress reviews and coordinate development with team	E1K0500	$122.00	120	$14,640		$14,640	Assuming 2 in-progress reviews - read-ahead is basically draft report
22R	2	Coordinate and attend In-progress reviews	E1K0500	$122.00	16	$1,952		$1,952	
22R	3	Prepare summary of in-progress review meeting and issue resolution of comments.	E1K0500	$122.00	50	$6,100		$6,100	
22R	4	Coordination of Project team reviews and comments on IPR RAM, draft, and final report	E1K0500	$122.00	56	$6,832		$6,832	
22R	5	Coordinate other management briefings.	E1K0500	$122.00	8	$976		$976	

Task Number/Subaccount	Sub-Task Number	Description of Task	Resource: Organization Code	1 Apr 2011: Hourly Rate	Man-Hours	Cost Calculations: Labor Cost	Non-Labor Resource	Total Cost	Notes
22R	6	Obtain Policy Interpretations for team	E1K0500	$122.00	4	$488		$488	
22R	7	Prepare for and attend one public meeting	E1K0500	$122.00	8	$976		$976	
22R	8	Backcheck comments to IPR RAM, Draft, and Final Reports.	E1K0500	$122.00	24	$2,928		$2,928	
22R	9	Agency Technial Review coordination	E1K0500	$122.00	24	$2,928		$2,928	
22R	10	Coordination with USACE HQ and Division	E1K0500	$122.00	24	$2,928		$2,928	Includes coordination for IPR, draft report review and getting report to ASA/Congress
22R	11	Coordinate signing of QCRR for Draft and final report	E1K0500	$122.00	8	$976		$976	
22R	12	Obtrain DE signature on final report	E1K0500	$122.00	4	$488		$488	
22R	13	Coordinate Public comment responses on draft report with team	E1K0500	$122.00	16	$1,952		$1,952	
22R	14	Prepare draft and final report and coordinate development with team.	E1K0500	$122.00	54	$6,588		$6,588	
22R	15	Review draft and final reports and generate submttal package	E1K0500	$122.00	54	$6,588		$6,588	
22R	16	Draft Evironnmental sections of Report. Use model outputs, read-ahead materials from IPR and other documents.	E1K0500	$115.00	54	$6,210		$6,210	
22R	17	Biologist produce figtures from existing sources and provide input and assist in development of new figures.	E1K0500	$115.00	6	$690		$690	
22R	18	Biologist support of in-progress review meeting Read Ahead Materials Prep	E1K0500	$115.00	24	$2,760		$2,760	
22R	19	Biologist support of in-progress review meeting summary and issue resolution	E1K0500	$115.00	24	$2,760		$2,760	
22R	20	Biologist support of coordination efforts with USACE higher authorities and Ageny Technical Review. Conference calls, summary write-ups.	E1K0500	$115.00	48	$5,520		$5,520	
22R	21	GIS specialist produce figures and graphics.	E1K0500	$122.00	16	$1,952		$1,952	
22R	22	Baltimore District Plan Form Quality Control advisor review IPR RAM, Draft, final report attend IPR	E1K0500	$122.00	40	$4,880		$4,880	

Task Number/Subaccount	Sub-Task Number	Description of Task	Resource Organization Code	1 Apr 2011 Hourly Rate	Man-Hours	Cost Calculations Labor Cost	Non-Labor Resource	Total Cost	Notes
22R	23	Baltimore District Environmental Quality Control advisor review IPR RAM, Draft, final report attend IPR	E1K0500	$122.00	16	$1,952		$1,952	
22R	24	Draft and Final Report Reproduction	E1K0500				$1,500	$1,500	Production of hardcopies of draft and final report.
H		Develop review plan							
22Q	1	Coordinate review Plan with Ecosystem Planning Center of Expertise (Eco-PCX) and	E1K0500	$122.00	8	$976		$976	
22Q	2	Resolution of comments	E1K0500	$122.00	8	$976		$976	
22Q	3	Negotiate costs and level of effort with Eco-PCX	E1K0500	$122.00	16	$1,952		$1,952	
I		Develop and Execute Communications Strategy							
	1	Develop Strategy to disseminate info to stakeholders and technical partners.							Costs included in Tasks A & K; no separate costs required.
	2	Coordinate Study Progress/delieverables with stakeholders and partners.							Same as above
	3	Meeting Preparation and Coordination							Same as above
	4	Meeting Attendance							Same as above
22R	5	Biologist provide comment on strategy and deliverables, meeting materials prepared for stakeholders.	E1K0500	$115.00	16	$1,840		$1,840	
22R	6	Biologist attend public meeting plus travel	E1K0500	$115.00	6	$690		$690	
J		USACE Required Quality Control Reviews							Costs in this section have not been negotiated - estimates only
22M	1	Coordination of Agency Techincal Review/Eco-PCX nomination of review team				$1,500		$1,500	USACE will MIPR funds to assigned reviewers
22M	2	Agency technical review of read-ahead materials for In-progress review meetings.				$15,000		$15,000	
22M	3	Attendance at In-Progress review meetings				$1,500		$1,500	
22M	4	Agency technical review of models.				$6,000		$6,000	

Task Number/Subaccount	Sub-Task Number	Description of Task	Resource Organization Code	1 Apr 2011 Hourly Rate	Man-Hours	Cost Calculations Labor Cost	Non-Labor Resource	Total Cost	Notes
K		Partcipation in Sediment Interagency Study Team (all parties)							
22R	1	Biologist Attend Project Development Team meetings	E1K0500	$115.00	60	$6,900		$6,900	
22J	2	H&H Engnieer Attend Project Development Team meetings	E1L0430	$100.00	60	$6,000		$6,000	
22T	4	DNR Staff attend all meetings, coordinate non-federal match activities, review all products.	IKS			$54,699		$54,699	Labor estimate includes salary/benefits/indirect cost rate and reflects an amalgam of several staff; actual costs will be broken out by individual and their personal hourly rate.
22T	5	MDE Staff attend all meetings, coordinate non-federal match activities, review all products.	IKS			$35,140		$35,140	Same as note above.
	Subaccount Subtotal					**$1,098,009**	**$142,359**	**$1,240,368**	
All Tasks		Engineering Division							
		Combined project tasks	E1L0430	$100.00	248	$24,800		$24,800	
		Engineering Branch Supervision and Administration	E1L0400			$4,960		$4,960	20% of H&H Labor costs.
	Subaccount Subtotal					**$29,760**	**$0**	**$29,760**	
All Tasks		USACE Operations Division	E1R0600	$108.00	168	$18,144		**$18,144**	
	Subaccount Subtotal					**$18,144**	**$0**	**$18,144**	
All Tasks		USACE Planning Division (except PM)							
			E1K0500	$122.00	710	$86,620	$1,500	$88,120	
			E1K0500	$115.00	308	$35,420		$35,420	
			E1K0500	$122.00	16	$1,952		$1,952	
			E1K0500	$122.00	40	$4,880		$4,880	
			E1K0500	$122.00	16	$1,952		$1,952	
		Planning Branch supervision and administration	E1K0500			$30,998		$30,998	25% of total branch labor (not including QC costs)
		USACE Quality Control- Agency Technical Review				$24,000		$24,000	
	Subaccount Subtotal					**$185,822**	**$1,500**	**$187,322**	

Task Number/Subaccount	Sub-Task Number	Description of Task	Resource Organization Code	1 Apr 2011 Hourly Rate	Man-Hours	Cost Calculations Labor Cost	Non-Labor Resource	Total Cost	Notes
All Tasks	Non Federal Sponsor								
						$0	$60,000	$60,000	
						$15,000	$0	$15,000	
						$75,000	$0	$75,000	
						$105,341	$68,659	$174,000	
						$20,000	$0	$20,000	
	Subaccount Subtotal					$215,341	$128,659	$344,000	
A-14		USACE Project Management (Planning)							
22T	1	Project reporting to Corps of Engineers	E1K0500	$122.00	60	$7,320		$7,320	Assume 2 hours per month
22T	2	Financial management actions -- CEFMS	E1K0500	$122.00	40	$4,880		$4,880	Project set-up, monitoring and final accounting
22T	3	Prepare budgetary materials	E1K0500	$122.00	40	$4,880		$4,880	
22T	4	Monitor/Coordinate with sponsors and USACE project budget and schedule	E1K0500	$122.00	56	$6,832		$6,832	Assume 2 hours per month
22T	5	Lead and document project team meetings	E1K0500	$122.00	100	$12,200		$12,200	Assume quarterly monthly meetings, 1 day each, and monthly conference calls
22T	6	Coordinate with Baltimore District team members	E1K0500	$122.00	40	$4,880		$4,880	Assume 2 hours per month
22T	7	Project support	E1K0500				$800	$800	Travel, government vehicle
22T	8	Planning Branch supervision and administration	E1K0500			$10,248		$10,248	25% of Branch labor
22T	9	Program management support	E1H0000			$7,500		$7,500	
	Subaccount Subtotal					$58,740	$800	$59,540	

Subtotal of USACE Project Costs	**$991,866**
4% contingency USACE Costs	**$39,675**
Total Sponsor Costs (includes contingency)	**$344,000**
Total study costs	**$1,376,000**
USACE Share (75%)	**$1,032,000**
Sponsor Share (25%)	**$344,000**

PROJECT MANAGEMENT PLAN

APPENDIX D

EXAMPLE OF NON-FEDERAL PARTNER IN-KIND COST-SHARE CONTRIBUTION DOCUMENTATION LETTER

Appendix D: Example of Non-Federal Partner In-Kind Cost-Share Contribution Documentation Letter

DATE:

The Maryland Department of the
Environment
1800 Washington Boulevard
Baltimore, MD 21230

RE: Partner Cost-Share Contribution to USACE-MDE Lower Susquehanna River Watershed Assessment

Dear X:

This letter documents the non-Federal contribution of ___$0.00___ in the form of in-kind services to the Lower Susquehanna River Watershed Assessment.

Details for the match reported in this letter are as follows:

Expense Activity	Name	No. of HRS/Miles	Rate (salary, benefits, and Federally improved indirect costs rate)	TOTAL	
				$0.00	
				$0.00	
				$0.00	
				$0.00	
				$0.00	
				$0.00	TOTAL MATCH

This contribution occurred between _____ and _____ and is not being utilized as match for any other federal award. Attached to this letter is a print out from our agency's financial system documenting these services.

Sincerely,

Name
Job Title
Organization (if not printed on letterhead)

Lower Susquehanna River Watershed Assessment

PROJECT MANAGEMENT PLAN

APPENDIX E

PROJECT SCHEDULE

ID	Task Name	Duration	Start	Finish
1	**Sediment Behind the Conowingo Dam**	225 wks	Mon 1/4/10	Fri 4/25/14
2				
3	**Feasibility Cost Sharing Agreement (FCSA)**	74.2 wks	Mon 1/4/10	Mon 6/6/11
4	Develop PMP and finalize PMP	56 wks	Mon 1/4/10	Fri 1/28/11
5	Staff PMP with respective mgmt chain	6 wks	Mon 1/31/11	Fri 3/11/11
6	Corps and DNR Execute FCSA	7 wks	Mon 3/14/11	Fri 4/29/11
7	Corps secures project funds after President signs budget	4 wks	Mon 5/2/11	Fri 5/27/11
8	PDT kick-off meeting	1 wk	Tue 5/31/11	Mon 6/6/11
9	Site visit to Conowingo Dam/flats area	1 wk	Tue 5/31/11	Mon 6/6/11
10	**Data Collection**	57 wks	Wed 6/1/11	Tue 7/3/12
11	MGS conducts bathymetry surveys of Susquehanna Flats	4 wks	Wed 2/1/12	Tue 2/28/12
12	USGS sampling/analysis of suspended sediments at Conowingo outflow	57 wks	Wed 6/1/11	Tue 7/3/12
13	ERDC collects sediment cores in ConowReserv & analyze w/SEDflume	17 wks	Mon 8/1/11	Fri 11/25/11
14	NAB completes lit search on reservoir sedimentation mgmt/summarize for PDT	13 wks	Wed 6/1/11	Tue 8/30/11
15	PDT review of lit search on reservoir sedimentation mgmt	2 wks	Thu 9/1/11	Wed 9/14/11
16	**Modeling and Documentation of Modeling**	117.6 wks	Wed 6/1/11	Fri 8/30/13
17	ERDC does Lit search to compile data for boundary conditions for model	4 wks	Mon 8/1/11	Fri 8/26/11
18	ERDC uses avail info to build boundary conditions for model	6 wks	Mon 8/22/11	Fri 9/30/11
19	**1D/2D/3D reservoir model development (ERDC&USGS)**	99.6 wks	Wed 6/1/11	Fri 4/26/13
20	USGS constructs & validates 1D model	26 wks	Tue 8/2/11	Mon 1/30/12
21	PDT decides on initial modeling scenarios & selects mgmt measures to be model	11 wks	Mon 8/1/11	Fri 10/14/11
22	ERDC-Scott gathers model input data	1 wk	Wed 2/29/12	Tue 3/6/12
23	ERDC prepares 2D vs 3D model comparision draft report	13 wks	Wed 6/1/11	Tue 8/30/11
24	PDT reviews 2D vs 3D comparision report & makes decision on 2D or 3D	2 wks	Thu 9/1/11	Wed 9/14/11
25	ERDC constructs 2D/3D numerical model portion of reservoir model	17 wks	Mon 8/1/11	Fri 11/25/11
26	ERDC modifies codes for 2D/3D reservoir model	8 wks	Mon 10/3/11	Fri 11/25/11
27	ERDC develops initial 2D/3D hydrodynamic model & proofs mesh	8 wks	Thu 12/1/11	Wed 1/25/12
28	ERDC validates hydrodynamics of reservoir model	8 wks	Thu 12/1/11	Wed 1/25/12
29	ERDC constructs sediment reservoir model & proofs mesh	17 wks	Thu 12/1/11	Wed 3/28/12
30	ERDC validates sediment model (model vs SEDflume data) to assess risk	17 wks	Wed 2/1/12	Tue 5/29/12
31	ERDC/USGS conduct CBEMP model simulations of scenarios & prepare draft re	25 wks	Thu 11/1/12	Wed 4/24/13
32	ERDC/USGS conduct sediment transport simulations to input CBEMP model	26 wks	Mon 4/2/12	Fri 9/28/12
33	ERDC conducts watershed/reservoir sedim transport simulations, draft report	35 wks	Fri 6/1/12	Thu 1/31/13
34	PDT reviews watershed/reservoir modeling report	4 wks	Fri 2/1/13	Thu 2/28/13
35	ATR of watershed/reservoir modeling report	9 wks	Mon 2/25/13	Fri 4/26/13
36	**CBEMP model development (ERDC)**	91.4 wks	Thu 12/1/11	Fri 8/30/13
37	CBEMP set-up & refine w/sediment & WQ data/coord w/reservoir modeling	52 wks	Thu 12/1/11	Wed 11/28/12
38	ERDC conducts CBEMP model simulations of scenarios & draft report	26 wks	Thu 11/1/12	Wed 5/1/13
39	PDT reviews draft CBEMP model simulations of scenarios report	2 wks	Thu 5/2/13	Wed 5/15/13
40	ATR of CBEMP; PDT addresses/resolves ATR cmts	9 wks	Mon 7/1/13	Fri 8/30/13
41	**Development of recommendations**	5 wks	Mon 6/3/13	Fri 7/5/13
42	PDT mtg to view model results & determines preliminary recommendations	1 wk	Mon 6/3/13	Fri 6/7/13
43	Agency Coord Mtg to discuss model results & prelim recommends	1 wk	Mon 7/1/13	Fri 7/5/13
44	**Dredging placement site evaluation**	87 wks	Mon 10/17/11	Fri 6/14/13
45	EN/Ops complete dredging placement desktop site eval	2 wks	Mon 10/17/11	Fri 10/28/11
46	EN/Ops do site visits to potential placement sites	1 wk	Mon 10/31/11	Fri 11/4/11
47	EN/Ops develops dredging plan & bypassing options	1 wk	Mon 11/7/11	Fri 11/11/11
48	EN/Ops develops schematics & cost estimates for dredging & bypassing options	8 wks	Mon 11/14/11	Fri 1/6/12
49	PDT reviews dredging plan & bypassing options/schematics/cost estimates	1 wk	Mon 1/9/12	Fri 1/13/12
50	EN/Ops refines schematics & cost estimates using model results	2 wks	Mon 6/3/13	Fri 6/14/13
51	**Draft Report Prep**	21.2 wks	Mon 7/1/13	Mon 11/25/13
52	PL prepare draft report containing PDT's tentative recommendations	7 wks	Mon 7/1/13	Fri 8/16/13
53	PDT reviews draft report/resolve cmts/incorporate into report	6 wks	Mon 8/19/13	Fri 9/27/13
54	PL finalizes draft report for upper mgmt review	1 wk	Mon 9/16/13	Fri 9/20/13
55	PL finalizes draft report for ATR	2 wks	Mon 9/16/13	Fri 9/27/13
56	ATR/USACE review	8 wks	Tue 10/1/13	Mon 11/25/13
57	**QA/QC Activities**	107.4 wks	Thu 12/1/11	Fri 12/20/13
58	PL coordinates ATR for initial IPR	4 wks	Thu 12/1/11	Wed 12/28/11
59	PL prepares read-ahead mat'ls for initial IPR	8 wks	Thu 3/1/12	Wed 4/25/12
60	PDT reviews initial IPR read-ahead mat'ls	2 wks	Tue 5/1/12	Mon 5/14/12
61	ATR on initial IPR read-ahead mat'ls	9 wks	Tue 5/15/12	Mon 7/16/12
62	PL holds initial IPR w/NAD&HQUSACE	1 wk	Mon 9/3/12	Fri 9/7/12
63	PL prepares read-ahead materials for final IPR (in-progress review)	8 wks	Tue 10/1/13	Mon 11/25/13
64	PL holds IPR to secure ok to release draft report w/recommendations	1 wk	Mon 12/16/13	Fri 12/20/13
65	**Final Report Prep**	14 wks	Mon 12/30/13	Fri 4/4/14
66	Public review period for draft final report	4 wks	Mon 12/30/13	Fri 1/24/14
67	Public meeting for draft final report	1 wk	Mon 1/13/14	Fri 1/17/14
68	PDT prepares final report after public review/route to DE for signature	2 wks	Mon 1/20/14	Fri 1/31/14
69	NAB transmits to NAD/HQ/ASA	5 wks	Mon 2/3/14	Fri 3/7/14
70	HQ/ASA, CW transmits to Congress	4 wks	Mon 3/10/14	Fri 4/4/14
71				
72	**Tech Integration & coordination w/Exelon, TMDL's, WIPS**	148 wks	Mon 5/2/11	Fri 2/28/14